

Report No

25608E/R1

Date

February 2011

Project

**Preliminary Phase 2 Geoenvironmental Assessment at
Phase 3 Calderstones Park, Whalley BB7 9JT**

Client

Taylor Wimpey Manchester Limited



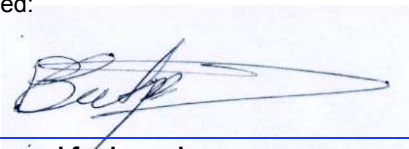
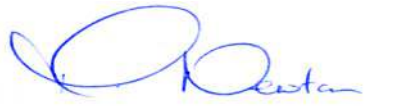
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Report No:	Date:
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Preliminary Phase 2 Geoenvironmental Assessment at Phase 3 Calderstones Park, Whalley BB7 9JT

Issue Number	Status	Description of Amendments
R1	Draft	

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1.0 INTRODUCTION

1.1 Instruction

Clarke Bond North Limited (Clarke Bond) has been commissioned by Dean Harrison of Taylor Wimpey Manchester Limited to undertake a Preliminary Phase 2 Geoenvironmental Assessment of land situated 50m North of Pendle Drive, Whalley BB7 9JT. It is understood that this assessment is part of a pre-acquisition survey and the property is to be developed for residential purposes comprising approximately 50 two-storey houses with associated gardens, car parking, landscaped areas and access roads.

1.2 Background

Previous assessments conducted upon the site comprise the following; which should be read in conjunction with this study.

- Phase 1 and 2 Geoenvironmental Site Investigation Report at Calderstones Park by RSK Group PLC (16372-R1 0) dated 4th of June 2010.
- Plot B1 Calderstones Hospital – Borehole Assessment by Strata Surveys Limited (ref NFJ/L13687 17072006.doc) dated 17th of July 2006
- Site Check Data report on land at Calderstones Hosiptal by Landmark (ref SCPRO-23698251-1-1) dated 29th November 2007
- Plan Search report on land at Calderstones Hosiptal by Landmark (ref PSC-21960143-1-1) dated 26th June 2007

The RSK Group Phase 1 Geoenvironmental Assessment incorporated a review of public available information; including historic mapping, geological mapping and an environmental database. Based on this review, a Preliminary Conceptual Site Model (PCSM) will be produced for the site, which identified potentially significant source-pathway-receptor pollutant linkages which identified potentially significant source-pathway-receptor pollutant linkages.

Clarkebond have been granted permission by Taylor Wimpey Manchester Limited to utilise the information within the above report so that a suitable preliminary Geoenvironmental risk assessment and conceptual model can be developed for the site; to facilitate the site investigation design.

1.3 Objectives

The objectives of the preliminary site investigation were as follows:

- To provide information on ground conditions to facilitate design of foundations and site infra-structure for the proposed development.
- To conduct a semi-quantitative assessment of potential risks from contaminants to human health and/or controlled waters, comprising a Refined Conceptual Model.
- Provide preliminary recommendations regarding any remedial measures necessary to mitigate any risks to human health or controlled waters resulting from contamination on the site; or recommendations for any further work.

1.4 Scope of Work

The overall scope of the current work included the following:

- Formation of 4no. window sample boreholes to depths circa 5.00m bgl.

- Formation of 1no. cable tool boreholes to depth circa 11.00m bgl.
- Formation of 9no. Trial pits to depth circa 3.00m bgl.
- Formation of 2no. soakaway tests in line with BRE 365 Soakaway Design.
- Installation of 4no. combined gas and water monitoring wells
- Collection of samples for limited chemical and geotechnical laboratory testing.
- Preparation of a fully interpretative report outlining findings and recommendations.

1.5 Report Layout

Section 2 of this report provides a summary of the Phase 1 desk study findings; including the site history, as established from available public record information/previous assessments by others.

Section 3 presents a preliminary Conceptual Model for the site and site characterisation attempts to identify potential previous and existing site sources of contamination.

Section 4 details the intrusive investigation carried out to validate the conceptual model.

Section 5, 6 & 7 details the geotechnical conditions identified by the investigation and makes recommendations for foundation design in respect of the proposed development.

Section 8 presents the records of the chemical analyses undertaken and gives the results of the qualitative risk assessment carried out using the results of the chemical analyses and taking account of the proposed end use of the site.

Section 9 provides conclusions and recommendations arising from this investigation.

1.6 Limitations

The accuracy of the data supplied by third parties should be considered in the context of any known site conditions for which Clarke Bond cannot be held liable.

The comments made in this report are based on the data available at the time of its completion. Any unusual or conflicting evidence discovered during any future site works must be presented to Clarke Bond as soon as possible so that any implications may be considered.

This report has been produced by Clarke Bond for the client solely for the purposes of a review of information for the above mentioned site. It may not be used by any person for any other purpose other than that specified without the express written permission of Clarke Bond. Any liability arising out of its use by a third party for purposes not wholly connected with the above shall be the responsibility of that party who shall indemnify Clarke Bond against all claims costs damages and losses arising out of such use.

In addition to the above it should be noted that when investigating or developing potentially contaminated sites, sub-surface conditions might vary both spatially and over time. Whilst this investigation and subsequent interpretation has been undertaken to reasonably characterise current sub-surface conditions at the site within the scope of works and agreed budget, the absence of certain ground, contamination or groundwater conditions at the individual locations is not a guarantee that these conditions do not exist elsewhere on the site. Additional information, changes in legislation or revised practices may necessitate re-interpretation of part or all of this report.

Unless specifically noted to the contrary, it should be assumed that this report has not been submitted to any regulatory authorities for approval. Redevelopment sites in particular may have planning conditions attached in respect of contaminated land assessment. Where we are made aware of such conditions in advance of scoping the works, we can tailor the report to the regulatory authority requirements. Where we are not made aware of any such requirements

there can be no certainty that our investigation will meet any or all of the regulatory authority requirements.

2.0 PHASE 1 ASSESSMENT

2.1 Site Location

The site is situated within Calderstones Park, Whalley at National Grid Reference (NGR) 372540, 437521 Access to the site is gained via a chain link fence from Pendle Drive to the south.

A Site Location Plan and site layout drawing is presented as Figure 01 in Appendix A.

2.2 Site Description

The site description has been established from a walkover survey conducted on 24th of January 2011 by Clarkebond Staff. The site layout drawing (Figure 2) presented in Appendix A, should be read in conjunction with this site description.

The site is triangular shaped, generally level and covers an area of approximately 2.11 hectares. The site currently comprises an area of scrub and marsh land with an area of low grade tarmac situated centrally to the site. A number of semi-mature trees are located around the site with a larger area of protected mature woodland present in the south.

Overhead telegraph poles are present along the northern and eastern boundaries. Numerous existing and relic services cross the site and the design team should make themselves familiar with the presence. Anecdotal evidence suggests that former underground tunnels used as service runs may be present within the area and conversations with the site vendor and local authority are recommended to confirm or discount their presence.

The site is bounded to the east by residential properties, to the north by a public footpath, and existing line of trees; to the west by scrub and marsh land (currently utilised by dog walkers); and to the south by Pendle Drive.

The surrounding area comprises a mix of residential properties, agricultural farmland and scrub/marsh land. The residential properties close to the site are positioned along Pendle Drive to the south and Mitton Road to the east. The existing Taylor Wimpey construction site is located to the south.

No evidence of sources of potential contamination or invasive plant species such as Japanese Knotweed was noted during the site walkover. The area of tarmac hardstanding and track leading from Pendle Drive suggests that relic infrastructure once occupied the site; which should be clarified within the historical map review.

2.3 Geology & Coal Authority

The geology of the site is shown on the 1:50,000 scale British Geological Survey maps obtained within the RSK Group Report which are extracted from the British Geological Survey Digital Geological Map of Great Britain at 1:50,000 scale and are summarised as follows:

- Superficial deposits consisting of Devensian Till (Boulder Clay).
- Bedrock comprises the Clitheroe Limestone Formation and Hodder Mudstone Formation (undifferentiated).

No faults are identified within 500m of the site boundary.

The site is not indicated to be within an area of known coal mining or brine mining as stipulated by the Coal Authority. The site is not indicated to be within a radon affected area, as less than 1% of homes are above the action level; no radon protective measures are necessary in the construction of new dwellings or extensions.

2.4 Hydrogeology & Hydrology

Records indicate the nearest surface water feature to the site is a drain, approximately 300m to the south of the site. Other drains/streams are present between 350m and 600m to the south east of the site. A pond is present approximately 300m to the north west. The River Calder and Barrow Brook are present approximately 800m to the south west and north of the site, respectively.

The River Calder, in a reach approximately 800m to the south west, is classified as having River Quality C grade water (fair). The risk to surface water features and/or main rivers is therefore considered low.

There is one surface water abstraction within approximately 600m east of the site listed as an impounded stream for Clitheroe Golf Club.

Guidance from the Environment Agency indicates that the bedrock underlying the site is deemed to be a minor aquifer overlain by soils of a low leaching potential. There are no records of groundwater and/or surface water abstraction licenses within 1000m of the site, and is not listed within an EA defined source protection zone.

As such the site sensitivity to groundwater receptors is deemed to be low to medium.

The site is not within an Environment Agency defined Flood Zone.

2.5 Local Authority & Environment Agency

Lancashire Council has yet to confirm whether or not there are no entries relating to the site in the Contaminated Land Register under s78R(1) of the Environmental Protection Act Part 2a and would be low priority for inspection by the council/EA. It is not known at this time whether the site or any of the surrounding land will be identified as contaminated.

One recorded historic landfills is identified within 500m of the Site. A landfill 100m west licensed for Commercial House Hold Waste.

The Landmark report indicates that the site is not included on the list of sites designated as contaminated land under Part 2A of the Environment Protection Act 1990.

No sites are designated as contaminated land under Part 2A of the Environment Protection Act 1990 with 500m of the site.

No nuisance, Statutory Notices for nuisance pollution incidents have been recorded at the site within the past 12 months.

2.6 Site History

Historical maps of the site area have been obtained from Groundsure. Pertinent information determined from review of these maps is set out in the following table; a full copy of the maps is presented in Appendix C:

Table 2.1: Historic Review of Mapping Coverage

Mapping Date	On-site	Off-site
1848 - 1895	The site occupies one field which is assumed agricultural. A woodland area occupies the south of the site.	The area surrounding the site is predominantly agricultural land, with some areas of woodland and a number of ponds nearby. Mitton road (unlabeled) is approximately 50m to the east of the site, the Blackburn Railway lies approximately 600m to the east. A brick and tile works is approximately 350m to the south east and a tile works approximately 400m to the north west.
1913	A new brick works, with a private railway leading to it, is present along the northern and western borders of the site, with an associated clay pit approximately 200m to the south. The main access route to the brick works forms what will become Pendle Drive.	By 1913 the brick and tile works to the south east and north west are indicated to no longer be operational. Whalley railway station, with its associated goods sheds, is present approximately 1km to the south east. The surrounding area remains predominantly agricultural with residential development in the town of Whalley.
1932 - 1955	An isolation unit of the mental hospital is located on the site. Houses are now present immediately to the east. A sewage works is present approximately 700m to the south west.	The 1932 map indicates the presence of a mental institution (later indicated simply as a hospital) immediately to the west of the site, with a pavilion and football club buildings to the south. Whalley has been further developed.
1970 - 2001	The isolation unit is still shown but is no longer labelled.	The 1970 map indicates a transport depot and cattle breeding centre approximately 100m and 150m to the east respectively.
2006 - 2009	The site is now in its present configuration. No structure is shown on the site, it is assumed to be derelict land with some scars relating to former access ways.	The northern section of the hospital has been redeveloped with residential properties, while the southern section remains in use as a hospital. The area surrounding the site remains largely unchanged to the latest date of mapping (2009).

2.7 Environmental Database

A Groundsure report commissioned for the Site has been used to provide an indication of the site history and surrounding land uses available on the public registers. The report provides data from a number of service providers including the British Geological Survey, Environment Agency and English Nature. A full copy of the Groundsure report is presented in Appendix B.

The table below indicates the risk scoring used on the potential pollutant linkages identified from the historic data search. The degree of risk (R) is calculated by multiplying the likelihood (L) with the effect (E):

Table 2.2 *Degree of risk (R) = Likelihood (L) x Effect (E)*

Likelihood (L)	Description	Probability	Effect (E)	Description	Increase in cost and time
5	Almost certain	>70%			
4	Probable	50-70%	4	Very high	>10%
3	Likely	30-50%	3	High	4-10%
2	Unlikely	10-30%	2	Low	1-4%
1	Negligible	<10%	1	Very low	<1%
Risk (R)	Risk Level	Action			
1-5	Trivial	None			
6-10	Significant	Undertake appropriate mitigation measures to reduce the risk level by appropriate on-site practice at little additional cost.			
>10	Substantial	Designers should take such risks into account and avoid or reduce risk level to acceptable levels. Additional resources required.			

The following table provides a summary of the data reference points, together with an indication of the hazard, likelihood, severity and degree of risk.

Table 2.3 - Environmental Data Review

Data Type	Distance from site	Hazard	Likelihood	Effect	Degree of risk	Mitigation measures
Current land uses	Onsite +	Migration of contaminants of concern including radioactive substances, inorganic and organic substances from sources offsite to onsite receptors	2	4	8	Phase II site investigation
Discharge consents	None	Discharge of contaminants of concern to the environment near site	1	4	4	Non Required
Landfills	100m	Release of known/unknown contaminants from landfill	2	4	8	Phase II Site Investigation
Groundwater vulnerability	0m	Minor aquifer overlain by strata of a low leaching potential	1	4	4	Non Required
Extreme flooding from rivers or sea without defences within 250m	Not shown within 250m	Flooding of the site	1	4	4	Non Required
Groundwater flooding	Onsite	Flooding due to increase in the level of groundwater in the region of the site	1	4	4	Non Required
Previous Land Uses	Onsite	Migration of contaminants of concern including inorganic and organic substances from sources onsite to offsite receptors	1	4	4	Non Required
Ground stability hazards	Onsite	Total and/or differential settlement	1	4	4	Non required
Historic ground workings	Onsite	Ground stability issues, migration of contamination from on-site sources	2	4	8	Phase II Site Investigation
Mining Affected Areas	Onsite	Ground instability	1	4	4	Non required
Brine Affected Areas	Listed	Ground instability	1	4	4	Non required
Radon Affected Areas	Onsite	Radon Gas migration	1	4	4	Radon protection measures not required

3.0 PRELIMINARY CONCEPTUAL MODEL

The site characterisation attempts to identify potential previous and existing site sources of contamination. The conceptual model links the identified sources likely to cause significant possibility of significant harm via pathways to identified critical receptors. The conceptual model is therefore based on a number of identified source-pathway-receptor scenarios. For land to be classified as contaminated a significant pollutant linkage will need to be identified which will include each component of the conceptual model. The absence or removal of a source or interception of a pathway will 'break' the pollutant linkage.

The conceptual model is characterised by identification of the following:

- On-site sources, which may impact on-site receptors via plausible pathways.
- On-site source, which may impact off-site receptors via plausible pathways.
- Off-site sources, which may impact on-site receptors via plausible pathways.

The change of land use will require assessment of the new site development layout within the context of introducing new exposure pathways. The planning regime will require assessment of the site to ensure the new development will not be classed as contaminated land under the definition provided by the Part 2A of the Environment Act 1990 as defined in the Environment Protection Act 1995.

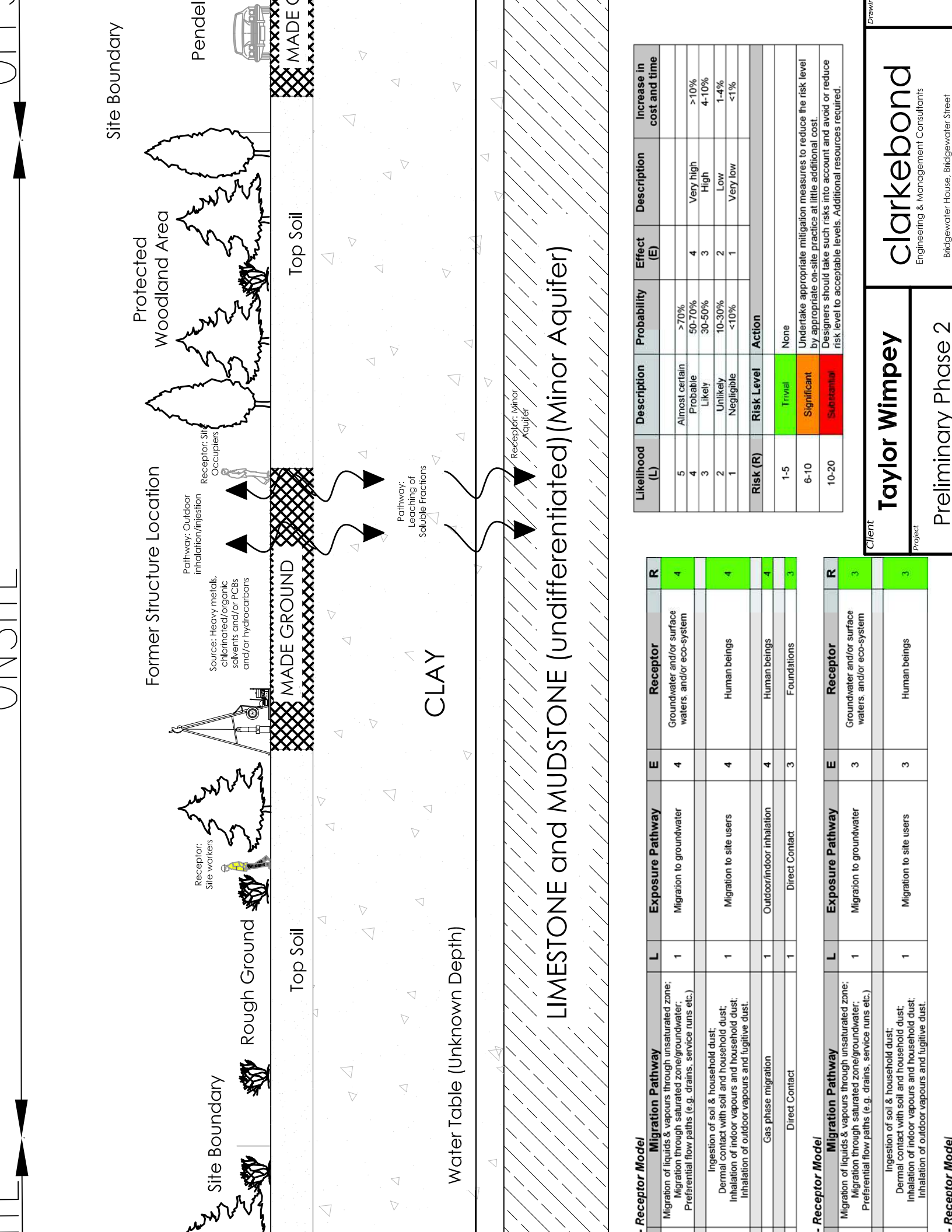
The preliminary conceptual model is presented over leaf. The drawing presents the source, pathway and receptors in tabular and graphical form. The first table provides an indication of the potential hazards and consequences. A qualitative score is given to the likelihood and effect to provide an indication of the degree of risk.

3.1 Site Investigation Design

The site investigation was designed to provide further information to help quantify the above risks. Boreholes, trial pits and window samples were positioned to provide geotechnical parameters to facilitate the design of future structures.

4no combined gas and groundwater monitoring wells were installed on site to allow adequate characterisation of risks from ground gas within Made Ground and fill deposits and appropriate mitigation measures, if necessary. Two of the installations were damaged and filled with soil following installation and ground gas monitoring was conducted via the two remaining active wells.

General screening was also conducted on a number of soil samples and tested for heavy metals and inorganic contaminants, sulphate. Visual or olfactory evidence of solvent or hydrocarbon contamination was not recorded during fieldworks and thus not incorporated into the chemical testing suite. A Photo Ionising Detector was utilised to conduct headspace analysis of recovered samples and confirm the above.



Receptor Model				
Migration Pathway	L	Exposure Pathway	E	Receptor
Migration of liquids & vapours through unsaturated zone; Migration through saturated zone/groundwater; Preferential flow paths (e.g. drains, service runs etc.)	1	Migration to groundwater	4	Groundwater and/or surface waters, and/or eco-system
Ingestion of soil & household dust; Dermal contact with soil and household dust; Inhalation of indoor vapours and household dust; Inhalation of outdoor vapours and fugitive dust.	1	Migration to site users	4	Human beings
Gas phase migration	1	Outdoor/indoor inhalation	4	Human beings
Direct Contact	1	Direct Contact	3	Foundations

Receptor Model				
Migration Pathway	L	Exposure Pathway	E	Receptor
Migration of liquids & vapours through unsaturated zone; Migration through saturated zone/groundwater; Preferential flow paths (e.g. drains, service runs etc.)	1	Migration to groundwater	3	Groundwater and/or surface waters, and/or eco-system
Ingestion of soil & household dust; Dermal contact with soil and household dust; Inhalation of indoor vapours and household dust; Inhalation of outdoor vapours and fugitive dust.	1	Migration to site users	3	Human beings

Likelihood (L)	Description	Probability	Effect (E)	Description	Increase in cost and time
5	Almost certain	>70%			
4	Probable	50-70%	4	Very high	>10%
3	Likely	30-50%	3	High	4-10%
2	Unlikely	10-30%	2	Low	1-4%
1	Negligible	<10%	1	Very low	<1%
Risk (R)	Risk Level	Action			
1-5	Trivial	None			
6-10	Significant	Undertake appropriate mitigation measures to reduce the risk level by appropriate on-site practice at little additional cost.			
10-20	Substantial	Designers should take such risks into account and avoid or reduce risk level to acceptable levels. Additional resources required.			

Client

Taylor Wimpey

Project

Preliminary Phase 2

Drawn

clarkebond

Engineering & Management Consultants

Bridgewater House, Bridgewater Street

4.0 FIELDWORKS

4.1 General

The intrusive investigation was carried by Geo Site Surveys (GSS) between 24th January 2011 and 25th of January 2011. A plan showing all the exploratory hole locations are presented as Figure 02 in Appendix A. All locations were checked for services against available service plans, scanned with a cable avoidance tool (CAT), and hand dug trial pits formed to a depth of 1.20mbgl prior to the intrusive investigation; in line with Clarke Bond health and safety methodology.

4.2 Cable Tool Percussion Boreholes

During the site investigation a total of 1 no. Cable Tool Percussion Boreholes (BH01) was formed to a depth of 10.30m bgl.

The exploratory hole retrieved continuous soil samples; these were then logged by an onsite engineer and representative samples were taken for geotechnical and chemical analysis.

Detailed Boreholes log sheets are included in Appendix B.

4.3 Window Sample Boreholes

During the site investigation a total of 4no. Window Sample Boreholes (WS01 to WS04) were formed to a depth of 3.00 to 5.00m bgl.

Exploratory holes retrieved continuous soil samples from each hole; these were then logged by an onsite engineer and representative samples were taken for geotechnical and chemical analysis.

Detailed window sample borehole log sheets are included in Appendix B.

4.4 Trial Pitting

9 no trial pits (TP01-07, TP09 and TP10) were formed to depths ranging from 1.5mbgl to 3.3m bgl using a JCB 3CX.

Once completed the trial pits were backfilled with arising and re-compacted.

Soakaways were conducted in TP01 and TP02 from ground level to 1.50mbgl and 1.90mbgl respectively in line with BRE Digest 365 – Soakaway design. The permeability tests conducted and calculated permeability soil infiltration rates are shown in appendix E.

Detailed trial pit logs are presented within Appendix B.

4.5 Sample Collection and Analysis

Environmental sample collection was carried out in accordance with Clarke Bond Groups standard operating procedures and BS EN ISO 22475-1:2006. All soil and groundwater samples were collected using either clean stainless steel utensils or clean disposable gloves and placed directly into clean containers provided by the laboratory. Samples obtained during the investigation were subjected to a range of geochemical testing at appropriate UKAS accredited laboratories.

Testing was carried out in accordance with the procedures outlined in BS EN ISO14688-1:2002, 14688-2:2004, and 14689-1:2003.

Geotechnical testing results are included as Appendix C.

Soil and groundwater samples were sent for chemical analysis to SAL Laboratories to be analysed for some or all of the following determinants:

- pH and Sulphate content in accordance with BRE 1 Special Digest on concrete in aggressive ground conditions (2005)
- General indicator suite comprising arsenic, boron (water soluble), cadmium, copper, chromium, lead, mercury, nickel, selenium, silver, zinc, total cyanide, free cyanide, phenols, pH, total sulphur, sulphide, total sulphur, thiocyanate, 2:1 soluble sulphate, magnesium, total organic carbon and nitrate analysis.

The results from the chemical analysis are included as Appendix D.

5.0 GROUND CONDITIONS

Ground conditions generally comprise a cover of clayey Topsoil (Made Ground) overlying a layer of soft to firm to firm to stiff reworked clay (Made Ground) possibly associated with site re-profiling and recorded to maximum depths of 3.60mbgl in BH01. The reworked clays possibly resulting from re-profiling of clays resulting from the former Brickworks to the north/northwest of the site. A land drain was recorded at a depth of 1.50m within TP01/SA01.

Exploratory holes excavated within areas of the former access routes and Isolation Unit (CP01, TP01, TP02, TP05, TP06, TP07, WS03 and WS04) Made Ground comprising silty clayey ashy gravel of brick, concrete, timber, clinker and slate was recorded to a maximum depth of 2.50m bgl (TP07). Relic infrastructure comprised occasional intact brick/concrete cobbles were recorded and a basement/cellar was wall was recorded within TP02/SA02 to a maximum depth of 1.90mbgl.

Underlying the Made Ground/Reworked Clay generally firm to stiff dark grey Glacial Boulder Clay was encountered to depth ranging from 0.50mbgl to maximum depths of 10.30mbgl; and was recorded within all the majority of exploratory boreholes with the exception of TP01/SA1.

SPT 'N' values ranged from 1.5 to 10 in the Reworked Clay indicating soft to firm to stiff conditions. SPT 'N' values ranged from 4 to 13 within the Glacial Boulder Clay indicating soft to firm to firm to stiff conditions.

Hand held shear vane tests conducted within relatively undisturbed samples from the trial pits recorded Cu values ranging from 30 to 51kN/m² in the reworked clays confirming they are generally soft to firm to firm. Cu values ranging from 39 to 126kN/m² were recorded in the Glacial Boulder Clay confirming generally soft to stiff conditions.

5.1 Groundwater

Groundwater was encountered during drilling within perched granular Made Ground in BH01 at 2.7mbgl and 8.6mbgl within the granular horizons superficial deposits. In both cases the flow was slow rising to 2.0mbgl and 8.2mbgl respectively after 20mins.

Groundwater was also encountered during the drilling of WS03 and WS04 at 4.00mbgl and 3.00mbgl respectively. No rise was noted.

Groundwater was encountered during the excavation of TP07 at 2.30m bgl within the Made ground and recorded as fast inflowing. It is assumed perched on the underlying natural Glacial Boulder Clay.

Four combined groundwater and ground gas monitoring wells were installed on the site and to date 2no. visits have been conducted. It should be noted that two installations located in WS02 and WS03 have been vandalised, WS03 has been partially repaired. Groundwater levels were recorded at the following depths within the Clarke Bond boreholes:

Borehole Number	Range of Depths Recorded (mbgl)	Depth of Response Zone (mbgl)
BH01	1.34	0.50 to 3.50
WS01	0.57	0.50 to 2.00
WS02	Vandalised	0.50 to 2.00
WS03	Vandalised, Repaired	0.50 to 2.00

5.2 Contamination Observations

No visual or olfactory evidence of hydrocarbon or solvent contamination was observed.

5.3 Underground Service Plans

The design team should fully satisfy themselves to the implications of underground services present within the vicinity of the site. Although unlikely and only anecdotal evidence suggests their presence to date, further information should be sought on the presence of former service tunnels beneath the site.

5.4 Below ground obstructions

As discussed above, obstructions in the form of relic foundations and basements should be anticipated within the areas of the former Isolation Units.

6.0 GEOTECHNICAL TESTING ANALYSIS

6.1 Laboratory Analysis

A programme of laboratory testing was undertaken in accordance with BS 1377 (1990) "Methods of Test for Soils for Civil Engineering Purposes". The results of which are presented in Appendix C and are summarised below.

BS Number	Test	Description
Part 2.3		Moisture Content
Part 2.5		Plasticity index
Part 3.5		Sulphate content
Part 3.9		pH

Moisture Content

Ten samples of the Clay were tested for natural moisture content. The results are summarised below:

Property	Range	Mean
Moisture Content (clay)	27% to 46%	35.00%

Plasticity Index

Ten samples of clay were analysed for plasticity index and hence shrinkage/swelling potential. The results are summarised below:

Property	Range	Mean
Plasticity index (Clay)	42 – 49	45.6
*Amended Plasticity index	14.00 - 21.39	45.21

*Amended for percentage of particles passing a 425mm sieve

The results demonstrate clays of high to very high plasticity with a corresponding high volume change potential.

Sulphate and pH

Six samples were analysed for pH and soluble sulphate as part of a BRE Concrete Suite:

Property	Range
Sulphate as SO ₄ 2:1 (acid soluble) (g/l)	<0.1 (below detectable limit)
pH	7.2 to 8.3

7.0 GEOTECHNICAL ASSESSMENT

7.1 General

It is understood that the site is to be redeveloped into 2-storey residential housing units, with associated gardens, car parking and landscaped areas. For ease of description and to help in the design of foundations for proposed units, recommendations for foundation design has been grouped and related to George Wimpey Manchester Limited Proposed Development Drawing in appendix A. A copy of the Borehole Location Plan is provided within Appendix A and summarises foundation types, indicative depths and bearing capacities. It is assumed that floor slabs will be of suspended block and beam construction.

Laboratory test results indicate that the grey upper gleyed Glacial Clay is high to very high with a corresponding high volume change potential. Thus the presence of trees and underground services (in particular the location of the currently unknown Calderstones Hospital Rising Water Main) are likely to be the overriding factor between conventional foundations and a piled solution. Where NHBC Chapter 4.2 established that foundations should be taken to depths greater than 2.50mbgl to 3.00mbgl a piled or semi-rigid raft solution should be considered.

To enable pile design, further cable tool boreholes are recommended to depths circa 12.50mbgl; due to the low SPT 'N' values recorded within BH01.

7.2 Foundations

Foundation loads have not been provided, however, it is understood that proposals include forming of approximately No.42 two story units. A foundation risk assessment, options appraisal and costs exercise should be conducted, considering the following options:

- Conventional trench fill and strip foundations (suspended slab)
- Piled Foundations where trench fill risks extending below 3.0mbgl to conform to current NHBC 'Chapter 4.2 - building near trees' guidelines

Should piled foundations be considered; a specialist piling contractor will need to be approached for advice on their own specialist propriety systems. Vibration and noise being a very important consideration.

Geotechnical testing indicates that site clays are of high to plasticity with a corresponding high shrinkage potential. A number of trees are present which are within possible influencing distance of the site foundations and drainage should be designed in line with NHBC Standards guidance document Chapter 4.2 Building Near Trees.

7.3 Protection of Buried Concrete

Recorded pH values ranged from, 7.2 to 8.3pH units and 2:1 Sulphate as SO₄ (acid soluble) values below detection limits of the instrument <1%. The results from the chemical laboratory sulphate and pH analysis for the site indicate that a worst case Design Sulphate Class of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) class of AC-1s.

7.4 Excavations and Groundwater

Spalling and collapse due to loosely backfilled Made Ground was recorded in TP7 (2.50mbgl), which will require support and consideration during foundations and drainage excavations. Groundwater was encountered during drilling in BH01 at 2.7mbgl and 8.6mbgl within the

superficial deposits. Additionally, groundwater was also encountered during the drilling of WS03 and WS04 at 4.00mbgl and 3.00mbgl respectively. Ingress was noted as generally slow to moderate with the exception of TP07 where ground water was encountered at 2.30m bgl in the made ground and recorded as fast inflowing.

It is considered likely that the excavations will not remain fully dry but should be able to be controlled by a screened sump pump techniques and no specialist dewatering techniques (such as well point systems) are envisaged. Localised seepages are likely to be encountered during period of heavy rainfall and within granular inclusions.

Safety precautions should not be neglected especially where personnel are to enter excavations when close support would be required. The stability of the Glacial Till deposits are likely to remain stable in the short term, however, spalling is likely where granular deposits exist. Excavations into sand deposits will require support in order to allow personnel to enter below a depth of 1.20mbgl. All excavations and basement construction should be conducted in line with CIRIA Report 97 – Trenching Practice and BRE 440 Foundations, Basements and External Works 2002.

If excavations are cut at a safe angle of repose or benched a suitably qualified geotechnical engineer should be present to check for potential signs of instability. Where possible all soils should be retained on site to reduce disposal costs.

7.5 Pavement Design

All topsoil, organic matter, soft or disturbed ground should be removed from beneath any exposed area of surfacing and the exposed surface should be proofed rolled to expose any excessively soft or compressible zones, which should be removed.

The formation should always be proof rolled and carefully inspected ensuring that any soft or loose spots are removed and replaced with properly compacted clean granular material.

For design purposes, a conservative CBR value of 1% should be used for pavement construction within the natural superficial deposits.

8.0 CONTAMINATION ASSESSMENT

8.1 Introduction

The preliminary conceptual site model identified that, the potential for the existence of contamination beneath the site, was low. As such, a number of general screening tests were undertaken during the intrusive investigation to confirm, or otherwise, the site's anticipated low to medium risk status.

The following contamination assessment sub-sections will discuss the identified risks associated with individual contaminant groups based on contamination testing results, undertaken on samples from the intrusive investigation.

8.2 Rationale

In May of 2008, Contaminated Land: Application in Real Environments (CLAIRE) in conjunction with the Chartered Institute of Environmental Health (CIEH), with support from the Soil and Groundwater Technology Association (SAGTA), released a document entitled 'Guidance on Comparing Soil Contamination Data with a Critical Concentration'⁷.

The document provides advice on the use of statistical techniques in the assessment of soil contamination data. It forms part of a package of improved UK guidance highlighted in the Defra discussion paper 'Assessing risks from land contamination – a proportionate approach. Soil Guideline Values: the Way Forward (CLAN 06/2006). The overall aim is to increase understanding of the role statistics can play in quantifying the uncertainty attached to estimates of the mean concentration of contaminants thereby creating a more informed basis for regulatory decision-making.

The guidance presents a structured approach that can be followed when employing statistical techniques for data assessment.

The key question under Planning will usually be "can it confidently be said that the level of contamination on this land is low relative to some appropriate measure of risk?"⁷. In a statistical basis this question is dealt with through the use of formal hypothesis; the null and the alternative, the null being the starting position against which the key question (the alternative hypothesis) can be tested.

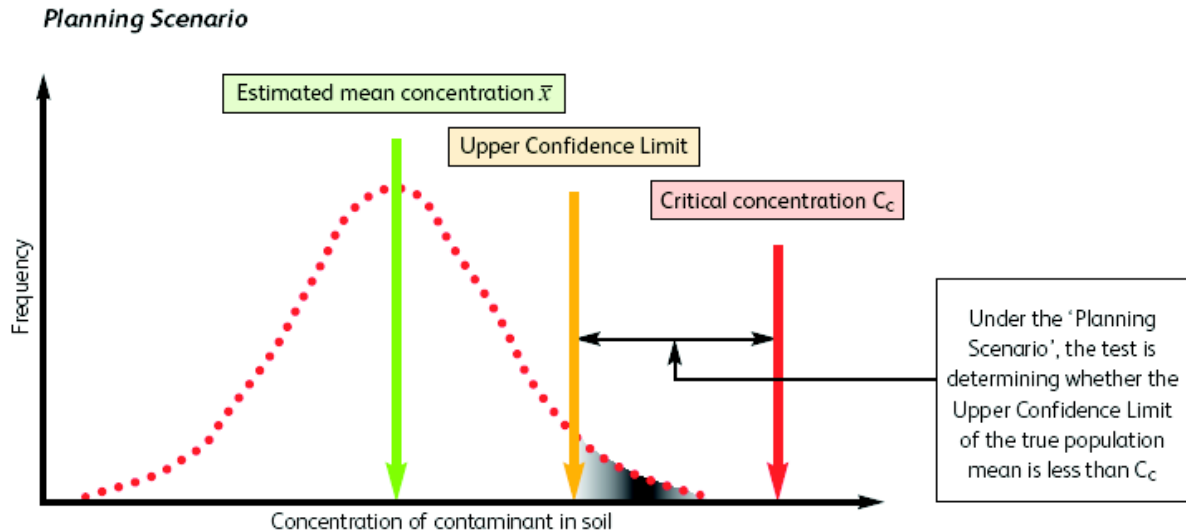
Under Planning, the Null hypothesis (H_0) is:

- "that the level of contamination [in the land of interest] is the same as or higher than the critical concentration".

Whilst the alternative hypothesis (H_1) is:

- "that the level of contamination in the land is lower than the critical concentration".

Under the planning process the statistical test must be designed to show that there is a 95% probability that the true population mean falls below the critical concentration and as such the statistical test must involve the comparison of the 95th Upper Confidence Limit (UCL) of the true population mean with the critical concentration as shown in the figure below.



Application of significance tests for the Planning process where data are normally distributed⁶

A guide to the application of the statistical testing of a dataset for planning purposes, after the CLAIRE and CIEH guidance⁷, was used for the purposes of this assessment. In general terms the following steps should be followed when applying the statistical test to a dataset under the Planning scenario:

- Calculate sample mean ($\bar{x}$) and sample standard deviation (s).
- Investigate the normality of the data distribution using tests as outlined in Appendix C of the CLAIRE/CIEH guidance.
- Investigate statistical outliers and anomalous concentrations as outlined in Appendix B of the CLAIRE/CIEH guidance.
- If $\bar{x} > C_c$ (SGV or LQM/CIEH GAC) conclude that the Null Hypothesis (H_0) cannot be rejected. The Developer may then have options on how to proceed including collecting further data and re-running the significance test at the same confidence level, or undertaking remediation on a precautionary basis.
- If $\bar{x} < C_c$ apply the one sample t-test if the dataset does NOT deviate significantly from normality (i.e. dataset is normally distributed). The one sample t-test is the same as the mean and maximum value test as outlined in CLR7⁸. If the dataset distribution deviates significantly from normality (i.e. dataset is not normally distributed), apply the one-sided Chebychev Theorem.

The 95th UCL values for the one sample t-test and the one-sided Chebychev theorem are calculated using the following formulae⁷:

$$UCL = \bar{x} + (t_{(n-1,0.95)} \times \frac{s}{\sqrt{n}})$$

LCL for one sample t-test

$$t_0 = \frac{\bar{x} - C_c}{\frac{s}{\sqrt{n}}}$$

Alternative method by calculating t_0 value for comparison with tabulated $t_{(n-1,0.95)}$ values

$$UCL = \bar{x} + (k_{(0.05)} \times \frac{s}{\sqrt{n}})$$

LCL for one-sided Chebychev Theorem

$$k_0 = \frac{\bar{x} - C_c}{\frac{s}{\sqrt{n}}}$$

Alternative method by calculating k_0 value for comparison with tabulated $k_{(0.05)}$ or $k_{(crit)}$ values

Where:

$\bar{x}$ = sample mean

$t_{(n-1,0.95)}$ = Value from Table A.1, Appendix A in CLAIRE/CIEH guidance⁷ and CLR7⁸

$k_{(0.05)}$ = Value from Table A.2, Appendix A in CLAIRE/CIEH guidance⁷

s = sample standard deviation

n = sample population

When applying either the one sample t-test or the one-sided Chebychev theorem to the dataset of a determinand where the sample mean is less than the Cc, two alternative techniques are possible for each, as shown by the formulae above and described below:

The 95th UCL value can be calculated for the determinand by inputting values into the formulae above for the separate tests and inputting the $t_{(n-1,0.95)}$ or $k_{(0.05)}$ values for the one sample t-test and the one-sided Chebychev theorem respectively. These values are tabulated within Appendix A of the CLAIRE/CIEH guidance. The calculated 95th UCL values can then be compared to the Cc and if the 95th UCL < Cc it can be concluded that the Null Hypothesis (H_0) can be rejected.

Alternatively the t_0 (one sample t-test) and the k_0 (one-sided Chebychev theorem) values can be calculated for a determinand where the mean is less than the Cc, using the formulae shown above. The calculated values for t_0 and k_0 are then compared to values for $t_{(n-1,0.95)}$ and $k_{(0.05)}$ respectively. If the t_0 and k_0 values are less than the respective $t_{(n-1,0.95)}$ and $k_{(0.05)}$ values then it can be concluded that the Null Hypothesis (H_0) can be rejected.

Within this assessment the 95th UCL values will be used for comparison against critical concentrations (Cc). The Cc with which the sample mean and the 95th UCL will be compared, will be published Soil Guideline Values (SGVs) or, in the absence of published SGVs, LQM/CIEH Generic Assessment Criteria (GAC) ⁹ for a residential end use. This scenario is considered to be a conservative approach given the timeframe and minimum age group of the on-site receptors.

8.3 Soil Guideline values

The Environment Agency's position on CLEA guidance is as follows:

"The CLEA guidance is non-statutory. It does not purport to interpret the policies or procedures of the Environment Agency and shall not operate as a statutory license, waiver, consent or approval from the Environment Agency"⁹.

"The CLEA guidance describes the soil concentrations above which, in the opinion of the Environment Agency, there may be concern that warrants further investigation and risk evaluation for both threshold and non-threshold substances. These levels are a guide to help assessors estimate risk. It does not provide a definitive test for telling when risks are significant"⁹.

The soil guideline value (SGV) is derived by estimating the concentration of a substance in soil, which will result in an amount of the contaminant entering the human body that is equal to the relevant Health Criteria Value(s). Revised guidance and software has been published for calculation of generic assessment criteria, which will lead to the publication of SGVs based on the new approach. New TOX and SGV reports for priority substances are due to be published after March 2009. The 'old' ten SGV reports will be replaced.

The Environment Agency and DEFRA have produced two new reports - "Human health toxicological assessment of contaminants in soil" and "Updated technical background to the CLEA model". This has led to the withdrawal of CLR7-10, which no longer reflects the current approach and formed the basis of the existing SGVs, as a result all the existing SGV reports have been withdrawn.

The publication of new substance specific TOX reports will lead to the withdrawal of the existing reports. Practitioners are expected to produce their own generic assessment criteria using the CLEA software and handbook.

The following table provides values for comparison on the old CLEA and approach and the new CLEA approach with details of the TOX report status:

Table 8.1 Soil Guideline Values

Substance	Old CLEA SGV Res. With plant Res. Without plant Allotment Commercial	New CLEA SGV published Res. With plant Allotment Commercial	LQM/CIEH 2 nd Edition GACs Res. With plant Allotment Commercial
Arsenic	20 20 20 500	32 43 640	
Beryllium			51 55 420
Cadmium	1(ph6),2(pH7),8(ph8) 30 1(ph6),2(pH7),8(ph8) 1400	10 1.5 230	3 0.53 348
Chromium	130 200 130 5000		CrIII 3000,CrIV 4.3 CrIII 34600 CrIV 2.1 CRIII 30400 CrIV 35
Copper			2330 524 71700
Lead	450 450 450 750		
Mercury Inorganic	8 15 8 480	170 80 3600	
Nickel	50 75 50 5000	130 230 1800	
Vanadium			75 18 3160
Selenium	35 260 35 8000	350 120 13000	
Zinc			3750 618 665000

The following table presents the published SGV and the newly published LQM/CIEH 2nd Edition 2009 GAC values calculated assuming 1%, 2.5% and 6% Soil Organic Matter (SOM). This provide a basis for correlation with the in house derived values using the new CLEA model Software Version 1.04 2009.

The following table shows LQM/CIEH GAC values for Polycyclic Aromatic Hydrocarbons of a residential development with plant uptake assume a soil of sandy clay loam, with 1%, 2.5% and 6% SOM.

Table 8.3 – LQM/CIEH 2nd Edition 2009 PAH GAC values (residential end use)

PAH Congener	Residential land-use LQM/CIEH GAC for Polycyclic Aromatic Hydrocarbons (mg kg ⁻¹ DW) ^{a,b,c,d,e}		
	1% SOM	2.5% SOM	6% SOM
Acenaphthene	210	480	1000
Acenaphthylene	170	400	850
Anthracene	2300	4900	9200
Benzo[a]anthracene	3.1	4.7	5.9
Benzo[a]pyrene	0.83	0.94	1.0
Benzo[b]fluoranthene	5.6	6.5	7.0
Benzo[ghi]perylene	44	46	47
Benzo[k]fluoranthene	8.5	9.8	10
Chrysene	6.0	8.0	9.3
Dibenz[ah]anthracene	0.76	0.86	0.90
Fluoranthene	280	460	670
Fluorene	160	380	780
Indeno[123-cd]pyrene	3.2	3.9	4.2
Naphthalene	1.5	3.7	6.7
Phenanthrene	92	200	380
Pyrene	560	1000	1600

^a Based on a sandy loam soil as defined in SR3 (Environment Agency, 2009C) and 1, 2.5 and 6% SOM.

^b GAC for Polycyclic Aromatic Hydrocarbons will vary according to SOM for all land-uses.

^c Values are rounded to two significant figures.

^d GACs assume that free phase contamination is not present.

^e GACs based on a sub-surface soil to indoor air correction factor of 1.

8.4 Metals

8.4.1 Human Health

Ten soil samples were taken from depths of 0.1m and 2.0m below ground level (bgl) and were sent under chain of custody to undergo laboratory analysis for metals.

The majority of the values fell below their respective CLEA/LQM/CIEH GACs for a residential end use.

A sample from TP10 at 0.1mbgl recorded a lead concentration of 970mg/kg within Made Ground strata; above the soil guideline value of 450mg/kg. All other concentrations for lead are well below the soil guideline value and this samples is considered to be associated with occasional ash and clinker recorded within the Made Ground.

Four samples of topsoil were taken and the calculated 95th Upper Confidence Limit values compared against the Critical concentration concludes that the Null Hypothesis (the true mean concentration is equal to or greater than the critical concentration: $\mu \geq C_c$) cannot be rejected unless TP10 at 0.10m bgl is designated as an outlier.

As such the risk from metals to identified receptors post development is considered medium and further analysis is required to confirm the need for capping systems within garden and landscaping areas.

8.5 Polycyclic Aromatic Hydrocarbons (PAH)

8.5.1 Human Health

Ten soil samples were taken from Made Ground and superficial deposits and analysed for Speciated PAH by GCMS.

The majority of the values fell below their respective LQM/CIEH GACs for a residential end use with plant uptake use using a conservative one percent of soil organic matter content (1% SOM).

Two samples taken from the topsoil from TP01 at 0.1mbgl and TP02 at 0.1mbgl, recorded benzo(a)Pyrene concentrations of 1.6mg/kg and 1.8mg/kg respectively, these are above the soil guideline value of 0.83mg/kg to 1.0mg/kg using a one to six percent of soil organic matter

content (1-6% SOM). The SOM for the TP01 and TP02 samples is estimated at 9.48% and 4.48% respectively based on the calculation defined in the CLEA model.

In total four samples of topsoil were taken and the calculated 95th Upper Confidence Limit values compared against the Critical concentration concludes that the Null Hypothesis (the true mean concentration is equal to or greater than the critical concentration: $\mu \geq C_c$) cannot be rejected.

Two samples taken in the Made Ground: Gravel from TP01 at 0.4mbgl and TP03 at 0.3mbgl, recorded benzo(a)Pyrene concentrations of 4.9mg/kg and 1.0mg/kg respectively, these are above the soil guideline value of 0.83mg/kg using a one to six percent of soil organic matter content but TP03 is equal to 1.0mg/kg at 6% SOM. The SOM for the TP01 and TP03 samples is estimated at 7.24% and 16.20% respectively based on the calculation defined in the CLEA model. Hence the TP03 sample can be discounted for the purposes of the evaluation.

TP01 at 0.4m bgl recorded values above the SGV's as shown in the table below;

Determinant	Recorded Value mg/kg at 7.24% SOM	LQM/CIEH 2 nd Edition 2009 PAH GAC values at 6% SOM (residential end use)
Benzo(a)anthracene	6.8	5.9
Benzo(a)pyrene	4.9	1.0

In total two samples of the Made Ground: Gravel were taken and the calculated 95th Upper Confidence Limit values compared against the Critical concentration concludes that the Null Hypothesis (the true mean concentration is equal to or greater than the critical concentration: $\mu \geq C_c$) cannot be rejected.

As such the risk from PAH compounds within the Made Ground to identified receptors post development is considered medium and further analysis is required to confirm the need for capping systems within garden and landscaping areas.

8.6 Groundwater

Groundwater was encountered during the excavation of TP07 at 2.30m bgl, BH 01 at 2.7m bgl in the Made Ground. It is assumed perched on the underlying natural Glacial Boulder Clay. Groundwater was also encountered in the Glacial Clay in WS03 at 4.00m bgl, WS04 at 3.00m bgl and BH01 at 8.6m bgl.

Rainfall infiltration and leaching of soluble fractions, within proposed landscaped areas, poses a slight risk to the underground minor Aquifer. However, no records of groundwater and/or surface water abstraction licenses are within 1000m of the site. The site location is also stated to be underlain by superficial deposits of a low leaching potential and this was confirmed by the investigation. The risks to Controlled Water receptors from leaching and groundwater migration are therefore, perceived to be negligible, post construction.

It may be a requirement of the Environment Agency and Lancashire Council to conduct further quantitative analysis to confirm the above. This should be clarified as soon as practically possible.

8.7 Ground Gas Protection Measures

To date 2no ground gas monitoring visits have been conducted from within the installed wells. WS01 recorded a peak CO₂ level of 0.5%v/v, and a peak CH₄ level of 0.1%v/v, flow rates were recorded at maximum of 4.9 litres/hrs. As carbon dioxide does not exceed the 5% threshold value the results (presented in Appendix G) indicate that traffic light classification of GREEN and as such no special protection measures are required for the proposed building, in line with NHBC Guidance on Methane and Carbon Dioxide (Rev4 March 2007).

It should be noted that this is based on the assessment of the two remaining active wells due to WS02 and WS03 being vandalised.

A further 2no ground gas visits are planned over the next 4 weeks and the findings will be forwarded on completion.

8.8 Disposal of Waste Soils from Site

In order to prevent excessive costs and reduce the environmental impact of the development it is recommended that removal of wastes from the site, including waste soils, is kept to a minimum. It is however, envisaged that arisings will be created during the works; in particular within the landscaped mounds.

To evaluate the various on-site soils for potential offsite disposal, soils are classified in accordance with the Hazardous Waste Directive (HWD) that enables the provision of a European Waste Catalogue (EWC) Code for use during offsite disposal and a Hazardous or Non-Hazardous Classification. Non-Hazardous material is suitable for disposal in a Non-Hazardous landfill; however, disposal to an Inert Landfill requires further Waste Acceptance Criteria (WAC) testing in accordance with BS EN 12457-3. Material classed as Hazardous also requires WAC testing to assign a suitable hazardous classification.

Testing conducted to date would indicate that any site materials to be removed off site to landfill; would be classified as stable non-reactive hazardous waste in a non-hazardous landfill.

The Landfill Regulations require that all Hazardous and Non-Hazardous solid waste must be treated prior to offsite disposal to landfill. You can define 'treatment' by using the following 'three-point test'. All three criteria must be satisfied for all of the waste to qualify as being treated:

1. It must be a physical, thermal, chemical or biological process including sorting.
2. It must change the characteristics of the waste.
3. It must do so in order to:
 - a. Reduce its volume; or
 - b. Reduce its hazardous nature; or
 - c. Facilitate its handling; or
 - d. Enhance recovery.

Solid chemical analysis indicates that the site soils may be classified as stable non-reactive Hazardous waste. However, Waste Acceptance Criteria (WAC) testing has not been undertaken on any samples to date and as such an Inert or hazardous classification for any site soils can not be given.

It should be noted that a site investigation is unable to identify all below ground conditions at a site and therefore, it should be noted that if during construction works soils that require offsite disposal are identified as being different to what has been preliminarily tested in this report, additional testing will be required prior to disposal or recovery at a licensed offsite facility.

It is also recommended that prior to offsite disposal or recovery of any waste soils; the receiving landfill facility should be sent copies of all relevant chemical analysis and written confirmation of acceptance of soils provided.

All producers of waste have a duty of care to ensure that any waste they produce is handled safely and within the law. They must check that anyone they pass waste on to is authorised to take it. This includes the authorised site earmarked to handle the waste and any haulier (licensed waste carrier) used to transport the waste between the sites.

All waste holders must act to keep waste safe against:

1. Corrosion or wear of waste containers;

2. Accidental spilling or leaking or inadvertent leaching from waste unprotected from rainfall;
3. Accident or weather breaking open contained waste and allowing it to escape;
4. Waste blowing away or falling while stored or transported;
5. Scavenging of waste by vandals, thieves, children, trespassers or animals.

Holders should protect waste against the above risks while it is in their possession and they should also protect it for its future handling requirements. Waste should reach not only its next holder but a licensed facility or other appropriate destination without escape. It is recommended that the container used to transport the waste is suitable not only to prevent solid and liquid residues escaping, but also any potentially dangerous vapours or odours associated with the waste.

Segregation of different categories of waste where they are produced may be necessary to prevent the mixing of incompatible wastes. Segregation may assist the disposal of waste to specialist outlets. Where segregation is practiced on sites, the waste holder should ensure that his employees and anyone else handling waste there are aware of the locations and uses of each segregated waste container.

Waste handed over to another person should be in some sort of container, which might include a skip. The only reasonable exception would be loose material loaded into a vehicle and then covered sufficiently to prevent escape before being moved. Waste containers should suit the material put in them.

A waste transfer note (WTN) is a document which must accompany any transfer of waste between different holders. The purpose of a WTN is to allow other people who handle your waste to know what they are dealing with so that they can manage it safely and properly.

A WTN must be created for each load of waste that leaves the site.

The WTN must contain enough information about the waste to enable anyone coming into contact with it to handle it safely, and either dispose of it or allow it to be recovered within the law. If insufficient information is given on the WTN the responsible party may liable to be prosecuted.

Records of all waste transferred or received must keep for at least two years.

8.9 Refined Risk Assessment

The following tables summarises the potential pollutant linkages associated with the proposed development. The degree of risk (R) is calculated by multiplying the likelihood (L) with the effect (E):

On-Site to On-Site Source - Pathway - Receptor Model

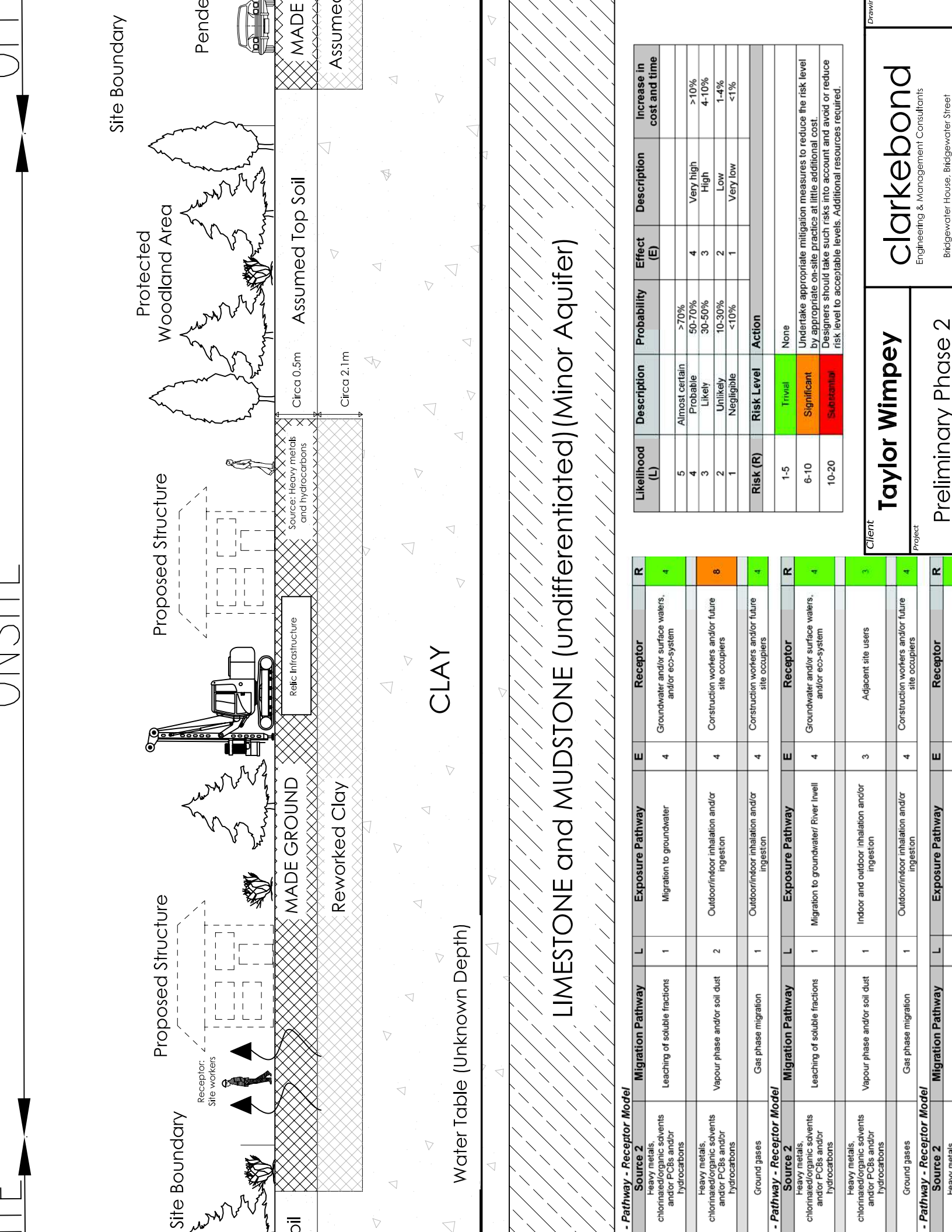
Source 1	Source 2	Migration Pathway	L	Exposure Pathway	E	Receptor	R
Made Ground soils	Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Leaching of soluble fractions	1	Migration to groundwater	4	Groundwater and/or surface waters, and/or eco-system	4
Made Ground soils	Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Vapour phase and/or soil dust	2	Outdoor/indoor inhalation and/or ingestion	4	Construction workers and/or future site occupiers	8
Made Ground soils	Ground gases	Gas phase migration	1	Outdoor/indoor inhalation and/or ingestion	4	Construction workers and/or future site occupiers	4

On-Site to Off-Site Source - Pathway - Receptor Model

Source 1	Source 2	Migration Pathway	L	Exposure Pathway	E	Receptor	R
Made Ground soils	Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Leaching of soluble fractions	1	Migration to groundwater	4	Groundwater and/or surface waters, and/or eco-system	4
Made Ground soils	Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Vapour phase and/or soil dust	1	Indoor and outdoor Inhalation and/or ingestion	3	Adjacent site users	3
Made Ground soils	Ground gases	Gas phase migration	1	Outdoor/indoor inhalation and/or ingestion	4	Construction workers and/or future site occupiers	4

Off-Site to On-Site Source - Pathway - Receptor Model

Source 1	Source 2	Migration Pathway	L	Exposure Pathway	E	Receptor	R
Made Ground soils	Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Leaching of soluble fractions	1	Migration to groundwater	3	Groundwater and/or surface waters, and/or eco-system	3
Made Ground soils	Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Vapour phase and/or soil dust	1	Indoor and outdoor Inhalation and/or ingestion	3	Adjacent site users	3
Made Ground soils	Ground gases	Gas phase migration	1	Outdoor/indoor inhalation and/or ingestion	4	Construction workers and/or future site occupiers	4



Site Boundary

Protected Woodland Area

Proposed Structure

Proposed Structure

Site Boundary

Receptor:
Site workers

Source: Heavy metals
and hydrocarbons

Pending

MADE

Assumed Top Soil

Circa 0.5m

Circa 2.1m

Relic Infrastructure

MADE GROUND

Reworked Clay

CLAY

Water Table (Unknown Depth)

LIMESTONE and MUDSTONE (undifferentiated) (Minor Aquifer)

- Pathway - Receptor Model

Source 2	Migration Pathway	L	Exposure Pathway	E	Receptor	R
Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Leaching of soluble fractions	1	Migration to groundwater	4	Groundwater and/or surface waters, and/or eco-system	4
Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Vapour phase and/or soil dust	2	Outdoor/indoor inhalation and/or ingestion	4	Construction workers and/or future site occupants	8
Ground gases	Gas phase migration	1	Outdoor/indoor inhalation and/or ingestion	4	Construction workers and/or future site occupants	4

- Pathway - Receptor Model

Source 2	Migration Pathway	L	Exposure Pathway	E	Receptor	R
Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Leaching of soluble fractions	1	Migration to groundwater/ River Inwell	4	Groundwater and/or surface waters, and/or eco-system	4
Heavy metals, chlorinated/organic solvents and/or PCBs and/or hydrocarbons	Vapour phase and/or soil dust	1	Indoor and outdoor inhalation and/or ingestion	3	Adjacent site users	3
Ground gases	Gas phase migration	1	Outdoor/indoor inhalation and/or ingestion	4	Construction workers and/or future site occupants	4

- Pathway - Receptor Model

Source 2	Migration Pathway	L	Exposure Pathway	E	Receptor	R
Heavy metals						

Likelihood (L)	Description	Probability	Effect (E)	Description	Increase in cost and time
5	Almost certain	>70%			
4	Probable	50-70%	4	Very high	>10%
3	Likely	30-50%	3	High	4-10%
2	Unlikely	10-30%	2	Low	1-4%
1	Negligible	<10%	1	Very low	<1%
Risk (R)	Risk Level	Action			
1-5	Trivial	None			
6-10	Significant	Undertake appropriate mitigation measures to reduce the risk level by appropriate on-site practice at little additional cost.			
10-20	Substantial	Designers should take such risks into account and avoid or reduce risk level to acceptable levels. Additional resources required.			

Client

Taylor Wimpey

Project

Preliminary Phase 2

Drawn

clarkebond

Engineering & Management Consultants

Bridgewater House, Bridgewater Street

9.0 CONCLUSIONS & RECOMMENDATIONS

Background

Clarke Bond has been commissioned by Dean Harrison of Taylor Wimpey Manchester Limited to undertake a Phase 2 Geoenvironmental Assessment of land situated 50m North of Pendle Drive, Whalley BB7 9JT. It is understood that this assessment is part of a pre-acquisition survey and the property is to be developed for residential purposes.

This report incorporated a previous assessments conducted upon the site by RSK Group PLC (Phase 1 and 2 Geoenvironmental Site Investigation Report at Calderstones Park (16372-R1 0) dated 4th of June 2010); Plot B1 Calderstones Hospital – Borehole Assessment by Strata Surveys Limited (ref NFJ/L13687 17072006.doc) dated 17th of July 2006; Site Check Data report on land at Calderstones Hospital by Landmark (ref SCPRO-23698251-1-1) dated 29th November 2007; and Plan Search report on land at Calderstones Hospital by Landmark (ref PSC-21960143-1-1) dated 26th June 2007 which should be read in conjunction with this study.

Preliminary Conceptual Model

The site is an agricultural field and woodland area until 1913 when brick works, with a private railway leading to it, is present along the northern and western borders of the site. In 1932 to 1970 an Isolation Unit of the Calderstone mental hospital is located on the site. By 2006 the site is in its present configuration. No structure is shown on the site, it is assumed to be derelict land with some scars relating to former access ways and Isolation Unit.

Guidance from the Environment Agency indicates that site is underlain by a minor-aquifer and the nearest surface water feature is a small balancing pond situated approximately 80m to the south of the site.

There are no entries relating to the site in the Contaminated Land Register under s78R(1) of the Environmental Protection Act Part 2a and currently have no intention to inspect the site due to its current commercial end use.

Coal workings and Brine Mining are unlikely to impact the site.

The preliminary conceptual model identified a low contamination potential associated with former end use and a low potential risk to identified receptors. Further site investigation works were recommended to establish risks associated with foundation design and to validate the contamination assessment.

Fieldworks & Ground Conditions

The intrusive investigation was carried by Geo Site Surveys (GSS) between 24th January 2011 and 25th of January 2011. A plan showing all the exploratory hole locations are presented as Figure 02 in Appendix A.

Ground conditions generally comprise a cover of clayey Made Ground and/or Topsoil overlying a layer of soft to firm to firm to stiff reworked clay possibly associated with site re-profiling with the former Brickworks. Made ground comprising Gravel of brick and concrete was also recorded within areas of former structures and/or access routes (2.50m bgl in TP07). Underlying the Made Ground/Reworked Clay generally soft to firm to firm to stiff Glacial Boulder Clay was encountered.

Groundwater was encountered during the excavation of TP07 at 2.30m bgl, BH 01 at 2.7m bgl in the Made Ground. It is assumed that the groundwater is perched on the underlying natural Glacial Boulder Clay and within granular inclusions within the Glacial Till deposits.

Contamination

The general risk of significant contamination being present within soil and groundwater beneath the site during the Phase 1 desk study was considered to be low to medium.

With regards to contaminant risks to end users, construction workers and maintenance staff, Made Ground soils (topsoil and Gravel) are deemed unsuitable for use without capping systems in gardens and landscaped areas. Further testing is required of this strata to delineate the extent of potential capping systems to remove preferential migration pathways. These materials are considered suitable for use beneath areas to be utilised for roads, car parks and hardstanding areas; which will restrict migration pathways for soil contamination to site occupiers.

To date, 2no ground gas monitoring visits (out of a proposed 4) have been conducted from within the installed wells. Results indicate that traffic light classification of GREEN and as such no special protection measures are required for the proposed building, in line with NHBC Guidance on Methane and Carbon Dioxide (Rev4 March 2007). Once the final 2no monitoring visits are conducted an addendum report will be provided to the client which should be submitted immediately to Lancaster Council Director of Planning for comment.

We are of the opinion that based on the findings of the site investigation the site presents a medium risk to end users and maintenance workers from historical industrial activity and a low risk to Controlled Waters post construction.

Although we cannot anticipate the actions of the regulatory authorities, we consider that the risks posed to identified receptors other than those mentioned above are sufficiently low to not warrant extensive remedial activities of the site in its current configuration.

Geotechnical Issues

A foundation risk assessment, options appraisal and costs exercise should be conducted, considering the following options:

- Conventional trench fill and strip foundations (suspended slab)
- Piled Foundations where trench fill risks extending below 3.0mbgl to conform to current NHBC 'Chapter 4.2 - building near trees' guidelines

Should piled foundations be considered; a specialist piling contractor will need to be approached for advice on their own specialist propriety systems. Vibration, noise and groundwater ingress being a very important consideration.

It is considered likely that the excavations will not remain fully dry but should be able to be controlled by a screened sump pump techniques and no specialist dewatering techniques (such as well point systems) are envisaged. Localised seepages are likely to be encountered during period of heavy rainfall and within granular inclusions.

Pavement design should utilise a CBR value of 1%. Temporary works access routes and hardstanding should be provided with a competent mat of hardcore and good run off drainage maintained.

In order to prevent excessive costs and to reduce the environmental impact of the development it is recommended that removal of wastes from the site, including waste soils, is kept to a minimum.

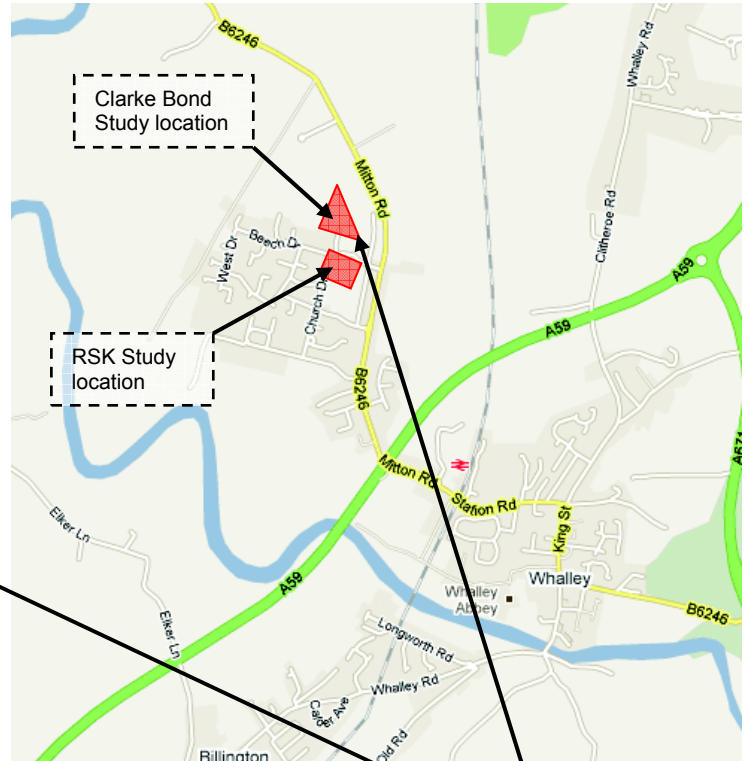
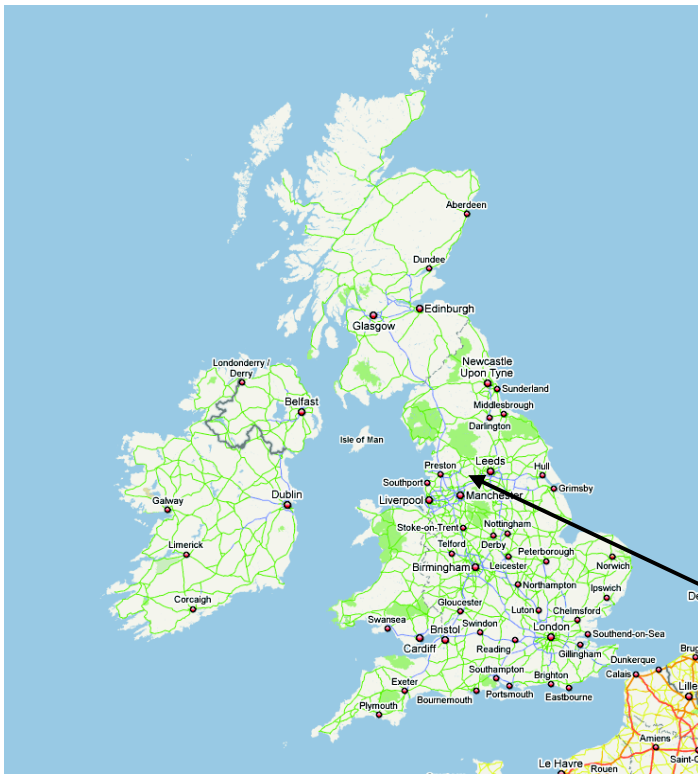
The results from the chemical laboratory sulphate and pH analyses for the site indicate that a worst case Design Sulphate Class of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) class of AC-1.

This report should be provided to Lancaster Council Director of Planning and the Environment Agency as part of any future planning applications to prevent delays in the proposed development.

APPENDICES

- Appendix A - Site Location Plan, Exploratory Hole Location Plan, Proposed Development & Foundation Plan & Site Photographs**
- Appendix B - Exploratory Hole Record Sheets & Exploratory Hole Photographs**
- Appendix C - Geotechnical Test Results**
- Appendix D - Chemical Test Results**
- Appendix E - Ground Gas Monitoring**
- Appendix F - Former Site Assessment Reports**

Appendix A - Site Location Plan, Exploratory Hole Location Plan, Proposed Development & Foundation Plan & Site Photographs



SITE

Site Centre:
OS X (Eastings) 372540
OS Y (Northings) 437521

clarkebond

Clarke Bond (Southwest & Wales) Ltd.
Engineering and Management Consultants

129 Cumberland Road
Bristol BS1 6UY
Tel: +44 (0) 117 929 2244
Fax: +44 (0) 117 929 3095
E-mail: bristol@clarkebond.co.uk
Web: www.clarkebond.co.uk

Birmingham Bristol Cardiff Exeter Harrogate London
Manchester Swansea Abu Dhabi

Project:

**PHASE 1 GEOENVIRONMENTAL ASSESSMENT
Calderstone Hospital Development**

Title:

SITE LOCATION MAP

Drawn:

BC

Scale:

NTS

Checked:

BC

Date:

**February
2011**

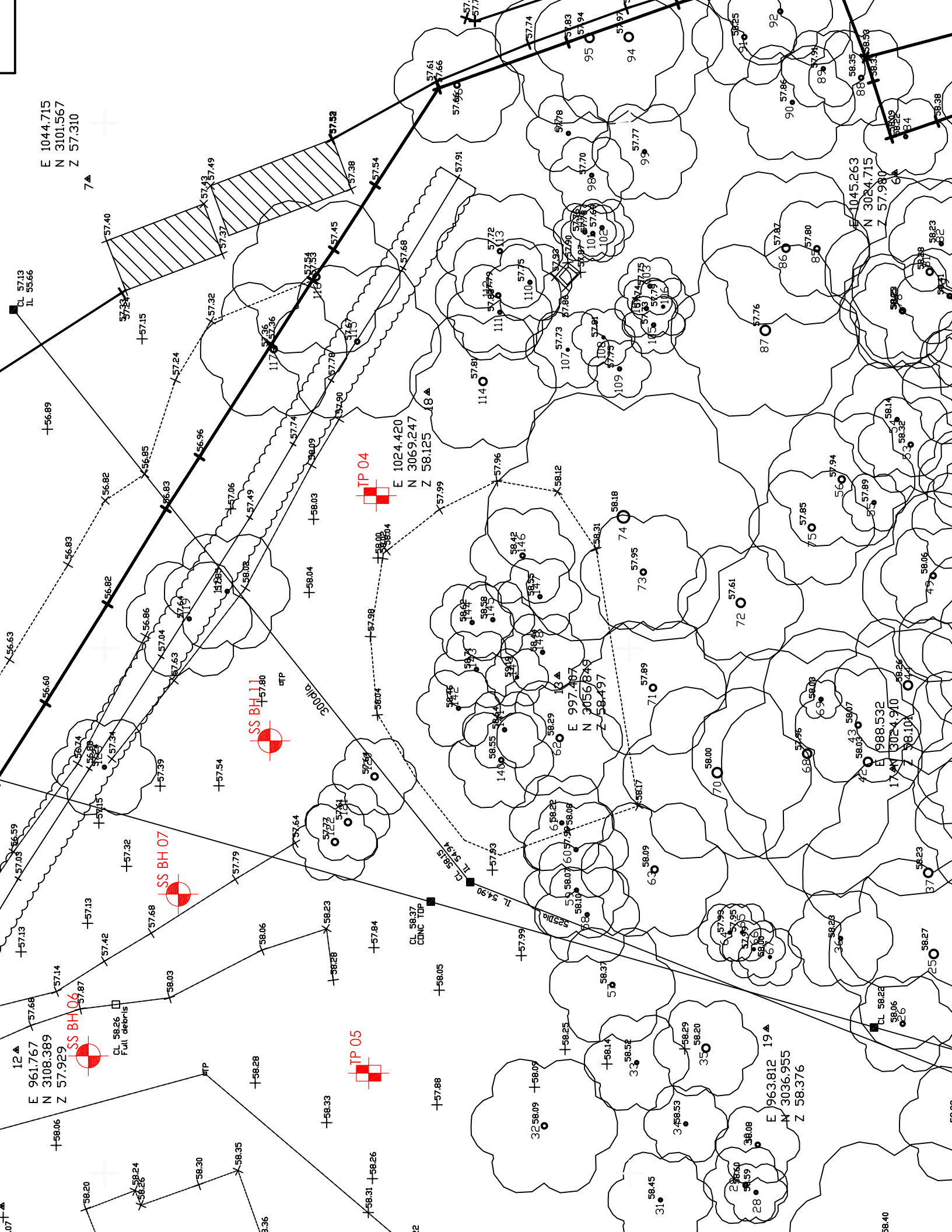
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Drawing No:

25608E Figure 1

Rev:

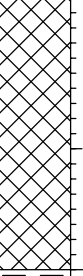
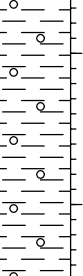
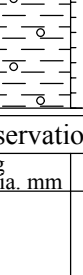




Appendix B - Exploratory Hole Record Sheets & Exploratory Hole Photographs

PERCUSSIVE BOREHOLE LOG

Project Phase 3 Calderstones Park, Whalley				PERCUSSIVE BOREHOLE No BH01	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 2	

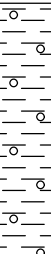
SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.50	D					(1.80)	MADE GROUND: Black brown slightly clayey sandy angular to subrounded fine to coarse gravel of brick, concrete, sandstone and mudstone with frequent cobbles and boulders of brick and concrete.		
1.20	D	N8				1.80			
2.00	D	N1.5				(1.80)	REWORKED CLAY: Soft to firm grey brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
3.00	D	N3				3.60			
4.00	D	N4				(5.00)	Soft to firm grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
5.00	D	N4.5							
6.50	D	N6							

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											No visual or olfactory evidence of contamination. Obstruction at 10.3m.
All dimensions in metres Scale 1:50			Client Taylor Wimpey - Manchester			Method/ Plant Used Dando 2000			Logged By BC		

Log 108A CBGE PERCUSSIVE BOREHOLE LOG L:\SALE PROJECTS\25680E CALDERSTONES HOSPITAL PHASE 3, WHALLEY, CLITHEROE\PRODUCTION\DATA - GEO ENV\CB DATA\GINT\25680E.GPJ CLARKE BOND.GDT 16/02/2011 11:52:57

PERCUSSIVE BOREHOLE LOG

Project Phase 3 Calderstones Park, Whalley				PERCUSSIVE BOREHOLE No BH01	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 2 of 2	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
8.00	D	N7.5				8.60	Soft to firm grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone(continued)		
9.50	D	N9				(1.70) 10.30	Firm to stiff grey slight sandy slightly gravelly CLAY with occasional mudstone and sandstone cobbles. Gravel is angular to subrounded of mudstone and sandstone.		
							End of hole at 10.3m.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
						14	15	1h			No visual or olfactory evidence of contamination. Obstruction at 10.3m.
All dimensions in metres Scale 1:50			Client Taylor Wimpey - Manchester			Method/ Plant Used Dando 2000			Logged By BC		

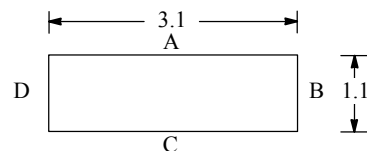
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TRIAL PIT LOG

Project Phase 3 Calderstones Park, Whalley				TRIAL PIT No TP01	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.10	D	0ppm				0.20	MADE GROUND TOP SOIL: Grass onto black brown organic slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse of brick, concrete, sandstone, tarmac, limestone and mudstone.		
0.40	D	0ppm				(0.60)	MADE GROUND: Black slightly clayey sandy angular to subrounded fine to coarse gravel of brick, concrete, tarmac, sandstone and mudstone with frequent cobbles of brick and concrete.		
1.00	SV	49				(0.70)	REWORKED CLAY: Soft to firm grey brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
1.50	D	0ppm				1.50	End of hole at 1.5m.		

Shoring/Support: None
Stability: Good



GENERAL REMARKS

No visual or olfactory evidence of contamination

All dimensions in metres
Scale 1:50

Client Taylor Wimpey - Manchester

Method/
Plant Used JCB 3CX

Logged By BC

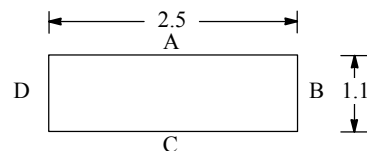
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TRIAL PIT LOG

Project Phase 3 Calderstones Park, Whalley				TRIAL PIT No TP02
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()	
Contractor GSS				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.10	D	0ppm				0.20	MADE GROUND (TOP SOIL): Black brown organic slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse of brick, concrete, sandstone, tarmac, limestone and mudstone.		
0.30	D	0ppm				(0.38) 0.58			
							MADE GROUND (TARMAC): Black sandy angular to subrounded fine to coarse gravel of tarmac.		
1.00	SV	46				(0.82)	REWORKED CLAY: Firm to stiff grey brown slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
1.00	D	0ppm				1.40			
1.50	D	0ppm				(0.50)	REWORKED CLAY: Soft to firm grey brown slightly sandy gravelly clay. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
1.80	SV	35				1.90			
							End of hole at 1.9m.		

Shoring/Support: None
Stability: Good



GENERAL REMARKS

No visual or olfactory evidence of contamination. Intact basement wall on south face of pit.

All dimensions in metres
Scale 1:50

Client Taylor Wimpey - Manchester

Method/
Plant Used JCB 3CX

Logged By BC

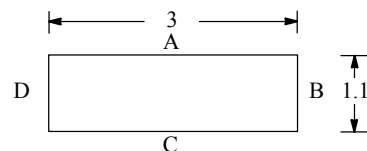
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TRIAL PIT LOG

Project Phase 3 Calderstones Park, Whalley				TRIAL PIT No TP03	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.20	CBR	1.3				0.20	MADE GROUND (TOP SOIL): Grass onto black brown organic slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse of brick, concrete, sandstone and mudstone.		
0.30	D	0ppm				0.50			
0.50	CBR	1.6					MADE GROUND: Black brown red slightly clayey sandy angular to subrounded fine to coarse gravel of brick, concrete, sandstone and mudstone with frequent cobbles of brick and concrete		
0.70	CBR	1.6							
1.00	SV	42.3					Firm to stiff grey slight sandy slightly gravelly clay. Gravel is angular to subrounded of mudstone and rare sandstone.		
1.50	D	0ppm							
2.00	SV	63.3				(2.80)			
3.00	SV	107.3				3.30			
							End of hole at 3.3m.		

Shoring/Support: None
Stability: Good



GENERAL REMARKS

No visual or olfactory evidence of contamination

All dimensions in metres
Scale 1:50

Client Taylor Wimpey - Manchester

Method/
Plant Used JCB 3CX

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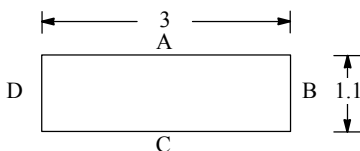
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TRIAL PIT LOG

Project Phase 3 Calderstones Park, Whalley				TRIAL PIT No TP04
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()	
Contractor GSS				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.10	D	0ppm			XXXX	0.20	MADE GROUND (TOP SOIL): Grass onto black brown organic slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse of brick, concrete, sandstone and mudstone.		
0.20	CBR	1							
0.50	CBR	1.25				(0.80)	REWORKED CLAY: Firm to stiff grey brown slightly sandy slightly gravelly clay with occasional rootlets. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
0.50	SV	36							
0.50	D	0ppm				1.00			
0.70	CBR	1.38							
1.50	SV	48.3					Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
2.00	D	0ppm				(2.00)			
3.00	SV	119.3				3.00	End of hole at 3.0m.		

Shoring/Support: None
Stability: Good



GENERAL REMARKS

No visual or olfactory evidence of contamination

All dimensions in metres
Scale 1:50

Client Taylor Wimpey - Manchester

Method/
Plant Used JCB 3CX

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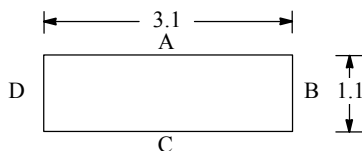
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TRIAL PIT LOG

Project Phase 3 Calderstones Park, Whalley				TRIAL PIT No TP05	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.20	CBR	Refusal				0.20	MADE GROUND (TOP SOIL): Grass onto black brown organic slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse of brick, concrete, sandstone and mudstone.		
0.40	D	0ppm				0.50			
0.50	CBR	1.13					MADE GROUND: Black slightly clayey sandy angular to subrounded fine to coarse gravel of brick, concrete, sandstone and mudstone with frequent cobbles of brick and concrete.		
0.70	CBR	1.13							
1.00	D	0ppm				(1.40)	REWORKED CLAY: Firm to stiff grey brown slightly sandy slightly gravelly clay with occasional rootlets. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
1.50	SV	49.3				1.90			
2.00	D	0ppm				(1.00)	Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
2.50	SV	101				2.90			
							End of hole at 2.9m.		

Shoring/Support: None
Stability: Good



GENERAL REMARKS

No visual or olfactory evidence of contamination. Brick infill wall on north face of pit.

All dimensions in metres
Scale 1:50

Client Taylor Wimpey - Manchester

Method/
Plant Used JCB 3CX

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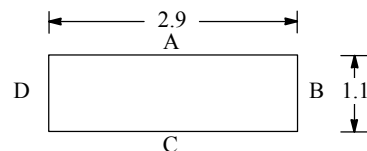
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TRIAL PIT LOG

Project Phase 3 Calderstones Park, Whalley				TRIAL PIT No TP06	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.20	CBR	Refusal				0.20	MADE GROUND (TOP SOIL): Black brown organic slightly sandy gravely clay. Gravel is angular to subrounded fine to coarse of brick, concrete, sandstone and mudstone.		
0.50	CBR	Refusal				(0.80)	MADE GROUND: Black slightly clayey sandy angular to subrounded fine to coarse GRAVEL of brick, concrete, sandstone and mudstone with frequent cobbles of brick and concrete.		
0.50	B	0ppm				1.00			
1.00	SV	38.7					Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
1.50	B	0ppm							
2.00	SV	45.3				(2.20)			
3.00	SV	68.7				3.20			
							End of hole at 3.2m.		

Shoring/Support: None
Stability: Poor



GENERAL REMARKS

No visual or olfactory evidence of contamination

All dimensions in metres
Scale 1:50

Client Taylor Wimpey - Manchester

Method/
Plant Used JCB 3CX

Logged By BC

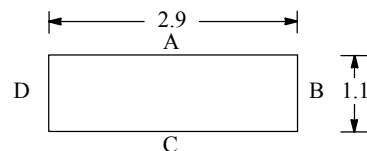
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TRIAL PIT LOG

Project Phase 3 Calderstones Park, Whalley				TRIAL PIT No TP07	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.30	D	0ppm				(0.50) 0.50	MADE GROUND (TARMAC): Black sandy angular to subrounded fine to coarse gravel of tarmac underlain by angular to subrounded fine to coarse gravel of limestone.		
1.50	D	0ppm				(2.00) 2.50	MADE GROUND: Black brown slightly clayey sandy angular to subrounded fine to coarse gravel of brick, concrete, sandstone and mudstone with frequent cobbles and boulders of brick and concrete.		
3.00 3.00	SV D	112 0ppm				(0.60) 3.10	Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
							End of hole at 3.1m.		

Shoring/Support: None
Stability: Good



GENERAL REMARKS

No visual or olfactory evidence of contamination

All dimensions in metres
Scale 1:50

Client Taylor Wimpey - Manchester

Method/
Plant Used JCB 3CX

Logged By BC

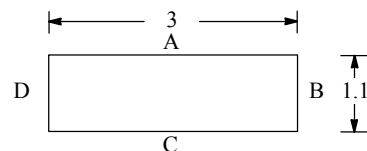
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TRIAL PIT LOG

Project Phase 3 Calderstones Park, Whalley				TRIAL PIT No TP09	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.20	CBR	1				0.20	MADE GROUND (TOP SOIL): Grass onto black brown organic slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse of brick, concrete, sandstone and mudstone.		
0.50	CBR	1.13					REWORKED CLAY: Firm to stiff grey brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
0.70	CBR	1.25				(1.30)			
1.00	SV	33.3				1.50			
1.00	D	0ppm							
2.00	SV	57.67				(1.50)	Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
2.00	D	0ppm				3.00			
							End of hole at 3.0m.		

Shoring/Support: None
Stability: Good



GENERAL REMARKS

No visual or olfactory evidence of contamination

All dimensions in metres
Scale 1:50

Client Taylor Wimpey - Manchester

Method/
Plant Used JCB 3CX

Logged By BC

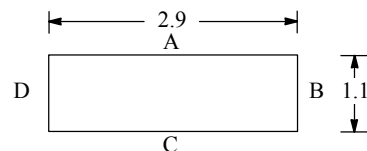
Log 108C CBGE TRIAL PIT LOG L:\SALE PROJECTS\25680E CALDERSTONES HOSPITAL PHASE 3, WHALLEY, CLUTHEROE\PRODUCTION\DATA - GEO ENVO\CB DATA\GINT\25680E GPJ CLARKE BOND.GDT 16/02/2011 12:00:42

TRIAL PIT LOG

Project Phase 3 Calderstones Park, Whalley				TRIAL PIT No TP10	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.20	CBR	1.25				(0.50)	MADE GROUND (TOP SOIL): Black brown organic slightly sandy gravelly clay. Gravel is angular to subrounded fine to medium of brick, concrete, ash, clinker, sandstone and mudstone.		
0.20	D	0ppm				0.50			
0.50	CBR	1.5				(0.70)	REWORKED CLAY: Firm to stiff grey brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
0.70	CBR	1.5							
1.00	SV	32.67				1.20	Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
1.00	D	0ppm							
2.00	SV	45.3				(1.70)			
2.00	D	0ppm							
3.00	SV	69.3				2.90			
							End of hole at 2.9m.		

Shoring/Support: None
Stability: Good



GENERAL REMARKS

No visual or olfactory evidence of contamination

All dimensions in metres
Scale 1:50

Client Taylor Wimpey - Manchester

Method/
Plant Used JCB 3CX

Logged By BC

Log 108C CBGE TRIAL PIT LOG L:\SALE PROJECTS\25680E CALDERSTONES HOSPITAL PHASE 3, WHALLEY, CLUTHEROE\PRODUCTION\DATA - GEO EN\CB DATA\GINT\25680E GPJ CLARKE BOND.GDT 21/02/2011 16:27:47

WINDOW SAMPLE LOG

Project Phase 3 Calderstones Park, Whalley				WINDOW SAMPLE No WS01	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						0.10	MADE GROUND (TOP SOIL): Black brown organic slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to medium of brick, concrete, sandstone and mudstone. REWORKED CLAY: Firm to stiff grey brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick. Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
						0.30			
						(2.70)			
2.00	SPT D	N13 0ppm							
2.00									
3.00	SPT D	N10 0ppm				3.00			
3.00							End of hole at 3.0m.		

Boring Progress and Water Observations						GENERAL REMARKS
Date	Time	Depth	Tube Depth	Tube Dia. mm	Water Dpt	
						No visual or olfactory evidence of contamination

All dimensions in metres Scale 1:50	Client Taylor Wimpey - Manchester	Method/ Plant Used	Competitor	Logged By BC
--	--------------------------------------	-----------------------	------------	-----------------

Log 108F CBGE WINDOW SAMPLE LOG L:\SALE PROJECTS\25680E CALDERSTONES HOSPITAL PHASE 3, WHALLEY, CLITHEROE\PRODUCTION\DATA - GEO EN\VCB DATA\GINT\25680E.GPJ CLARKE BOND.GDT 16/02/2011 12:02:00

WINDOW SAMPLE LOG

Project Phase 3 Calderstones Park, Whalley				WINDOW SAMPLE No WS02	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
1.00	D SPT	0ppm N10				0.20	MADE GROUND (TOP SOIL): Black brown organic slightly sandy gravelly clay. Gravel is angular to subrounded fine to medium of brick, concrete, sandstone and mudstone.		
1.00						(1.10)	REWORKED CLAY: Firm to stiff grey brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
1.00						1.30			
2.00	D	0ppm				(0.70)	Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
2.00						2.00			
3.00	SPT	N5				(1.00)	NO RECOVERY		
3.00						3.00			
4.00	D SPT	0ppm N10				(1.00)	Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
4.00						4.00			
							End of hole at 4.0m.		

Boring Progress and Water Observations						GENERAL REMARKS
Date	Time	Depth	Tube Depth	Tube Dia. mm	Water Dpt	
						No visual or olfactory evidence of contamination
All dimensions in metres Scale 1:50		Client Taylor Wimpey - Manchester		Method/ Plant Used Competitor		Logged By BC

Log 108F CBGE WINDOW SAMPLE LOG L:SALE PROJECTS\25680E CALDERSTONES HOSPITAL PHASE 3, WHALLEY, CLITHEROE\PRODUCTION\DATA - GEO ENV\CB DATA\INT\25680E.GPJ CLARKE BOND.GDT 16/02/2011 12:02:00

WINDOW SAMPLE LOG

Project Phase 3 Calderstones Park, Whalley				WINDOW SAMPLE No WS03	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

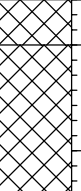
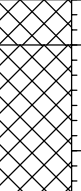
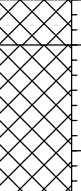
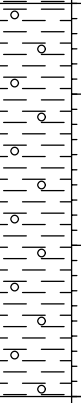
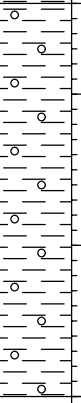
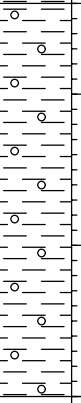
SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
						0.20	MADE GROUND (TOP SOIL): Black brown organic slightly sandy gravely clay. Gravel is angular to subrounded fine to medium of brick, concrete, sandstone and mudstone.	
						(0.80)	MADE GROUND (SUBBASE): Grey slightly clayey sandy angular to subangular fine to medium gravel of limestone.	
						1.00		
							Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.	
							... Soft to firm band at location of water strike at 4.0m.	
2.00	SPT	N13						
2.00	D	0ppm						
3.00	SPT	N9				(4.00)		
4.00	SPT	N8						
5.00	SPT	N12				5.00		
5.00	D	0ppm					End of hole at 5.0m.	

Boring Progress and Water Observations						GENERAL REMARKS
Date	Time	Depth	Tube Depth	Tube Dia. mm	Water Dpt	
						No visual or olfactory evidence of contamination
All dimensions in metres Scale 1:50		Client	Taylor Wimpey - Manchester		Method/ Plant Used	Competitor
				Logged By		BC

Log 108f CBGE WINDOW SAMPLE LOG L:SALE PROJECTS\25680E CALDERSTONES HOSPITAL PHASE 3, WHALLEY, CLITHEROE\PRODUCTION\DATA - GEO ENV\CB DATA\GINT\25680E.GPJ CLARKE BOND.GDT 16/02/2011 12:02:00

WINDOW SAMPLE LOG

Project Phase 3 Calderstones Park, Whalley				WINDOW SAMPLE No WS04	
Job No 25680E	Date 24-01-11	Ground Level (m)	Co-Ordinates ()		
Contractor GSS				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill	
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)			DESCRIPTION
1.00	D/J					0.30	MADE GROUND (TARMAC): Black sandy angular to subrounded fine to coarse gravel of tarmac.		
						(1.00)	MADE GROUND: Black brown slightly clayey sandy angular to subrounded fine to coarse gavel of brick, concrete, sandstone and mudstone with frequent cobbles of brick and concrete.		
						1.30			
2.00	D/J					(1.10)	REWORKED CLAY: Firm to stiff grey brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and occasional brick.		
						2.40			
3.00	SPT	N13				(2.60)	Firm to stiff grey slight sandy slightly gravelly CLAY. Gravel is angular to subrounded of mudstone and rare sandstone.		
4.00	SPT	N12							
5.00	SPT	N10				5.00	End of hole at 5.0m.		

Boring Progress and Water Observations						GENERAL REMARKS
Date	Time	Depth	Tube Depth	Tube Dia. mm	Water Dpt	
						No visual or olfactory evidence of contamination
All dimensions in metres Scale 1:50		Client Taylor Wimpey - Manchester		Method/ Plant Used Competitor		Logged By BC

Log 108F CBGE WINDOW SAMPLE LOG L:SALE PROJECTS\25680E CALDERSTONES HOSPITAL PHASE 3, WHALLEY, CLITHEROE\PRODUCTION\DATA - GEO ENV\CB DATA\GINT\25680E.GPJ CLARKE BOND.GDT 16/02/2011 12:02:01



Figure 1 – TP1/SW1



Figure 2 – TP1/SW1 Arisings



Figure 3 – TP2/SW2



Figure 4 – TP2/SW2 Arisings



Figure 5 – TP3



Figure 6 – TP3 Arisings



Figure 7 – TP4



Figure 8 – TP4 Arisings



Figure 9 – TP5



Figure 10 – TP5 Arisings



Figure 11 – TP6



Figure 12 – TP6 Arisings



Figure 13 – TP7



Figure 14 – TP7 Arisings



Figure 15 – TP9



Figure 16 – TP9 Arisings



Figure 17 – TP10



Figure 18 – TP10 Arisings



Figure 19 – WS1

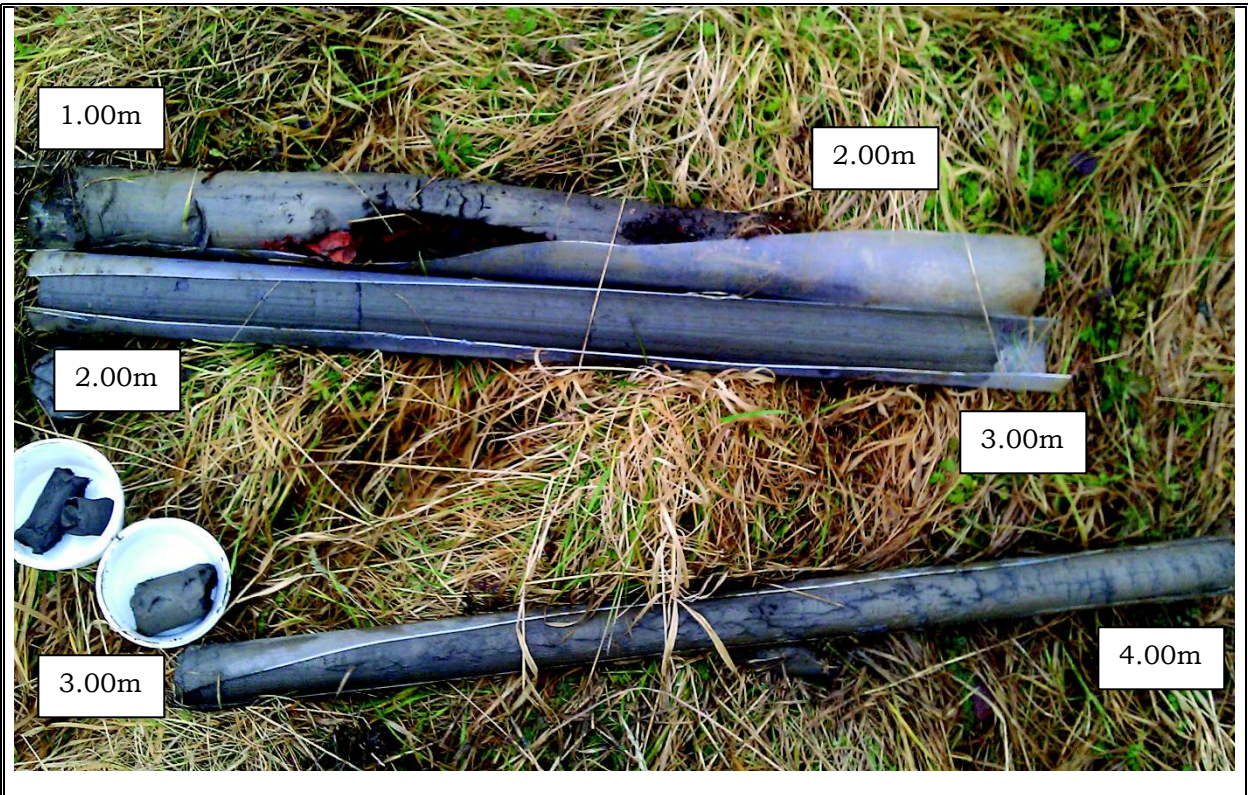


Figure 20 – WS2



Figure 21 – WS3



Figure 22 – WS4



Figure 23 – WS4

Appendix C - Geotechnical Test Results

Contract Number: PSL11/0215

Client's Reference:

Report Date: 03 February 2011

Client Name: Clarke Bond
Bridgewater Street
Sale
Cheshire

M33 7EQ

For the attention of: Ben Calpin

Contract Title: Calderstones Hospital

Date Received: 31-January-11

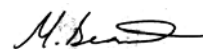
Date Commenced: 31-January-11

Date Completed: 03-February-11

Notes: Observations 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 in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:



R Gunson
(Director)

A Watkins
(Director)

M Beastall
(Laboratory Manager)

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

PST
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date				
	02/02/11		03/02/11		03/02/11				
CALDERSTONES HOSPITAL									
						Contract No:		PSL11/0215	
						Client Ref:		25608E	

(B.S. 1377 : PART 2 : 1990)

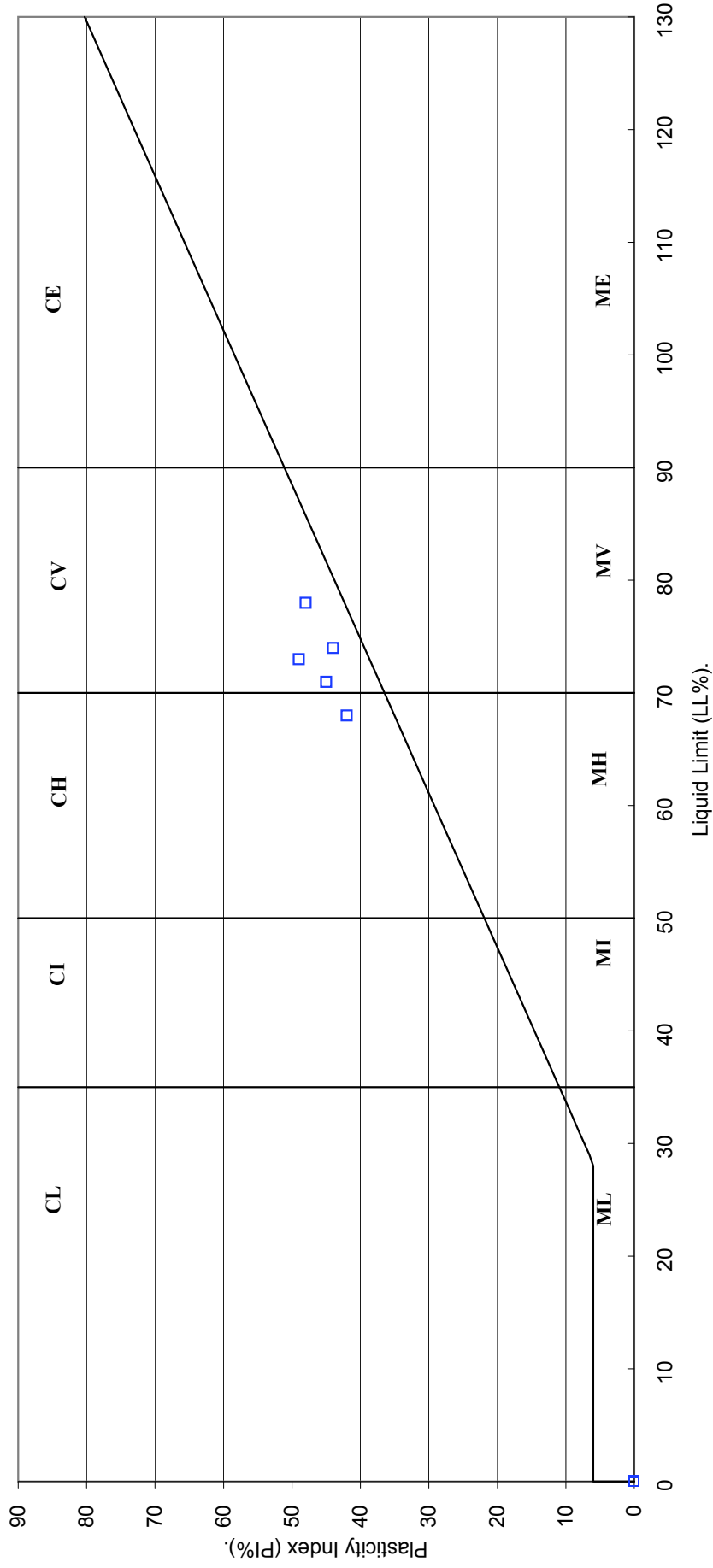
SYMBOLS: NP : Non Plastic

*: Liquid Limit and Plastic Limit Wet Sieved.

PSLR002 Issue 1

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
<i>[Signature]</i>	02/02/11	<i>[Signature]</i>	03/02/11	<i>[Signature]</i>	03/02/11
CALDERSTONES HOSPITAL				Contract No:	PSL11/0215
				Client Ref:	(25608E)

Appendix D - Chemical Test Results



Scientific Analysis Laboratories is a
limited company registered in England and
Wales (No 2514788) whose address is at
Hadfield House, Hadfield Street, Manchester M16 9FE

Scientific Analysis Laboratories

Certificate of Analysis

Hadfield House
Hadfield Street
Cornbrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2468

Report Number: 226022-1

Date of Report: 04-Feb-2011

Customer: Clarke Bond Group Ltd.
Bridgewater House
Bridgewater Street
Sale
Cheshire
M33 7EQ

Customer Contact: Mr Ben Calpin

Customer Job Reference: 25608E

Date Job Received at SAL: 27-Jan-2011

Date Analysis Started: 28-Jan-2011

Date Analysis Completed: 04-Feb-2011

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs



1549

Report checked
and authorised by :
Mr Ross Walker
Customer Services Manager

Issued by :
Mr Ross Walker
Customer Services Manager

SAL Reference: 226022 Customer Reference: 25608E															
Soil TOC		Analysed as Soil													
SAL Reference					226022 001	226022 002	226022 003	226022 004	226022 005	226022 006	226022 007	226022 008	226022 009	226022 010	
Customer Sample Reference					TP4 0.1	TP51.0	TP9 1.0	TP1 0.4	TP10 0.1	TP2 0.1	TP10 2.0	TP3 0.3	TP1 1.5	TP1 0.1	
Date Sampled					24-JAN- 2011	24-JAN- 2011	24-JAN- 2011	24-JAN- 2011	24-JAN- 2011	24-JAN- 2011	24-JAN- 2011	24-JAN- 2011	24-JAN- 2011	24-JAN- 2011	
Determinand		Method	Test Sample	LOD	Units										
Total Organic Carbon		T21	AR	0.1	□	7.7	2.8	1.7	4.2	8.5	5.5	1.5	9.4	1.6	2.6

Index to symbols used in 226022-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Method Index

Value	Description
T4	Colorimetry
T7	Probe
T2	Grav
T21	O□IR
T149	GC:MS (SIR)
T6	ICP:OES

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Total Organic Carbon	T21	AR	0.1	□	N	001-010
SO4(2:1)	T6	AR	0.1	g/l	N	003-004,007
pH	T7	AR			U	001-010
Arsenic	T6	AR	1	mg/kg	U	001-010
Boron (water-soluble)	T6	AR	1	mg/kg	N	001-010
Cadmium	T6	AR	1	mg/kg	U	001-010
Chromium	T6	AR	1	mg/kg	U	001-010
Chromium □l	T6	AR	1	mg/kg	N	001-010
Copper	T6	AR	1	mg/kg	U	001-010
Lead	T6	AR	1	mg/kg	U	001-010
Mercury	T6	AR	1	mg/kg	U	001-010
Nickel	T6	AR	1	mg/kg	U	001-010
Selenium	T6	AR	3	mg/kg	U	001-010
□inc	T6	AR	1	mg/kg	U	001-010
Cyanide(Total)	T4	AR	1	mg/kg	U	001-010
Cyanide(free)	T4	AR	1	mg/kg	U	001-010
Phenols(Mono)	T4	AR	1	mg/kg	U	001-010
SO4(Total)	T6	AR	0.01	□	N	001-010
Sulphide	T4	AR	10	mg/kg	N	001-010
Sulphur(Free)	T2	AR	500	mg/kg	N	001-010
Thiocyanate	T4	AR	10	mg/kg	N	001-010
Naphthalene	T149	AR	0.01	mg/kg	U	001-010
Acenaphthylene	T149	AR	0.01	mg/kg	U	001-010
Acenaphthene	T149	AR	0.01	mg/kg	U	001-010
Fluorene	T149	AR	0.01	mg/kg	U	001-010
Phenanthrene	T149	AR	0.01	mg/kg	U	001-010
Anthracene	T149	AR	0.01	mg/kg	U	001-010
Fluoranthene	T149	AR	0.01	mg/kg	U	001-010
Pyrene	T149	AR	0.01	mg/kg	U	001-010
Ben□o(a)Anthracene	T149	AR	0.01	mg/kg	U	001-010
Chrysene	T149	AR	0.01	mg/kg	U	001-010
Ben□o(b,k)Fluoranthene	T149	AR	0.01	mg/kg	U	001-010
Ben□o(a)Pyrene	T149	AR	0.01	mg/kg	U	001-010
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	U	001-010

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	U	001-010
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	U	001-010
PAH(total)	T149	AR	0.01	mg/kg	U	001-010



Appendix E - Ground Gas Monitoring

clarkebond

Job No:	25608E
Date:	04.02.11
Engineer:	CT

Site:	Calderstone Hospital
Client:	Taylor Wimpey
Equipment:	GA2000 Gas Analyser

BH01	Flow Rate (l/h)	Pressure Differential	Gas Concentration										Water		Start		Finish	
			Peak					Steady										
Date			CH ₄ %	CO ₂ %	O ₂ %	LEL %	H2S/ CO (ppm)	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H2S/ CO (ppm)	Depth to Water	Depth to Base	Time	Barometric Pressure	Time	Barometric Pressure
04.02.11	0	-0.18	0	0.1	20.2	79.7	210	0	0.1	20.2	79.7	210	1.34	2.1	2.30pm	997		
15.02.11	0	0.12	0.1	0.1	21	78.8	290	0.1	0.1	21	78.8	274	1.68	2.3	3.00pm	977		

WS01	Flow Rate (l/h)	Pressure Differential	Gas Concentration										Water		Start		Finish	
			Peak					Steady										
Date			CH ₄ %	CO ₂ %	O ₂ %	LEL %	H2S/ CO (ppm)	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H2S/ CO (ppm)	Depth to Water	Depth to Base	Time	Barometric Pressure	Time	Barometric Pressure
04.02.11	0	-0.12	0	0.2	20.3	79.5	137	0	0	20.5	79.5	137	0.57	2.1	2.45pm	997		
15.02.11	-4.9	0	0.1	0.5	20.8	78.6	233	0.1	0.5	20.8	78.6	233	0.4	2.1	3.15pm	977		

WS02	Flow Rate (l/h)	Pressure Differential	Gas Concentration										Water		Start		Finish	
			Peak					Steady										
Date			CH ₄ %	CO ₂ %	O ₂ %	LEL %	H2S/ CO (ppm)	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H2S/ CO (ppm)	Depth to Water	Depth to Base	Time	Barometric Pressure	Time	Barometric Pressure
04.02.11			Handalised: cannot locate															

WS03	Flow Rate (l/h)	Pressure Differential	Gas Concentration										Water		Start		Finish			
			Peak					Steady												
Date			CH ₄ %	CO ₂ %	O ₂ %	LEL %	H2S/ CO (ppm)	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H2S/ CO (ppm)	Depth to Water	Depth to Base	Time	Barometric Pressure	Time	Barometric Pressure		
04/02/11			Handalised: gas readings as atmosphere										0.79		4.10pm	997				
15/02/11	0	-0.08	0.1	0.2	20.2	79.5	181	0.1	0.2	20.2	79.5	181	0.7	236	3.40pm	977				
			Note: Borehole again tampered with. Difficult to locate.																	

CH₄ Above the **1.0%** v/v guideline value in Waste Management Paper no 27 (WMP27). **CO₂** Above the **1.5%** v/v guideline value given in WMP27.

Date	Weather	Pressure Trend	Ground Conditions
04.02.11	Cloudy, mild, poor light	997	amp
15.02.11	Light rain, 4 degrees	977	Wet

Appendix F - Former Site Assessment Reports



RSK

 **GROUP PLC**

**GEOENVIRONMENTAL SITE
INVESTIGATION REPORT**

CALDERSTONES PARK, WHALLEY

REFERENCE: 16372-R1 (01)

TAYLOR WIMPEY MANCHESTER

4 JUNE 2010



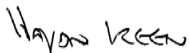
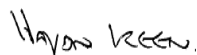
RSK STATS Geoconsult Ltd
 Spring Lodge
 172 Chester Road
 Helsby
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 Telephone: +44 (0) 1928 726006
 Fax: +44 (0) 1928 727524
www.rsk.co.uk

GEOENVIRONMENTAL SITE INVESTIGATION REPORT CALDERSTONES PARK, WHALLEY

REPORT NO : 16372-R1 (01)

**Client : Taylor Wimpey Manchester
 George Wimpey House
 1 Lumsdale Road
 Stretford
 Manchester
 M32 0UT**

DOCUMENT issue status

Report Issue	FINAL		
Reference Number	16372-R1 (01)		
Title	Name	Signature	Date
Author	Gwen Harrison		4 June 2010
Project Manager	Haydn Keen		4 June 2010
Technical Reviewer	Haydn Keen		4 June 2010

This report is not to be used for contractual or engineering purposes unless the above is signed where indicated by the author, the project manager and the technical reviewer of the report, and the report is designated "FINAL".



INVESTORS
IN PEOPLE

RSK STATS Geoconsult Ltd

Registered office

Spring Lodge • 172 Chester Road • Helsby • Cheshire • WA6 0AR • UK

Registered in England No. 2611785

www.rsk.co.uk

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EXECUTIVE SUMMARY

It is proposed to redevelop a parcel of land within Calderstones Park, Whalley, near Clitheroe with low-rise residential properties.

A Preliminary Risk Assessment (PRA) in relation to potentially contaminated land has been carried out based on a site walkover and review of published data, including historical maps and an environmental database.

The site is indicated to be underlain directly by Boulder Clay, which is in turn underlain by solid geology consisting of the Clitheroe Limestone Formation and Hodder Mudstone Formation (undifferentiated). The geology is classed as a minor aquifer by the Environment Agency and the superficial deposits are indicated to have low leaching potential.

The site has been occupied by agricultural land with a small pond to the west and, more recently, a playing field. The area surrounding the site was largely occupied by agricultural land until the 1930s, when the Calderstones Hospital was constructed adjacent to the site. Some residential development took place to the south east of the site in the 1970s.

The PRA undertaken by RSK has identified a number of potential pollutant linkages associated with the site. These include ground gas migration (in particular from the backfilled pond) into excavations or buildings, and ingestion, inhalation or dermal contact with potentially contaminated soils / leachate from on- and off-site sources. It was therefore deemed necessary to carry out an intrusive investigation to confirm ground conditions prior to redevelopment.

The site investigation comprised the drilling of nine probeholes one borehole and ten shallow hand-dug pits across the site. During the investigation, soil samples were recovered and submitted to the laboratory for a range of testing. In situ geotechnical testing was also undertaken while drilling the probeholes and boreholes. A monitoring well was installed in two of the probeholes and the borehole to enable future monitoring of ground gas and groundwater.

Made ground was encountered to depths of less than 1.00m. Ashy made ground was encountered in the vicinity of WS2. It appears, from the hand-dug pits around WS2, that the ashy made ground represents a drainage layer placed across the playing field. The made ground was generally underlain by soft to firm sandy clay to depths of up to 2.10m, underlain in turn by firm/firm to stiff sandy clay to the full depth of drilling. In borehole BH1, however, the clay was soft/soft to firm to a depth of approximately 9.00m, and firm to stiff beneath this. A layer of peat was encountered in WS7 in the vicinity of the former pond.

The investigation has indicated the presence of elevated concentrations of a polyaromatic hydrocarbon compound (Benzo-a-pyrene) and some semi volatile organic compounds (SVOC's) within the thin layer of ashy made ground when compared against generic assessment criteria (GAC) for human health. It is therefore recommended that either a 600mm layer of clean cover

material be placed over the ashy made ground in garden areas or the ashy layer is removed off-site in which case no cover would be required.

The ground gas assessment indicates that gas protection measures are not required at the site. However, depleted oxygen concentrations were recorded and it will therefore be necessary to continually monitor excavations for oxygen concentrations and a policy of no man-entry into excavations should be adopted unless suitable conditions are proven by gas monitoring.

The findings of the geotechnical assessment indicated that a Design Sulphate Class of DS-1 may be adopted for the site, and that an Aggressive Chemical Environment for Concrete classification of AC-1 may be assumed for design purposes. Wide strip or trench foundations are likely to be suitable for most of the development, whilst engineered fill with a semi-rigid raft foundation will be an option for foundations within the area of the former pond former pond.

1. INTRODUCTION

RSK STATS Geoconsult Limited (RSK) was commissioned by Taylor Wimpey Manchester to carry out an environmental and geotechnical assessment of a parcel of land within Calderstones Park, Whalley, near Clitheroe. This assessment was carried out with the understanding that the site is to be redeveloped for residential end-use.

1.1 OBJECTIVES

The objectives of this assessment are as follows:

- To enable sufficient information regarding ground conditions to be obtained from which risks to end-users and the environment can be assessed; and
- To obtain sufficient information pertaining to ground conditions to assist in the design of foundations and infrastructure.

1.2 SCOPE

The scope of the investigation and layout of this report has been designed in accordance with CLR11 ⁽¹⁾ (all numbered references are listed at the end of this report in Section 8) and PPS23, as well as guidance issued by the Environment Agency in July 2005 for land contamination reports ⁽²⁾. A summary of relevant legislation and government policies applicable to land development is included in Appendix A.

The risk management process comprises up to three stages of risk assessment: preliminary, generic quantitative and detailed quantitative (PRA, GQRA and DQRA). The basis for the risk assessment is a conceptual model that is produced as part of the PRA and is updated throughout the risk management process.

The scope of works for the environmental assessment includes:

- A PRA involving the review of geological, hydrogeological and hydrological information, a commercially available database (Envirocheck report), historical plans and a site walkover. This information is used to construct an outline conceptual model and consider any possible pollutant linkages (where a receptor may be connected to a source by a viable pathway) that may be present and design intrusive investigation if required;
- Evaluation of possible pollutant linkages by intrusive investigation and laboratory analysis. This information is used to refine the conceptual model;
- GQRA to assess possible pollutant linkages identified in the PRA and enable outline conceptual model to be refined; and
- Provide recommendations for further works, DQRA and remedial actions of ground and groundwater (if deemed applicable).

The scope of works for the geotechnical assessment includes:

- Review of published geological data including a commercially available database with information pertaining to ground stability;
- Review of utility location information and site walkover;
- Coal mining search/solution features search/cavities search;
- Intrusive investigation and laboratory analysis to enable soil parameters for geotechnical purposes to be ascertained; and
- Interpretation of ground conditions and geotechnical data to provide recommendations with respect to foundation, floor slab and infrastructure design.

1.3 LIMITATIONS

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater and ground gas levels may vary from those reported due to seasonal, or other, effects.

This report is subject to the RSK STATS Geoconsult Limited service constraints given in Appendix B.

1.4 PREVIOUS WORK

RSK has not been provided with records of any previous site investigations undertaken at the site.

2. SITE DETAILS

The site location, description and future development are discussed below.

2.1 SITE LOCATION

The site is situated off Pendle Drive and currently forms part of Calderstones Park. It is located at National Grid reference SD 725 373, to the north west of the village of Whalley. The site lies within the grounds of Calderstones Hospital and is bounded to the east and west by residential properties, to the north by Pendle Drive and to the south by the remainder of Calderstones Park, an area of public open space. A site location plan is presented as Figure 1.

2.2 SITE DESCRIPTION

The site occupies approximately 1.4ha, lies at an elevation of approximately 61m above Ordnance Datum (AOD) and is sensibly level. A site plan is presented as Figure 2.

2.3 FUTURE DEVELOPMENT

It is proposed to redevelop the site with low-rise residential properties. The proposed layout of the development is included on Figure 2.

3. PRELIMINARY RISK ASSESSMENT

The following describes the results of the review of available information for the site and the findings from the site inspection. The information, together with that presented in Section 2, has been used to identify potential contaminant sources and sensitive receptors, from which an outline conceptual model has been developed.

3.1 GEOLOGY

Published geological records, included in the Envirocheck report (reproduced in CD format in Appendix C) indicate the site to be underlain directly by drift deposits consisting of Devensian Till (Boulder Clay). This is underlain in turn by solid geology consisting of the Clitheroe Limestone Formation and Hodder Mudstone Formation (undifferentiated).

The mining and ground stability report, contained within the Envirocheck report, indicates the property is not within an area likely to be affected by coal mining or brine subsidence.

The potential for collapsible/compressible ground, ground dissolution, landslide, running sand, and shrinking/swelling clay ground stability are considered very low or no hazard.

The Envirocheck report indicates that the site is not in a radon affected area, as less than 1% of homes are above the action level; no radon protective measures are necessary in the construction of new dwellings or extensions.

3.2 HYDROGEOLOGY

The Groundwater Vulnerability Map provided within the Envirocheck report indicates the geology beneath the site to be classified as a minor aquifer, defined as fractured or potentially fractured rocks, which do not have a high primary permeability, or other formations of variable permeability including unconsolidated deposits. These aquifers will seldom produce large quantities of water for abstraction, but are important for both local supplies and in supplying base flow to rivers. The aquifer designation relates to the underlying solid geology.

3.2.1 *Groundwater Abstractions*

The Environment Agency has defined source protection zones (SPZ) for nearly 2,000 groundwater sources used for public drinking water supply. The SPZ provides an indication of the potential risk of pollution. Three zones (Inner, Outer and Total Catchment) are usually defined. The site is not situated within a groundwater SPZ.

Groundwater abstractions identified within a 2km radius of the site are summarised in Table 1.

Reference	Distance and Orientation from Site	Comment
2671310010	1057m to north west	Abstraction borehole for general agricultural use (medium loss)
2671309052	1891m to north east	Abstraction borehole for general industrial/commercial/public services (medium loss)

Table 1: Groundwater Abstractions

3.2.2 *Soil Leaching Potential*

The soils beneath the site are classified as having low leaching potential. These are soils where pollutants are unlikely to penetrate the soil layer either as a result of largely horizontal water movement or because the soil has the ability to attenuate diffuse pollutants. Lateral flow in these soils may contribute to groundwater recharge elsewhere in the catchment and generally they have a high clay content.

3.3 **HYDROLOGY**

The nearest surface water feature to the site is a drain, approximately 200m to the south. Other drains/streams are present between 250m and 500m to the south east of the site. A pond is present approximately 400m to the north west. The River Calder and Barrow Brook are present approximately 700m to the south west and north of the site, respectively.

The River Calder, in a reach approximately 700m to the south west, is classified as having River Quality C grade water (fair).

3.3.1 *Surface Water Abstractions*

There is one surface water abstraction within 1km of the site, details of which are provided in Table 2.

Reference	Distance and Orientation from Site	Comment
2671309037	606m to east	Impoundment of stream for Clitheroe Golf Club

Table 2: Surface Water Abstractions

3.3.2 Flooding

Information from the Envirocheck report indicates that the site is not located within a flood zone.

3.4 SENSITIVE LAND USES

The site is in a nitrate vulnerable zone. There are otherwise no identified sensitive land uses in the immediate vicinity of the site.

A comprehensive evaluation of ecological receptors is outside the scope of this report.

3.5 SITE HISTORY REVIEW

A review of the site history has been carried out through the study of Ordnance Survey maps dating from the late 1800s, and information from the regulatory authorities and trade directories. The review is designed to identify potential historic sources of contamination that may have impacted soil or groundwater quality beneath the site and to identify any potentially contaminative land uses in the area that may have impacted the site.

3.5.1 Historic Maps

A review of the historical maps for the site from between 1848 and 2009 were undertaken using the extracts provided within the Envirocheck report. Selected maps are presented as Figures 3 to 11. These are not to scale, although all the evaluations in this report have been made from the scaled plans.

3.5.1.1 History of the Site

The 1893 map (Figure 4) indicates the site to be occupied by agricultural land, with a pond and small strip of woodland in the western section of the site.

The 1912 map (Figure 5) indicates the presence of a small building (unspecified use) in the very north eastern most corner of the site. On later maps this is indicated to have been extended and named 'The Bungalow'.

By 1932 (Figure 7) the pond appears to have been backfilled and the area replanted with trees. A football ground is now present across the main body of the site.

The 1968 map (Figure 8) indicates the site to be part of the Calderstones Hospital, although it remains occupied by a playing field, with no buildings on the site itself, other than the Bungalow.

The 1992 map (Figure 10) indicates a structure (possibly an area of hardstanding, not thought to be a building) in the western section of the site, though this has been removed from later mapping. The site remains largely unchanged to the latest date of mapping (2009).

3.5.1.2 History of the Surrounding Area

The 1848 map (Figure 3) indicates the area surrounding the site to be largely occupied by agricultural land, with some areas of woodland and a number of ponds nearby. A road (later indicated as Mitton Road) is present approximately 50m to the east of the site, while the Blackburn Railways lies approximately 500m to the east. A brick and tile works is present approximately 350m to the south east and a tile works approximately 500m to the north west.

By 1913 (Figure 6) the brick and tile works to the south east and north west are indicated to no longer be operational. A new brick works, with a private railway leading to it, is present approximately 200m to the north of the site, with an associated clay pit approximately 175m to the west. Whalley railway station, with its associated goods sheds, is present approximately 1km to the south east.

The 1932 map (Figure 7) indicates the presence of a mental institution (later indicated simply as a hospital) immediately to the west of the site, with an isolation unit to the north and a pavilion and football club buildings to the south. Houses are now present immediately to the east. A sewage works is present approximately 600m to the south west.

The 1970 map (Figure 9) indicates a transport depot and cattle breeding centre approximately 200m to the east and north east, respectively.

By 2006 (Figure 11) the northern section of the hospital has been redeveloped with residential properties, while the southern section remains in use as a hospital. The area surrounding the site remains largely unchanged to the latest date of mapping (2009).

3.5.2 Database and Regulatory Information

3.5.2.1 Pollution Incidents

There have been three recorded pollution incidents within 500m of the site, all but one of which were classed as Category 3 (minor) incidents. The Category 2 (significant) incident

occurred approximately 420m to the north west of the site and involved the release of crude sewage into a nearby watercourse. A further eight incidents have occurred within 1km of the site, all but one of which was classed as Category 3, with the remaining one classed as Category 2, for the release of filter backwash water into a nearby watercourse.

3.5.2.2 Discharge Consents

There is one current discharge consent within 500m of the site (~400m to the north), for the discharge of final or treated sewage effluent into nearby watercourses. A further consent is held within 1km of the site, also for the discharge of sewage into watercourses.

3.5.2.3 Waste

There are three historical landfill sites within 1km of the subject site, which lie approximately 145m and 220m to the north west and 975m to the south (references EAHLD07479, EAHLD07517, EAHLD07127, respectively). The specified waste for each site was Commercial and Household. No further details are supplied.

There was one registered waste treatment or disposal site within 1km of the subject site (~250m to the west). It was classed as very small (<10,000 tonnes/yr) and was licensed to Burnley, Pendle and Rossendale H.A. (license no longer active), generally for clinical waste.

There were three BGS recorded mineral sites within 1km of the subject site, all of which were opencast clay and shale quarries whose operations have now ceased. The closest was approximately 80m to the west of the site.

3.5.2.4 Trade Directories

There are five active trade directory entries within 500m of the site. These are for a paper and cardboard products facility, road haulage services, a hospital, a washing machine service and repair facility and a fireplaces and mantelpieces centre.

3.5.3 Summary of Historic Potentially Contaminative Land Uses

The review of the site history indicates that there has been no potentially contaminative land use on the site itself, other than perhaps the presence of an infilled pond within the western section of the site, which may be a potential source of ground and ground gas contamination.

A number of brick/tile works, waste/landfill sites, quarries, as well a sewage farm, are present within 1km of the site; however, none are in the immediate vicinity of the site and are therefore considered unlikely to represent potential contamination sources.

As with any site, it is possible that made ground will be present across the site and the surrounding area, having been used to raise levels. Any made ground present may have resulted in the generation of hazardous ground gases and/or soil/groundwater contamination.

3.6 SITE WALKOVER

An engineer from RSK carried out a site inspection on 20 January 2010. The key findings are summarised below:

- No visual or olfactory evidence of contamination was noted during the site walkover;
- No invasive plant species were noted on-site (however a detailed inspection was not completed and the walkover was carried out outside the growing season for such plants);
- No buildings, and very little hardstanding, were observed on site; and
- The site is in a predominantly residential area.

3.7 SUMMARY OF POTENTIAL CONTAMINANT SOURCES

There are a number of potential sources of contamination to soils, groundwater and soil gas. These include:

- Inorganic and organic soil contamination from any made ground/fill materials used to raise site levels;
- Inorganic and organic soil contamination from the on-site former pond; and
- Ground gas and leachate from any made ground on or close to the site (in particular the infilled former pond).

3.8 SENSITIVE RECEPTORS

There are a number of sensitive receptors that may be affected by the potential contamination hazards identified above. These may include:

- Nearby ponds and land drains;
- River Calder and Barrow Brook;
- Shallow (perched) water in any made ground materials or superficial deposits;
- Deeper groundwater in the minor aquifer;
- Plant uptake of contaminated soils;
- Site operatives during redevelopment works;
- Future site occupants;
- Neighbouring residents and surrounding areas; and
- Building infrastructure and services.

3.9 SUMMARY OF PLAUSIBLE PATHWAYS

The routes by which potential contamination could plausibly come into contact with the receptors are:

- Surface water run-off and/or infiltration;
- Groundwater migration in any permeable soils and existing/proposed service runs;
- Phytotoxic effects on plants;
- Direct human ingestion, dust inhalation and/or dermal contact;
- Ground gas migration in permeable soils or existing/proposed service runs; and
- Vapour migration from volatile compounds.

3.10 OUTLINE CONCEPTUAL MODEL

The information presented in the preceding sections has been used to compile an outline conceptual model. The identified potential contaminants and receptors have been considered with any possible pathways that may link them. The resulting pollutant linkages are considered in Table 3. The risk classification has been estimated in accordance with information in Appendix D.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk
Organic and inorganic soil and groundwater contamination and leachate associated with fill materials on or close to the site, including backfilled former pond	Off site surface water features	Surface water run-off, groundwater migration	Unlikely	Mild	Very low. The nearest surface water feature is 200m from the site (a land drain); this is considered sensitive and there is no evidence to suggest that any contamination is present on-site. The closest river is 700m from the site
	Perched water, Groundwater (minor aquifer)	Vertical and horizontal migration of perched water and groundwater	Unlikely	Medium	Low. There is no reason to suspect that any fill material present on-site is contaminated. Furthermore, the low permeability superficial deposits beneath the site will reduce the likelihood of the pathway being realised
	Site operatives	Vapour and dust inhalation, human ingestion, and dermal contact	Unlikely	Medium	Low. Although contact with soil is likely during the redevelopment works, risks can be mitigated during the development process using personal protective equipment (PPE)

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk
	Future site occupants	Vapour and dust inhalation, human ingestion, and dermal contact	Unlikely	Medium/severe	Moderate/low. Contact with soil by future occupants is likely given that gardens will be present; however, there is no evidence to suggest that the soil will be contaminated
	Plant uptake (phytotoxic effects)	Plant uptake from contaminated soil	Unlikely	Minor	Very low. Although any made ground at the site may contain determinants that are detrimental to the growth of plants, this can be easily mitigated by placing a suitable growing medium in garden areas
	Neighbouring residents	Groundwater and leachate migration in permeable soils	Unlikely	Medium	Low. There is no reason to suspect that any fill material present on-site is contaminated, and the site is underlain by impermeable superficial deposits, thereby reducing the likelihood of migration of any contaminants off-site
	Plastic utilities	Permeation	Unlikely	Mild	Very low. There is no reason to suspect the presence of organic soil contamination on site at this stage
Hazardous ground gases associated with backfilled pond	Site operatives	Ground gas migration in permeable soils	Low likelihood	Medium/severe	Moderate. The potential risk to human health of any ground gas associated with the backfilled pond is potentially severe
	Future site occupants	Ground gas migration in permeable soils	Low likelihood	Medium/severe	Moderate. The potential risk to human health of any ground gas associated with the backfilled pond is potentially severe
	Neighbouring residents, building infrastructure & services	Ground gas migration in permeable soils	Unlikely	Medium/severe	Moderate/low. The potential risk to human health of any ground gas associated with the backfilled pond (e.g. explosion from methane build-up) is potentially severe

Table 3: Risk Estimation for Potential Pollutant Linkages in Outline Conceptual Model

The conceptual model identifies the following potential pollutant linkages with a severity of moderate or higher:

- Inhalation of vapours, dust inhalation, ingestion and dermal contact with any soils contaminated from on-and off-site sources by future site occupants;
- Inhalation of hazardous ground gases from on- and off-site made ground by site operatives and future site occupants; and
- Build-up of explosive concentrations of migrating gases into buildings (on- and off-site).

3.11 PRELIMINARY RISK ASSESSMENT CONCLUSIONS AND RECOMMENDATIONS

Based on the outline PRA, it is considered unlikely that significant remediation of soil and/or groundwater will be necessary prior to redevelopment of the site. Given that there are a number of potential sources of contamination on or close to the site, however, it will be necessary to undertake a basic intrusive investigation of the site, which will provide further information on actual contaminants present and viable pathways to sensitive receptors. A number of wells should be installed to enable future gas monitoring and groundwater sampling.

4. ENVIRONMENTAL SITE INVESTIGATION

RSK carried out intrusive investigation work on 25 February 2010. Subsequent ground gas and groundwater monitoring was carried out between 8 March and 4 June 2010. The investigation has been designed to further investigate the potential pollutant linkages identified in the outline conceptual model.

4.1 SCOPE OF WORKS

The site investigation comprised the following scope of works:

- Drilling of nine probeholes to a maximum depth of 4.00m bgl using a competitor (windowless sample) rig;
- Drilling of one cable percussive borehole to 10.80m bgl using a shell and auger drilling rig;
- Excavation of ten hand-dug inspection pits to a maximum depth of 0.50m bgl;
- Recovery of soil samples for laboratory chemical and geotechnical analyses;
- Recovery of groundwater samples for laboratory chemical analysis; and
- Undertaking six ground gas monitoring visits.

Upon completion, each exploratory hole was backfilled either with gravel and bentonite or a monitoring installation (consisting of bentonite seal, pea gravel, backfill and groundwater/gas monitoring pipework). The installations enable future monitoring of ground gas concentrations and flow rates and obtaining groundwater samples (if present). The installations were finished with a lockable cover to maintain the integrity of the exploratory hole.

The investigation locations were chosen to target areas of potential concern and to provide a spread of data across the site.

4.1.1 Health and Safety Considerations

Service plans were not available for review. A utility clearance survey was therefore carried out at each investigation location to confirm the presence or otherwise and location of any underground services. The utility survey was carried out by RSK personnel using a cable avoidance tool (CAT) and Genny.

4.1.2 Investigation Locations

The intrusive investigation locations are shown in Figure 2. The rationale for these locations is given in Table 4.

Exploratory Hole Number	Location and Rationale	Rationale for Installation
WS1 to WS6, WS8, BH1	To provide spread of data across site	To enable future gas and groundwater monitoring
WS7	In the vicinity of the former pond	N/A
WS9	In the vicinity of the former building	N/A

Table 4: Exploratory Hole Location Rationale

Note that no standpipe was installed in WS7 (the former pond) because Taylor Wimpey intends to remove any pond material prior to development.

The depths of the exploratory holes, descriptions of strata encountered, comments on groundwater conditions, samples obtained and installation details are included on the probehole and borehole records in Appendices E and F, respectively.

4.1.3 Soil Sampling

At least one sample of soil was recovered from each stratum encountered. Where visual or olfactory evidence of contamination was observed, where possible samples were obtained above, below and in the area of contamination. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination. The samples were transported to the laboratory in chilled cool boxes. The samples are recorded, together with their depths, on the probehole and borehole logs presented in Appendices E and F, respectively. Laboratory Chain of Custody Forms can be provided if required.

Samples were selected and scheduled for a range of organic and inorganic chemical analysis in order to classify the near surface ground conditions with regards to contamination.

4.1.4 *Groundwater Monitoring*

Depths to groundwater were recorded using an electronic dip meter during each of the gas monitoring visits.

The groundwater monitoring data are included with the ground gas monitoring data presented in Appendix G.

4.1.5 *Groundwater Sampling*

The groundwater monitoring wells were purged during the monitoring visit on 8 March 2010. The wells were purged dry due to the limited volume of water and the slow recharge rate.

Groundwater sampling was subsequently carried out during the visit on 31 March 2010. Samples were taken using disposable bailers dedicated to each monitoring location to avoid the risk of cross contamination of samples. The groundwater samples were collected in a variety of containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation. Samples were transported to the testing laboratory in a cool box under Chain of Custody documentation directly to the testing laboratory.

4.1.6 *Ground Gas Monitoring*

Ground gas monitoring has been carried out over six monitoring rounds, as considered the minimum for residential properties, in line with the NHBC report ⁽³⁾.

An infrared gas analyser meter was used to measure concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂) in percentage by volume, whilst hydrogen sulphide (H₂S) and carbon monoxide (CO) were recorded in parts per million (ppm). Initial and steady state concentrations were recorded. A flow meter was used to measure flow rates in litres per hour (l/hr).

In addition, the atmospheric pressure during monitoring, together with the weather conditions, was recorded.

All monitoring results, together with the temporal conditions, are contained within Appendix G and discussed in Section 4.2.3.

4.2 **GROUND CONDITIONS**

On-site observations are detailed below. The probehole and borehole records are presented in Appendices E and F, respectively, and include notes on soil samples

recovered, in-situ testing, visual or olfactory evidence of contamination and details of the probehole/borehole/pit completion, i.e. installation of monitoring wells or reinstatement.

4.2.1 *Soil Stratigraphy*

Ground conditions generally consisted of a surface covering of brown sandy topsoil from ground level up to approximately 0.40m, underlain at most locations directly by natural superficial deposits. In WS2 it was underlain by made ground consisting of ashy gravel from 0.20m to 0.40m. In probeholes WS7, WS8 and WS9 the surface materials consisted of brick gravel to depths of between 0.80m and 1.00m, underlain by natural superficial deposits.

The natural deposits consisted generally of soft to firm grey mottled orange slightly sandy thinly laminated clay to depths of between 1.40m and 2.10m, underlain in turn by firm/firm to stiff grey thinly laminated slightly sandy clay to the full depth of drilling (up to 4.45m in the window sampling locations). In borehole BH1, however, the clay was stiff and soft to firm to a depth of approximately 9.00m, and firm to stiff beneath this to the full depth of drilling (10.80m).

A peat horizon was encountered directly beneath the made ground in WS7 from 1.00m to 1.50m. Occasional peat partings were also encountered in WS2, within the clay horizon from 0.40m to 1.30m.

Eight shallow hand dug inspection pits were excavated on a 10m grid centred around WS2 to delineate the extent of the ashy made ground, with a further 2 pits extended 25m north and west from WS2. The ashy made ground observed in WS2 was found to be present in all of the hand dug pits from approximately 0.10m to between 0.20m and 0.40m. A slight hydrocarbon sheen was observed on the surface of perched water within one of the hand-dug pits.

Three of the investigation locations (WS2, WS8, and BH1) were installed with ground gas/groundwater monitoring standpipes.

4.2.2 *Groundwater Regime*

Groundwater was not encountered during drilling. The results of the subsequent groundwater monitoring are included within the gas monitoring records presented in Appendix G.

4.2.3 *Ground Gas Regime*

The gas monitoring results are included in Appendix G and are summarised in Table 5, where calculated gas screening values (GSVs) are also provided (GSVs are the product of gas concentration and gas flow from a borehole and therefore provide an indication of

the flow of the particular gas in question out of the ground). Approximate atmospheric pressure data for 3 days prior to each monitoring visit (taken from www.weatheronline.co.uk and the readings extrapolated from Keighley to Whalley) has also been provided.

Methane was not detected in any of the installations. The results indicate measurable concentrations of carbon dioxide (up to 5.1% in probehole WS8) at each location. Hydrogen sulphide and carbon monoxide concentrations were negligible. Oxygen concentrations were generally near atmospheric, although depleted concentrations were encountered in WS8.

Flow rates were negligible in WS2 and WS8; however, measureable positive flow rates were recorded in BH1 on two occasions (4.4l/hr and 3.5l/hr).

Date	Methane		Carbon Dioxide		Oxygen		Flow Rate l/hr		GSV CO ₂ and Methane	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Monitoring round 1 8 March 2010	<0.1	<0.1	0.1	4.2	14.7	20.1	<0.1	<0.1	0.000	0.004
Monitoring round 2 31 March 2010	<0.1	<0.1	0.2	1.6	18.6	20.2	<0.1	4.4	0.000	0.070
Monitoring round 3 14 April 2010	<0.1	<0.1	0.5	3.2	18.5	20.4	<0.1	3.5	0.001	0.112
Monitoring round 4 21 May 2010	<0.1	<0.1	0.2	5.1	8.9	20.5	<0.1	<0.1	0.000	0.005
Monitoring round 5 28 May 2010	<0.1	<0.1	0.1	2.4	17.7	19.0	<0.1	<0.1	0.000	0.002
Monitoring round 6 4 June 2010	<0.1	<0.1	0.1	1.4	17.9	19.1	<0.1	0.1	0.000	0.001

Date	Atmospheric pressure during the preceding three days prior to the			Temporal conditions during the monitoring round		
	3	2	1	Atmospheric Pressure	Rainfall	Other
Monitoring round 1 8 March 2010	1024	1025	1030	1028	Dry	Sunny, clear
Monitoring round 2 31 March 2010	1001	996	980	983	Light rain	Cloudy
Monitoring round 3 14 April 2010	1029	1027	1024	1021	Dry	Sunny, clear
Monitoring round 4 21 May 2010	1023	1023	1027	1027	Dry	Sunny, clear

Monitoring round 5 28 May 2010	1006	1003	1003	1006	Dry	Sunny, clear
Monitoring round 6 4 June 2010	1010	1014	1015	1012	Dry	Sunny, clear

Table 5: Summary of Ground Gas Monitoring Data

The gas monitoring data indicate that there may be a risk posed to site end users in relation to elevated carbon dioxide and oxygen depletion.

4.2.4 Observed Contamination

Ashy made ground was encountered in WS2 and the hand-dug inspection pits nearby, indicating the potential for heavy metal impact in this area.

An oily sheen was noted on the perched water surface in one of the inspection pits (H2).

4.3 ANALYTICAL STRATEGY AND METHODOLOGY

A total of nine soil samples were tested for chemical contamination, as listed in Table 6. Three groundwater samples were also tested for chemical contamination, as listed in Table 7. In addition, six soil samples were submitted for asbestos screening. The analytical schedule was based on the ground conditions encountered, as discussed in Section 4.2. All analyses were undertaken by UKAS and MCERTS certified laboratories (Envirolab Ltd.). The details of the laboratory certification are included on the certificates in Appendices H and I, respectively.

Exploratory Hole No. & Sample Depth (m bgl)	Analyte	Rationale
BH1 @ 0.80-1.20	Asbestos screen	To assess the natural soils
WS5 @ 0.10-0.40		To assess the made ground
BH1 @ 2.50-3.00	Metals, Sulphate, Speciated TPH, Speciated PAH, TOC/FOC	To assess the natural soils
WS2 @ 0.10-0.40	Metals, Sulphate, Speciated TPH, Speciated PAH, SVOC, Asbestos screen	To assess the ashy made ground
WS7 @ 0.50-1.00		To assess the soils in the vicinity of the infilled pond
WS8 @ 0.10-0.40		To assess the made ground
WS9 @ 0.50-0.80		To assess the soils in the vicinity of the former building

Exploratory Hole No. & Sample Depth (m bgl)	Analyte	Rationale
WS2 @ 2.50-3.00	Metals, Sulphate, Speciated TPH, Speciated PAH, TOC/FOC, SVOC	To assess the natural soils beneath the ashy made ground
WS8 @ 1.50-2.00		To assess the natural soils
WS4 @ 0.10-0.40	Metals, Sulphate, Speciated TPH, Speciated PAH, TOC/FOC	To assess the natural soils
WS5 @ 1.00-1.50	Metals, Sulphate, Speciated TPH, Speciated PAH	To assess the natural soils

Table 6: Scheduled Analysis – Soil

Exploratory Hole No.	Analyte	Rationale
BH1	Metals, Sulphate, Speciated TPH, Speciated PAH	To assess the groundwater within in the natural sandy clay
WS2	Metals, Sulphate, Speciated TPH, Speciated PAH	To assess the groundwater within in the natural sandy clay
WS8	Metals, Sulphate, Speciated TPH, Speciated PAH	To assess the groundwater within in the natural sandy clay

Table 7: Scheduled Analysis – Groundwater

4.4 CHEMICAL CONDITIONS

Full analytical certificates are provided in Appendices H and I, respectively. The results are discussed in the GQRA, Section 5.

5. GENERIC QUANTITATIVE RISK ASSESSMENT

In line with CLR11 ⁽¹⁾, there are two stages of quantitative risk assessment: generic and detailed. The generic quantitative risk assessment (GQRA) comprises the comparison of soil, groundwater and ground gas results with generic assessment criteria (GAC) that is appropriate to the linkage being assessed. The GAC used in this assessment are included in Appendix J for human health (together with details of their derivation) and in Appendix K for the assessment of phytotoxic effects, risks to plastic utilities and to controlled waters.

The site investigation work and subsequent monitoring indicates that there are relevant pollutant linkages at the site, which require further consideration.

5.1 RELEVANT LINKAGES FOR ASSESSMENT

The linkages for assessment are presented in Table 8.

Relevant Pollutant Linkage	GAC
Direct contact pathways to future residents	Human health GAC for a proposed residential end use with private gardens since proposed end use includes residential gardens (Appendix J).
Leaching and dissolved phase migration to minor aquifer and off-site surface water features	GAC recorded in Table 3 of Appendix K for minor aquifers.
Concentrations of methane and carbon dioxide in ground gas entering and accumulating in: - Depressions and excavations during any site works and development that could affect site workers; and - Enclosed spaces or small rooms in new buildings, which could affect future residents. In the case of methane, this could create a potentially explosive atmosphere, whilst death by asphyxiation could result from carbon dioxide.	Gas screening values (GSV) have been calculated using maximum methane and carbon dioxide concentrations with maximum flow rates recorded at the site. The GSV have been compared with the generic Traffic Lights, as presented within the NHBC ground gases guide ⁽³⁾ .
Plant uptake	GAC values presented in Appendix K for phytotoxic determinants.
Permeation of plastic utilities	GAC values presented in Appendix K for water supply pipes.

Table 8: Linkages for Generic Quantitative Risk Assessment

5.2 METHODOLOGY AND RESULTS

The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn.

5.2.1 *Direct Contact and Vapour Inhalation by Future Residents*

The laboratory analytical data for soils (Appendix H) have been compared directly to the GAC, presented in Appendix J. The results are summarised in Tables 9, 10 and 11.

Contaminant	GAC mg/kg	Range of Results in mg/kg <u>Made Ground</u> (No. tested)	Pass/Fail (Failed sample and groundwater in mg/kg)	Range of Results in mg/kg <u>Natural</u> (No. tested)	Pass/Fail
Arsenic	32	8-26 (4)	Pass	9-19 (5)	Pass
Cadmium	29	<0.5-1.4 (4)	Pass	0.9-1.2 (5)	Pass
Chromium (hexavalent)	38	<0.1 (2)	Pass	<0.1 (5)	Pass
Copper	4,700	19-110 (4)	Pass	29-34 (5)	Pass
Lead	450	16-25,600 (4)	Fail WS7 @ 0.5-1.0m (25,600)	22-93 (5)	Pass
Mercury	170	<0.17-2.14 (4)	Pass	<0.17-0.26 (5)	Pass
Nickel	130	19-45 (4)	Pass	33-76 (5)	Pass
Selenium	350	<0.1-2 (4)	Pass	2-3 (5)	Pass
Zinc	25,000	34-203 (4)	Pass	97-131 (5)	Pass

Table 9: Summary of Soil Test Results – Metals

Contaminant	GAC mg/kg	Range of Results in mg/kg <u>Made Ground</u> (No. tested)	Pass/Fail (Failed above in mg/kg)	Range of Results in mg/kg <u>Natural</u> (No. tested)	Pass/Fail
Acenaphthene	7.1	<0.01-0.68 (4)	Pass	<0.01-0.06 (5)	Pass
Acenaphthylene	0.52	<0.01-0.32 (4)	Pass	<0.01 (5)	Pass
Anthracene	1,300	0.10-2.55 (4)	Pass	<0.01-0.19 (5)	Pass
Benz(a)anthracene	5.2	0.05-12.5 (4)	Fail WS7 @ 0.5-1.0m (12.5)	<0.01-0.29 (5)	Pass
Benzo(a)pyrene	0.95	0.13-15.5 (4)	Fail WS7 @ 0.5-1.0m (15.55) WS8 @ 0.1-0.4m (2.47) WS9 @ 0.5-0.8m (1.00)	<0.01-0.20 (5)	Pass
Benzo(b)fluoranthene	9.3	<0.01-9.14 (4)	Pass	<0.01-0.07 (5)	Pass
Benzo(ghi)perylene	2,300	<0.01-14.8 (4)	Pass	<0.01 (5)	Pass
Benzo(k)fluoranthene	9.6	<0.01-7.38 (4)	Pass	<0.01-0.05 (5)	Pass
Chrysene	80	0.31-20.7 (4)	Pass	<0.01-1.3 (5)	Pass
Dibenzo(ah)anthracene	0.93	<0.01-1.06 (4)	Fail WS7 @ 0.5-1.0m (1.06)	<0.01 (5)	Pass
Fluoranthene	13	0.28-32.4 (4)	Fail WS7 @ 0.5-1.0m (32.4)	<0.01-0.67 (5)	Pass
Fluorene	85	<0.01-0.52 (4)	Pass	<0.01 (5)	Pass
Indeno(123cd)pyrene	9.1	<0.01-13.4 (4)	Fail	<0.01 (5)	Pass

Contaminant	GAC mg/kg	Range of Results in mg/kg <u>Made Ground</u> (No. tested)	Pass/Fail (Failed above in mg/kg)	Range of Results in mg/kg <u>Natural</u> (No. tested)	Pass/Fail
			WS7 @ 0.5-1.0m (13.4)		
Naphthalene	1.5	0.05-0.28 (4)	Pass	<0.01-0.03 (5)	Pass
Phenanthrene	790	0.15-8.82 (4)	Pass	<0.01-0.50(5)	Pass
Pyrene	130	0.22-26.6(4)	Pass	<0.01-0.51(5)	Pass

Table 10: Summary of Soil Test Results – PAH

Contaminant	GAC mg/kg	Range of Results in mg/kg <u>Made Ground</u> (No. tested)	Pass/Fail	Range of Results in mg/kg <u>Natural</u> (No. tested)	Pass/Fail
Benzene	0.08	<0.01 (4)	Pass	<0.01 (5)	Pass
Toluene	120	<0.01 (4)	Pass	<0.01 (5)	Pass
Ethylbenzene	65	<0.01 (4)	Pass	<0.01 (5)	Pass
Xylene	44	<0.01 (4)	Pass	<0.01 (5)	Pass
MTBE	1.8	<0.01 (4)	Pass	<0.01 (5)	Pass
Aliphatic C ₅ –C ₆	25	<0.01 (4)	Pass	<0.01 (5)	Pass
Aliphatic C ₆ –C ₈	51	<0.01 (4)	Pass	<0.01 (5)	Pass
Aliphatic C ₈ –C ₁₀	11	<0.01 (4)	Pass	<0.01 (5)	Pass
Aliphatic C ₁₀ –C ₁₂	50	<0.1 (4)	Pass	<0.1 (5)	Pass
Aliphatic C ₁₂ –C ₁₆	22	<0.1 (4)	Pass	<0.1 (5)	Pass
Aliphatic C ₁₆ –C ₂₁	88,000	<0.1 (4)	Pass	<0.1 (5)	Pass
Aliphatic C ₂₁ –C ₃₅	88,000	<0.1 (4)	Pass	<0.1 (5)	Pass
Aromatic C ₈ –C ₁₀	16	<0.01 (4)	Pass	<0.01-0.03 (5)	Pass
Aromatic C ₁₀ –C ₁₂	58	<0.1 (4)	Pass	<0.1 (5)	Pass
Aromatic C ₁₂ –C ₁₆	130	<0.1-8.6 (4)	Pass	<0.1 (5)	Pass
Aromatic C ₁₆ –C ₂₁	88,000	<0.1-73.9 (4)	Pass	<0.1 (5)	Pass
Aromatic C ₂₁ –C ₃₅	1,100	<0.1-73.9 (4)	Pass	<0.1 (5)	Pass

Table 11: Summary of Soil Test Results – Petroleum Hydrocarbons

Six soil samples were submitted for asbestos screening, the results of which indicate there to be no detectable asbestos present.

The GAC value for lead and some PAH compounds were exceeded in the made ground in WS7 at 0.50-1.00m. This location was drilled within the former pond. It is understood that Taylor Wimpey intends to remove and dispose of the material from this area prior to development as it is considered unsuitable. The pollutant pathway linkage can therefore be discounted for these soils, as long as they are indeed removed.

Minor exceedences of benzo (a) pyrene were also recorded in made ground in WS8 at 0.10m-0.40m and WS9 at 0.50m-0.80m. It has not been proposed to remove the soils from these areas and therefore a potential pollutant linkage exists.

Six soil samples were also submitted for speciated semi volatile organic compounds (SVOCs), the results of which are included in Appendix H and summarised in Tables 12 and 13.

Contaminant	GAC mg/kg	Range of Results in mg/kg Made Ground (No. tested)	Pass/Fail (Failed in mg/kg)	Range of Results in mg/kg <u>Natural</u> (No. tested)	Pass/Fail (Failed in mg/kg)
Acenaphthene	7.1	<0.05 - 3 (4)	Pass	<0.05 - 0.07 (2)	Pass
Acenaphthylene	0.52	<0.05 - 0.3 (4)	Pass	<0.05 (2)	Pass
Anthracene	1,300	0.10- 8.94 (4)	Pass	<0.03 - 0.09 (2)	Pass
Benz(a)anthracene	5.2	0.5- 39.2 (4)	Fail WS7 @ 0.5-1.0 (39.2)	<0.06 - 0.8 (2)	Pass
Benzo(a)pyrene	0.95	0.3 – 48.0 (4)	Fail WS7 @ 0.5-1.0 (48.0) WS8 @ 0.1-0.4 (2.0) WS9 @ 0.5-0.8 (2.0)	<0.07 - 0.4 (2)	Pass
Benzo(b)fluoranthene	9.3	<0.6- 57.7 (4)	Fail WS7 @ 0.5-1.0 (57.7)	0.1 - 0.7 (2)	Pass
Benzo(ghi)perylene	2,300	<0.5- 24.4 (4)	Pass	0.08 - 0.4 (2)	Pass
Benzo(k)fluoranthene	9.6	<0.2- 16.3 (4)	Fail WS7 @ 0.5-1.0 (16.3)	<0.05 - 0.2 (20)	Pass
Chrysene	80	0.7 – 38.1 (4)	Pass	0.2 - 0.8 (2)	Pass
Dibenzo(ah)anthracene	0.93	0.2- 4.9 (4)	Fail WS7 @ 0.5-1.0 (4.9)	<0.1 (2)	Pass
Fluoranthene	13	2- 44.6 (4)	Fail WS7 @ 0.5-1.0 (44.6)	0.1 - 2 (2)	Pass
Fluorene	85	0.08 - 2 (4)	Pass	<0.06 - 0.1 (2)	Pass
Indeno(123cd)pyrene	9.1	0.4 – 19.8 (4)	Fail WS7 @ 0.5-1.0 (19.8)	0.2 (5)	Pass
Naphthalene	1.5	0.2- 1 (4)	Pass	0.1 - 0.3 (2)	Pass
Phenanthrene	790	1- 33.5 (4)	Pass	0.2 - 1 (2)	Pass
Pyrene	130	2 - 32.8 (4)	Pass	0.2 - 2 (2)	Pass
Phenol	440	0.2 (4)	Pass	0.1 (2)	Pass

Table 12: Summary of Soil Test Results – SVOC

Table 13 lists the maximum concentration of detected SVOC which have no GAC available.

Contaminant	Maximum in mg/kg Made Ground	Maximum mg/kg Natural
1,3-Dinitrobenzene	0.05	-
1,4-Dinitrobenzene	0.1	-
4-Chloroaniline	1	0.3
1-Methylnaphthalene	0.8	0.4
2-Methylnaphthalene	0.9	0.5
Di-n-butylphthalate	0.1	-
Di-n-butylphthalateBis(2-ethylhexyl)phthalate	0.9	-
Bis(2-chloroisopropyl) ether	0.2	-
Carbazole	2	-
Dibenzofuran	1	0.2
Dipethylphthalate	0.02	0.06
Pentachlorophenol	86.2	-
- not detected		

Table 13: Maximum Concentrations of SVOC for which no GAC are available

PAH concentrations were measured by GCMS in both a PAH suite and SVOC suite. For the purposes of this assessment the greatest recorded concentration of PAH was assumed to be representative of the sample.

In addition pentachlorophenol was measured at a concentration of 86.2mg/kg in WS7 at 0.50m to 1.00m and 56.6mg/kg in WS8 at 0.10m to 0.40m. It is intended to remove the affected soil in WS7 and since this is a category B2 carcinogen, affected soil from WS8 should also be removed or isolated.

5.2.2 Uptake of Contaminants by Vegetation Potentially Inhibiting Plant Growth

The results have been compared with the GAC presented in Appendix K for this linkage. The results are summarised in Table 14 and indicate very marginal exceedences of zinc in WS7 at 0.50m-1.00m and nickel in WS5 at 1.00m-1.50m. As discussed in Section 5.2.1, it is understood that the soils in the vicinity of WS7 will be removed prior to development. The exceedence of nickel in WS5 is considered so marginal that it can be discounted, as all other samples of the natural soils returned concentrations below the GAC values. It is therefore considered that no potential pollutant linkage will exist with regard to inhibition of plant growth.

Contaminant	pH (units)	GAC mg/kg	Range of Results in mg/kg <u>Made Ground</u> (No. tested)	Pass/Fail (Failed above in mg/kg)	Range of Results in mg/kg <u>Natural</u> (No. tested)	Pass/Fail (Failed above in mg/kg)
Zinc	>6	200	34-203 (4)	Fail WS7 @ 0.5-1.0m (203)	97-131 (5)	Pass
Copper	>6	135	19-110 (4)	Pass	29-34 (5)	Pass
Nickel	>6	75	19-45 (4)	Pass	33-76 (5)	Fail WS5 @ 1.0-1.5m (76)

Table 14: Summary of Soil Test Results – Phytotoxic Effects

5.2.3 Permeation of Plastic Utilities

The results have been compared with the GAC presented in Appendix K for this linkage, and indicate elevated arsenic concentrations in several locations, although none exceed the GAC. The GAC is, in this case, for the protection of residents during their lifetime, arsenic is not likely to permeate plastic pipes. Provision of adequate PPE will mitigate any potential risk to site workers when laying the utility pipes.

Elevated lead, mercury, PAH and petroleum hydrocarbon concentrations have been recorded in WS7 at 0.50m-1.00m. Although the PAH and petroleum hydrocarbon concentrations recorded could pose a risk via permeation of plastic utilities, this material is intended for removal and a relevant pollutant linkage associated with permeation of plastic utilities is not therefore considered to exist.

5.2.4 Leaching and Migration of Dissolved Phase Contaminants to Minor Aquifer and off-site Surface Water Bodies

Three groundwater samples were tested for metals, speciated TPH and speciated PAH. The results are presented in Appendix I. The concentrations have been compared with the GAC for minor aquifers, included in Appendix K. These, although very conservative, were considered the most appropriate GAC owing to the site's location on a minor aquifer.

The comparison indicates marginal exceedences of some GAC values, including the worst case values for chromium, copper, zinc (based on the Freshwater Environmental Quality Standards for all fish life and dependant upon hardness range) and selenium.

Given the marginal concentrations of contaminants present, that the site is underlain by clay (relatively impermeable), and that the closest surface water receptor is 200m from the site (and therefore dilution will almost certainly result in concentrations being below these criteria before they reach the receptor), it is considered highly unlikely that the

concentrations encountered pose a risk to controlled waters. Furthermore, it is very unlikely that the lower range conditions exist in the nearby surface water features.

5.2.5 Ground Gas

In order to assess the significance of ground gases at the site, measured concentrations and flow rates have been used to derive GSVs, as discussed in section 4.2.3 above. For the purposes of this assessment it has been assumed that the dwellings will have a ventilated sub-floor void. As such, the GSVs have been compared with the generic Traffic Lights, as presented within the NHBC ground gases guide ⁽³⁾.

The GSV for both methane and carbon dioxide is calculated by multiplying the maximum borehole flow rate by the maximum gas concentration. This calculation is automatically generated in the NHBC GSV worksheets presented in Appendix L, which also indicate the level of gas protection measures required, if any.

The results have characterised the site as Green, indicating a negligible gas regime for which gas protection measures are not required. However, the depleted oxygen concentrations pose a potential risk to construction workers from asphyxiation.

5.3 REFINED CONCEPTUAL SITE MODEL

Following intrusive investigations, subsequent monitoring and the GQRA, it is now possible to refine the outline conceptual site model as detailed in Section 3.10, given our better understanding of the site.

The identified potential contaminants and receptors have been reconsidered and are presented in Table 15 below.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk
Organic and inorganic soil and groundwater contamination and leachate associated with fill materials on or close to the site, including former pond	Off site surface water features	Surface water run-off, groundwater migration	Unlikely	Mild	Very low. The nearest surface water feature is 200m from the site (a land drain); this is not considered sensitive and there is no evidence to suggest that any contamination is present on-site. The closest river is 700m from the site.
	Perched water, Groundwater (minor aquifer)	Vertical and horizontal migration of perched water and groundwater	Unlikely	Medium	Very Low. Perched water is generally not present at the site, and very little contamination has been encountered. It is not considered that perched water or groundwater is contaminated (the low permeability superficial deposits beneath the site will reduce the likelihood of the pathway being realised).
	Site operatives	Vapour and dust inhalation, human ingestion, and dermal contact	Unlikely	Medium	Moderate. The ashy layer encountered at WS7 and evident across part of the site has elevated PAH, lead, PCP and other compounds.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk
	Future site occupants	Vapour and dust inhalation, human ingestion, and dermal contact	Likely	Medium	Moderate. Elevated PAH, lead and other organic compounds are evident in the ashy material, which is present at WS7 and across part of the site. Removal of this material will reduce the potential risk from this pathway to future residents
	Neighbouring residents	Groundwater and leachate migration in permeable soils	Unlikely	Medium	Low. The results of the laboratory analyses on soil samples have generally returned negligible to low concentrations of contaminants. Furthermore, site is underlain by impermeable superficial deposits, thereby reducing the likelihood of migration of any contaminants off-site
Hazardous ground gases	Site operatives	Ground gas migration in permeable soils	Low likelihood	Severe	Moderate. Although concentrations of hazardous ground gases are low, depleted oxygen concentrations have been recorded, representing an asphyxiation hazard unless precautions are taken
	Future site occupants	Ground gas migration in permeable soils	Unlikely	Medium	Low. Concentrations of hazardous ground gases have been recorded to be low, and are therefore not considered to pose a risk to human health
	Neighbouring residents, building infrastructure & services	Ground gas migration in permeable soils	Unlikely	Medium	Low. Concentrations of hazardous ground gases have been recorded to be low, and are therefore not considered to pose a risk to human health

Table 15: Risk Estimation for Refined Conceptual Model

The refined conceptual model identifies the following potential pollutant linkages:

- Vapour and dust inhalation, human ingestion, and dermal contact by site operatives and future site occupants; and
- Inhalation of oxygen-depleted air by site operatives.

6. GEOTECHNICAL SITE ASSESSMENT

It is proposed to construct low-rise residential properties at the site. The aim of the geotechnical investigation is to ascertain ground conditions at the site and provide sufficient data regarding the soil parameters to enable the design of foundations, floor slabs and infrastructure to be carried out. This aim was achieved by:

- Drilling of nine probeholes to a maximum depth of 4.00m bgl using a competitor (windowless sample) rig;
- Drilling of one cable percussive borehole to 10.80m bgl using a shell and auger drilling rig;
- Excavation of ten hand-dug inspection pits to a maximum depth of 0.50m bgl;
- Completion of in-situ standard penetration tests (SPT); and

- Recovery of soil samples for inspection and laboratory analyses.

6.1 METHODOLOGY

Information from the probeholes, borehole and hand-dug pits was used for the geotechnical assessment. Details of the intrusive investigation and the ground conditions encountered are provided in Sections 4.1 and 4.2. The methodology for the geotechnical intrusive investigation is presented below.

6.1.1 *In-situ Testing*

SPTs were carried out to assess the relative density of the strata. The values of penetration resistance (N values) are given in the probehole and borehole records (Appendices E and F, respectively).

6.1.2 *Laboratory Analysis*

pH and water soluble sulphate analysis was carried out on four samples of the made ground and five samples of the natural soils. An assessment of the potential for chemical attack on buried concrete based on current BRE guidance ⁽⁴⁾ was carried out.

The results of the laboratory pH and sulphate analysis are included in Appendix H.

6.1.3 *Assessment of Mining*

The mining and ground stability report, contained within the Envirocheck data (see Appendix C), indicates the property is not within an area likely to be affected by coal mining or brine subsidence. It is considered, therefore, that intrusive works to investigate mining issues are not required.

6.2 CHEMICAL ATTACK ON BURIED CONCRETE

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance ⁽⁴⁾. The desk study and site walkover indicate that, for the purposes of this assessment of the aggressive chemical environment, the site should be considered as a Brownfield site that has not been subject to previous industrial development and does not contain pyrite. A suite of chemical analyses appropriate to this site classification was carried out on soil samples, the results of which are included in Appendix H.

The maximum water-soluble sulphate content in soil of 0.09g/l has been taken as the characteristic value. As this value is below the limiting value of 3.0g/l consideration of magnesium is not required. Based on Table 2 in the BRE guidance, result one for Design Sulphate Class for the site is DS-1.

The maximum water-soluble sulphate content in groundwater of 0.081g/l has been taken as the characteristic value. As this value is below the limiting value of 3.0g/l, consideration of magnesium is not required. Result two for Design Sulphate Class for the site is therefore DS-1.

Although for the purposes of this assessment the site has been classified as Brownfield, the pH is nowhere less than the limiting value of 5.5. The third assessment of Design Sulphate Class specific to Brownfield sites is therefore not required in this case.

From consideration of results one and two, a Design Sulphate Class of DS-1 may be adopted for the site. It has been assumed that groundwater conditions are mobile. From consideration of the characteristic pH value, an Aggressive Chemical Environment for Concrete classification of AC-1 may be assumed for design purposes.

6.3 FOUNDATION DESIGN

Based on inspection of the soils encountered in the probeholes and boreholes, as well as the results of the in-situ testing and the anticipated structural loads for the proposed two-storey buildings, it is considered that the majority of the housing units may be supported on deep strip or trench fill foundations taken down through any made ground and soft soils and placed on the underlying firm or firm to stiff clay. The clay in BH1 was found to be soft to a depth of approximately 9m. Following discussions with our Structural Engineering colleagues in RSK Land & Development Engineering Limited (RSK LDE) it is therefore recommended that, in this area, a wide reinforced strip or semi rigid raft foundation solution be adopted. There is no obvious reason for the presence of lower strength soils in BH1 and it is possible that other areas of soft clays may be present, which will also require variation to traditional foundation. The natural clay soils generally had a soft upper layer but became firm or firm to stiff at depths of between 1.40m and 1.80m, which represent the minimum foundation depths. Careful inspection of all foundation excavations should be made by Taylor Wimpey Engineers and/or your consultant Structural Engineers, RSK LDE. This should ensure that foundations are constructed on clay soils with firm or firm to stiff consistency.

At one location (WS7) a layer of peat was recorded between depths of 1.00m and 1.50m underlain by soft clay to 2.10m. This location is in the vicinity of the former pond and the organic soils may relate to its presence. In this area it is understood that the made ground deposits are to be removed and it is recommended that the underlying peat and soft clays are also removed. These natural soils may be suitable to be retained on site. There are two foundation options for this area. The first would be infilling the ensuing void with well-compacted granular fill and constructing the buildings on semi-rigid raft foundations. The alternative would allow infilling with suitable site arisings without engineering control but with adoption of piled foundations.

When excavation and off-site removal of the made ground over the former pond area is completed it is important that this is inspected and supervised. This work should include excavation of the underlying peat layer and inspection should confirm the extent of this material. The potential compressibility of the peat means that it is unsuitable to remain beneath any built structure, service runs or road pavement.

Where trees are present on site or are to be planted, foundation depths should be in accordance with the guidance given in NHBC Chapter 4.2 Building near trees ⁽⁵⁾. The results of the plasticity index testing is not yet available and at this stage minimum foundation depths should be based on the Tables in NHBC Chapter 4.2 based on soils of a high volume change potential.

Ground bearing floors may only be used where made ground is less than 600mm in thickness and where the bearing capacity of the ground is suitable (no peat, organic soils or very soft clays).

Foundations may generally be designed to an allowable net bearing pressure of 100kN/m². All formations should be inspected and if any pockets of soft to firm clay are found these should be excavated and the foundation locally deepened.

6.4 ROAD CONSTRUCTION

Based upon inspection and the widespread presence of soft cohesive soils, road pavements should be designed on a California Bearing Ratio (CBR) value of less than 2%. Any loose or soft material at formation level (in particular the infilled pond material) should be removed and replaced with well-compacted granular material. All formations should be compacted to make good any disturbance caused by excavation. It is recommended that the formation not be exposed for any period of time during inclement weather. It may be beneficial to carry out in situ CBR tests to measure values at anticipated road pavement levels.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 ENVIRONMENTAL

The relevant pollutant linkages that require further action based on the available information are:

- Vapour and dust inhalation, human ingestion, and dermal contact by site operatives and future site occupants; and
- Inhalation of oxygen-depleted air by site operatives.

Elevated lead, PAH and pentachlorophenol (PCP) concentrations were recorded in the made ground in WS7. It is understood that Taylor Wimpey intends to remove and dispose of this material, in which case no pollutant linkage exists in this area.

Elevated benzo(a)pyrene and other PAH concentrations were recorded in the made ground in WS8 and WS9 and elevated PCP in WS8. The elevated PAH and other compounds appear to be associated with a layer of ashy material, possibly placed as a levelling material under the playing fields. If this ashy layer were removed from this area, the potential source to future residents via contact with garden soil would be removed. If the ashy layer were to remaining place, and given that it appears to be present at several locations, it is recommended, at this stage, that a 600mm thickness of clean cover material be placed in private garden areas.

Gas monitoring was undertaken over six monitoring visits. The data have been used to assess the gas screening values for the site using NHBC guidance. The assessment indicates that gas protection measures are not required at the site. However, the depleted oxygen concentrations pose a potential risk to construction workers from asphyxiation. It will therefore be necessary to continually monitor excavations for oxygen concentrations and a policy of no man-entry into excavations should be adopted unless suitable conditions are proven by gas monitoring.

7.2 GEOTECHNICAL

The results of the pH and sulphate analysis indicate that a Design Sulphate Class of DS-1 may be adopted for the site, and that an Aggressive Chemical Environment for Concrete classification of AC-1 may be assumed for design purposes.

For the majority of the site, it is likely that deep strip and trench fill foundations will be suitable. All foundations should be taken down through any made ground and placed on the underlying firm clay. Foundations may be designed to an allowable net bearing pressure of 100kN/m². In the vicinity of the former pond foundation options include engineered backfill with a semi-rigid raft or piles.

It is anticipated that road pavements should be designed on a CBR value of less than 2%. Any loose material at formation level should be removed and replaced with well-compacted granular material.

8. REFERENCES

1. Environment Agency. Model Procedures for the Management of Contaminated Land. Contaminated Land Report Number 11 (CLR11). September 2004.
2. Environment Agency. Guidance on Requirements for Land Contamination Reports. Version 1, July 2005.
3. Boyle, RA, and Witherington, PJ (2007, Edition 04) "Guidance On Evaluation Of Development Proposals On Sites Where Methane And Carbon Dioxide Are Present", National House Builders Council.
4. BRE Special Digest 1, Concrete in Aggressive Ground, BRE, Third Edition 17 June 2005.
5. NHBC Standards - Chapter 4.2, Building near Trees, National House Building Council, (current version effective 1 September 2006).

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CLIENT	TA		
PROJECT	CA		
TITLE	PRO		
JOB No.:			



PUBLIC OPEN SPACE
(Landscape Details to be agreed)



FIGURES

APPENDIX A

Summary of Legislation and Policy Relating to Contaminated Land

Summary of Legislation and Policy Relating to Contaminated Land

Part IIA of the Environmental Protection Act (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, are the basis for the current regulatory framework and form the statutory regime for the identification and remediation of contaminated land.

Part IIA of the EPA 1990 defines contaminated land 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 significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters, defined by the Water Resources Act, are considered all groundwater, inland waters and estuaries.

The intention of the EPA 1990 Part IIA is to deal with contaminated land issues that are considered to cause significant harm, on land that is not undergoing development, (see circular 2-2000 for definitions of what is significant harm, website link - <http://www.defra.gov.uk/environment/land/contaminated/circ2-2000/index.htm>).

The Water Framework Directive 2000/60/EC (WFD) legislation aims to deliver long-term protection of the water environment and to improve the quality of all water bodies, including rivers, wetlands, coasts, estuaries, lakes, man-made structures and groundwater.

The Water Resources Act 1991 introduces an offence to cause or knowingly permit pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so. The Groundwater Regulations, 1998, aim to complement EPA 1990. These regulations give the Environment Agency the power to *prevent* the discharge of List I substances and *restrict* the discharge of List II substances to groundwater.

Contaminated land is often dealt with through planning because of land redevelopment. This approach is documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use. The overall aim of the planning and pollution control policy is to promote the sustainable and beneficial use of land (in particular, encouraging reuse of previously developed land in preference to greenfield sites). Within this aim, polluting activities that are necessary for society and the economy should be so sited and planned, and subject to such planning conditions, that their adverse effects are minimised and contained to within acceptable limits.

APPENDIX B

Service Constraints

**RSK STATS GEOCONSULT LIMITED
SERVICE CONSTRAINTS**

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK STATS Geoconsult Limited (RSK) for Taylor Wimpey Manchester (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK Limited. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walkover survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walkover survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.
8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX C

Envirocheck Report (CD)

Envirocheck[®] Report:

Geology 1:50,000 Maps

Order Details:

Order Number:

29946638_1_1

Customer Reference:

16372

National Grid Reference:

372540, 437330

Slice:

A

Site Area (Ha):

1.25

Search Buffer (m):

1000

Site Details:

3 Pendle Drive

Whalley

CLITHEROE

Lancashire

BB7 9JT

Client Details:

MS G Harrison

RSK STATS Geoconsult Ltd

Spring Lodge

172 Chester Road

Helsby

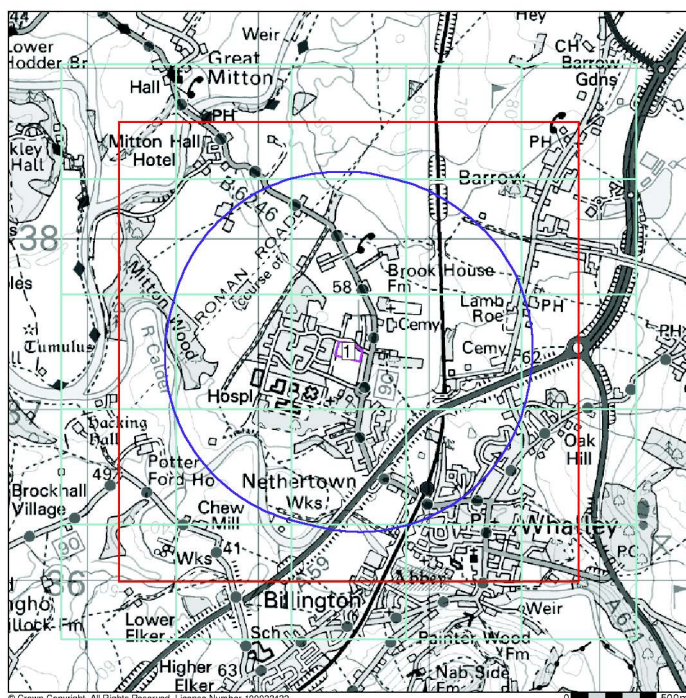
Cheshire

WA6 0AR

This report is designed for users carrying out preliminary site assessments who require geological maps for the area around a site. The report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale. This mapping may be more up to date than previously published paper maps.

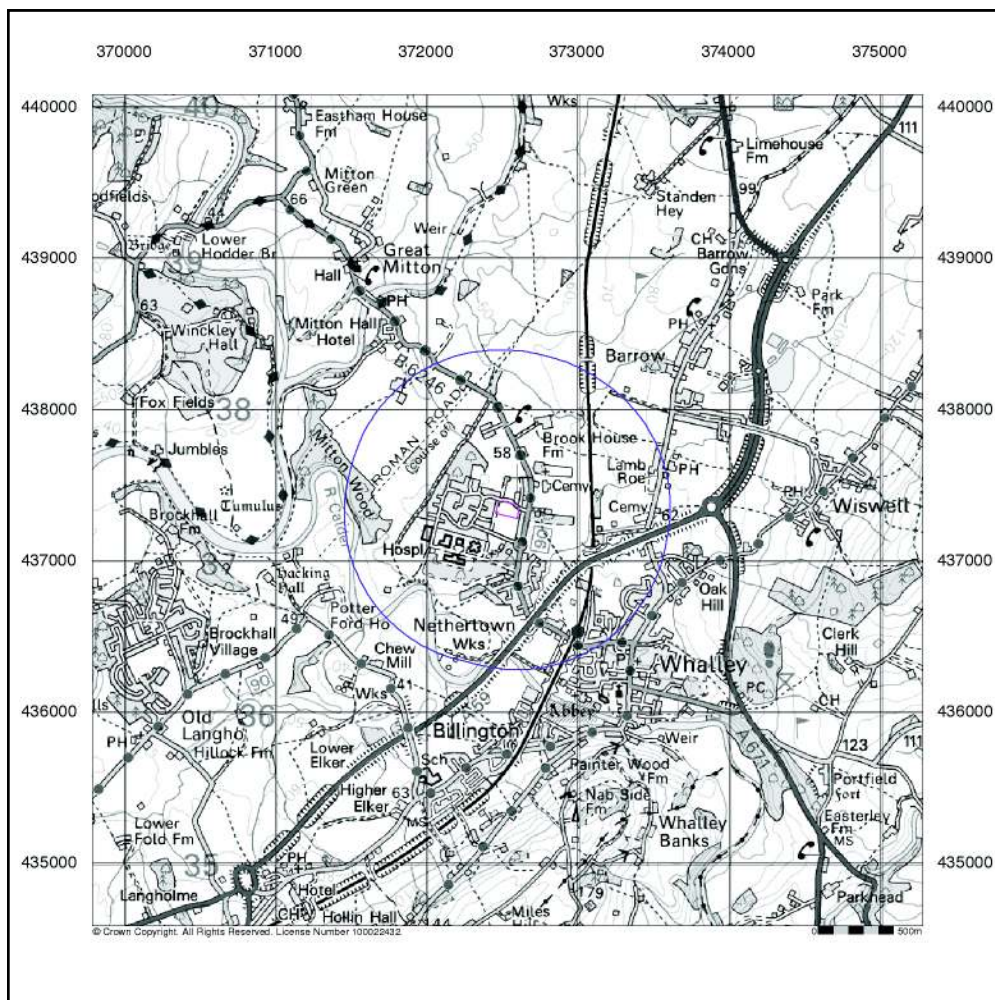
The various geological layers - artificial (man-made) and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps. The final map, that of 'Combined Surface Geology', superimposes all these distinct layers into one, producing a map that shows the rocks that occur at the surface just beneath the soil. NOTE: The legend is in chronological order in accordance with the BGS geological age index.

Not all of the layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

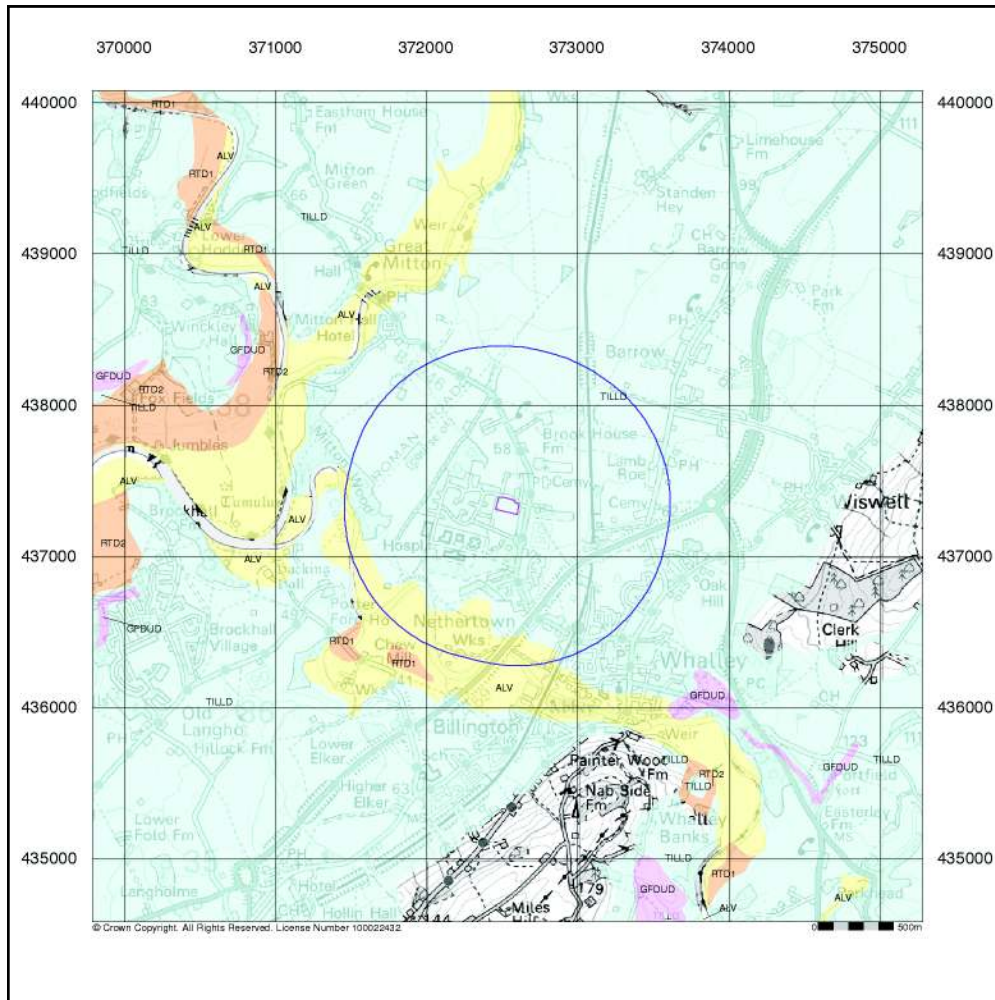


Legend	
	Map ID
	Specified Site
	Specified Buffer
	Slice
	Segment within a Slice

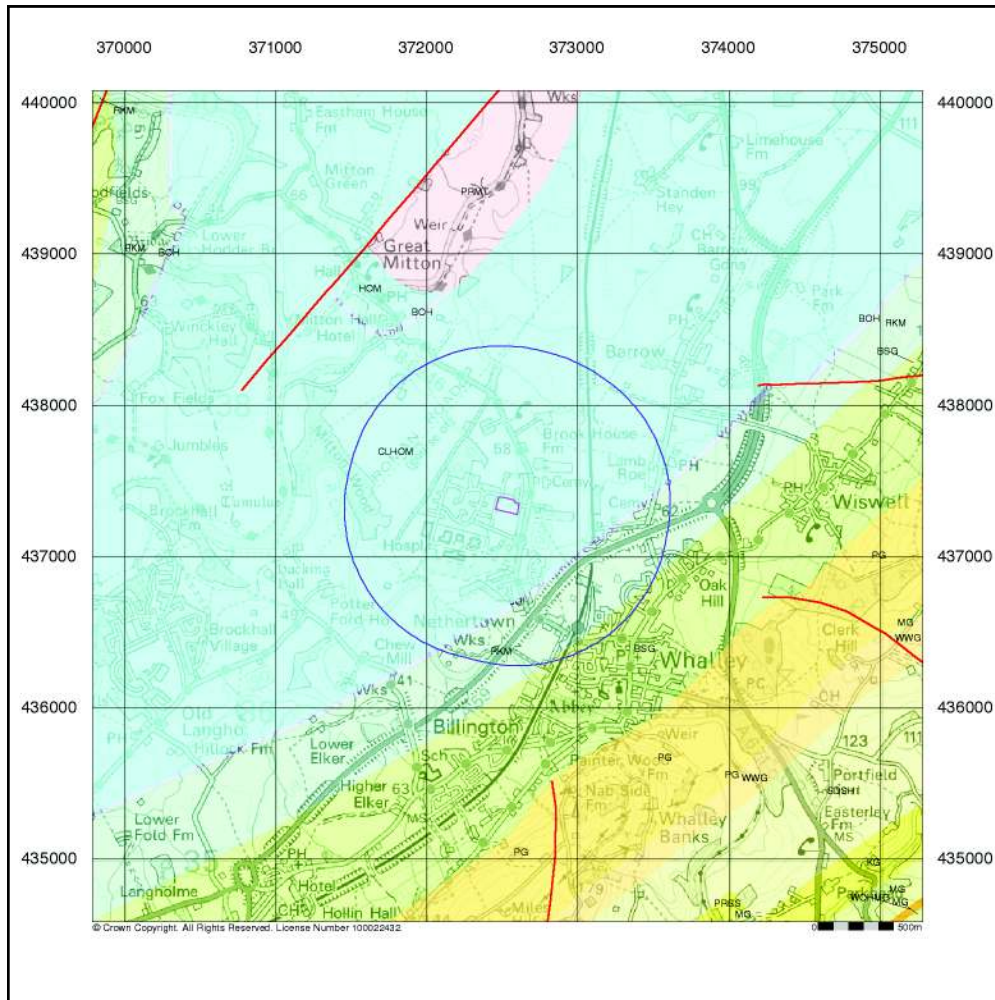
BGS 1:50,000 Geological Mapping Coverage	
Map ID:	1
Map Sheet No:	068
Map Name:	Clitheroe
Map Date:	1975
Bedrock Geology:	Available
Superficial Geology:	Available
Artificial Geology:	Not Available
Faults:	Available
Landslip:	Available
Rock Segments:	Available



Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
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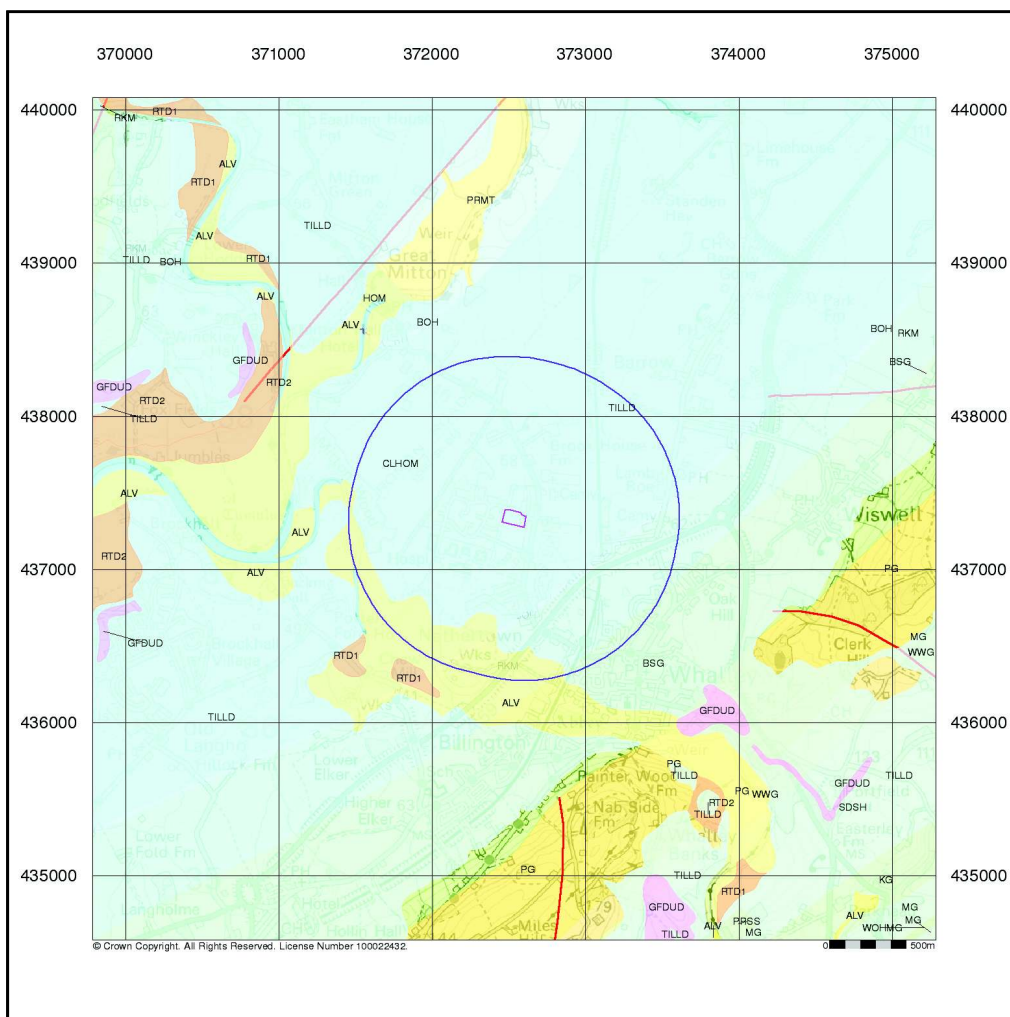


Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Flandrian - Flandrian
	GFDUD	Glaciofluvial Deposits, Devensian	Sand and Gravel	Devensian - Devensian
	TILLD	Till, Devensian	Diamicton	Devensian - Devensian
	RTD2	River Terrace Deposits, 2	Sand and Gravel	Quaternary - Quaternary
	RTD1	River Terrace Deposits, 1	Sand and Gravel	Quaternary - Quaternary



Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	PRMT	Permian Rocks and Triassic Rocks (Undifferentiated)	Sandstone and Mudstone	Triassic - Permian
	WOHMG	Woodhouse Flags and Midgley Grit (Undifferentiated)	Sandstone	Marsdenian - Marsdenian
	PRSS	Parsonage Sandstone	Sandstone	Kinderscoutian - Kinderscoutian
	KG	Kinderscout Grit	Sandstone	Kinderscoutian - Kinderscoutian
	SDSH	Sabden Shales	Mudstone and Siltstone	Kinderscoutian - Arnsbergian
	PG	Pendle Grit Member	Sandstone	Pendleian - Pendleian
	PG	Pendle Grit Member	Siltstone and Sandstone	Pendleian - Pendleian
	WWG	Warley Wise Grit	Sandstone and Siltstone, Interbedded	Pendleian - Pendleian
	MG	Millstone Grit Group [See also Migr]	Mudstone, Siltstone and Sandstone	Namurian - Namurian

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	BSG	Bowland Shale Formation	Mudstone	Yeadonian - Asbian
	RKM	Rad Brook Mudstone Member	Mudstone	Holkerian - Holkerian
	BOH	Hodderense Limestone Formation	Limestone	Holkerian - Holkerian
	CLHOM	Clitheroe Limestone Formation and Hodder Mudstone Formation (Undifferentiated)	Mudstone	Holkerian - Chadian
	HOM	Hodder Mudstone Formation	Mudstone	Holkerian - Chadian
		Faults		



Additional Information

More information on 1:50,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

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British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Envirocheck[®] Report:

Datasheet

Order Details:

Order Number:

29946638_1_1

Customer Reference:

16372

National Grid Reference:

372540, 437330

Slice:

A

Site Area (Ha):

1.25

Search Buffer (m):

1000

Site Details:

3 Pendle Drive

Whalley

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Report Section	Page Number
Summary	-
Agency & Hydrological	1
Waste	8
Hazardous Substances	-
Geological	9
Industrial Land Use	11
Sensitive Land Use	13
Data Currency	14
Data Suppliers	18
Useful Contacts	19

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination. For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.

In the attached datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

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Report Version v47.0

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 1			3	4
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control					
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls	pg 2			1	
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 2		Yes		
Pollution Incidents to Controlled Waters	pg 2			3	10
Prosecutions Relating to Authorised Processes					
Prosecutions Relating to Controlled Waters	pg 5				1
Registered Radioactive Substances					
River Quality	pg 5				1
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register	pg 5				1
Water Abstractions	pg 5				1 (*6)
Water Industry Act Referrals					
Groundwater Vulnerability	pg 6	Yes	n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
Waste					
BGS Recorded Landfill Sites					
Historical Landfill Sites	pg 8		2		1
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)					
Local Authority Recorded Landfill Sites					
Registered Landfill Sites					
Registered Waste Transfer Sites					
Registered Waste Treatment or Disposal Sites	pg 8			1	

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					
Geological					
BGS Recorded Mineral Sites	pg 9		1	1	1
BGS 1:625,000 Solid Geology	pg 9	Yes	n/a	n/a	n/a
Brine Compensation Area			n/a	n/a	n/a
Coal Mining Affected Areas			n/a	n/a	n/a
Mining Instability			n/a	n/a	n/a
Natural and Mining Cavities					
Potential for Collapsible Ground Stability Hazards				n/a	n/a
Potential for Compressible Ground Stability Hazards				n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 9	Yes		n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 9	Yes		n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 9	Yes		n/a	n/a
Radon Potential - Radon Affected Areas			n/a	n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a	n/a
Shallow Mining Hazards				n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries	pg 11		2	4	11
Fuel Station Entries	pg 12				1

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Areas of Adopted Green Belt					
Areas of Unadopted Green Belt					
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones	pg 13	1	1		
Ramsar Sites					
Sites of Special Scientific Interest					
Special Areas of Conservation					
Special Protection Areas					

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
1	Discharge Consents Operator: United Utilities Water Plc Property Type: Sewage Disposal Works - Water Company Location: Kingsmill Stw, Nr Whalley, Lancashire Authority: Environment Agency, North West Region Catchment Area: Not Given Reference: 017160329 Permit Version: 1 Effective Date: 1st January 1900 Issued Date: Not Supplied Revocation Date: 1st January 1900 Discharge Type: Trade Boiler Blowdown Effluent: Unspecified Discharge: Freshwater Stream/River Environment: Receiving Water: River Ribble Status: Authorisation revokedRevoked Positional Accuracy: Located by supplier to within 10m	A18SW (NW)	393	1	372350 437760
2	Discharge Consents Operator: United Utilities Water Plc Property Type: Sewage Disposal Works - Water Company Location: Kingsmill Stw, Nr Whalley, Lancashire Authority: Environment Agency, North West Region Catchment Area: Not Given Reference: 017180349 Permit Version: 2 Effective Date: 25th April 1990 Issued Date: Not Supplied Revocation Date: Not Supplied Discharge Type: Sewage Discharges - Final/Treated Effluent - Water Company Discharge: Freshwater Stream/River Environment: Receiving Water: Trib River Calder Status: Post National Rivers Authority Legislation where issue date > 31/08/1989 Positional Accuracy: Located by supplier to within 100m	A18SE (N)	395	1	372650 437760
2	Discharge Consents Operator: United Utilities Water Plc Property Type: Sewage Disposal Works - Water Company Location: Kingsmill Stw, Nr Whalley, Lancashire Authority: Environment Agency, North West Region Catchment Area: Not Supplied Reference: 017180349 Permit Version: 1 Effective Date: 12th September 1989 Issued Date: Not Supplied Revocation Date: 24th April 1990 Discharge Type: Sewage Discharges - Final/Treated Effluent - Water Company Discharge: Freshwater Stream/River Environment: Receiving Water: Trib River Calder Status: Authorisation revokedRevoked Positional Accuracy: Located by supplier to within 10m	A18SE (N)	395	1	372650 437760
3	Discharge Consents Operator: Derek Hamilton Clegg Property Type: Sewage Disposal Works - Other Location: Brook House Farm, Mitton Road, Whalley, Lancashire, Bb7 4jh Authority: Environment Agency, North West Region Catchment Area: Ribble Reference: 017190784 Permit Version: 1 Effective Date: 1st December 2003 Issued Date: 24th October 2003 Revocation Date: Not Supplied Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge: Freshwater Stream/River Environment: Receiving Water: Barrow Brook Status: New Consent (Water Resources Act 1991, Section 88 & Schedule 10 as amended by Environment Act 1995) Positional Accuracy: Located by supplier to within 10m	A18NE (N)	680	1	372780 438020

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
3	Discharge Consents Operator: Linda Ann Clegg Property Type: Sewage Disposal Works - Other Location: Brook House Farm, Mitton Road, Whalley, Lancashire, Bb7 4jh Authority: Environment Agency, North West Region Catchment Area: Ribble Reference: 017190784 Permit Version: 1 Effective Date: 1st December 2003 Issued Date: 24th October 2003 Revocation Date: Not Supplied Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge: Freshwater Stream/River Environment: Receiving Water: Barrow Brook Status: New Consent (Water Resources Act 1991, Section 88 & Schedule 10 as amended by Environment Act 1995) Positional Accuracy: Located by supplier to within 10m	A18NE (N)	680	1	372780 438020
4	Discharge Consents Operator: Whitbread Bowland Inns Property Type: Public Houses & Bars Location: Whitbread Bowland Inns, Nr Whalley, Lancashire Authority: Environment Agency, North West Region Catchment Area: Not Given Reference: 01719190201 Permit Version: 1 Effective Date: 8th September 1986 Issued Date: Not Supplied Revocation Date: 1st November 1994 Discharge Type: Discharge Of Other Matter-Surface Water Discharge: Freshwater Stream/River Environment: Receiving Water: Trib For Drainage Area 72 Status: Authorisation revokedRevoked Positional Accuracy: Located by supplier to within 100m	A14NE (E)	900	1	373500 437500
5	Discharge Consents Operator: United Utilities Water Plc Property Type: Sewerage Network - Sewers - Water Company Location: Whalley Relief Sewer Sso, Whalley, Lancashire Authority: Environment Agency, North West Region Catchment Area: Not Given Reference: 01rib0043 Permit Version: 1 Effective Date: 1st July 1991 Issued Date: Not Supplied Revocation Date: 1st January 1995 Discharge Type: Public Sewage: Storm Sewage Overflow Discharge: Unknown Environment: Receiving Water: Unknown Outlet; Licence Status: Revoked Status: Authorisation revokedRevoked Positional Accuracy: Located by supplier to within 100m	A3NW (S)	996	1	372350 436310
6	Local Authority Pollution Prevention and Controls Name: Calderstones Hospital Location: Mitton Road, Whalley, CLITHEROE, Lancashire, BB6 9PE Authority: Ribble Valley Borough Council, Environmental Health Department Permit Reference: Rvbc/Epa/03/92 Dated: 1st February 1993 Process Type: Local Authority Air Pollution Control Description: PG5/1Clinical waste incineration processes under 1 tonne an hour Status: Authorisation revokedRevoked Positional Accuracy: Manually positioned to the address or location	A12SE (SW)	365	2	372156 437101
	Nearest Surface Water Feature	A13SE (S)	182	-	372581 437093
7	Pollution Incidents to Controlled Waters Property Type: Farm Drainage Location: Location Description Not Available Authority: Environment Agency, North West Region Pollutant: Agricultural: General Note: Tributary River Calder Incident Date: 16th January 1991 Incident Reference: 91330003 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Unknown Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A14SW (SE)	348	1	372900 437100

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
8	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Lancashire Authority: Environment Agency, North West Region Pollutant: Unknown Note: No Pollution Found; None Pollution Found Incident Date: 25th April 1995 Incident Reference: 95330088 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Other Incident/Unknown Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A18SW (NW)	358	1	372300 437700
9	Pollution Incidents to Controlled Waters Property Type: Private Sewage (Non-PLC): Sewerage Systems Location: Location Description Not Available Authority: Environment Agency, North West Region Pollutant: Crude Sewage Note: Tributary Calder Incident Date: 15th November 1994 Incident Reference: 94330294 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Blocked Sewer Incident Severity: Category 2 - Significant Incident Positional Accuracy: Located by supplier to within 100m	A18SW (NW)	417	1	372200 437700
10	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Lancashire Authority: Environment Agency, North West Region Pollutant: Not Given Note: Tributary River Calder; No Pollution Found Incident Date: 13th July 1991 Incident Reference: 91330190 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A8SE (S)	675	1	372600 436600
11	Pollution Incidents to Controlled Waters Property Type: Hospital Location: River Calderstones Hospital Authority: Environment Agency, North West Region Pollutant: Crude Sewage Note: Not Supplied Incident Date: 24th June 1998 Incident Reference: CE980568 Catchment Area: Calder - Lancs Receiving Water: Freshwater Stream/River Cause of Incident: Blocked Sewer Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A8SW (SW)	754	1	372200 436600
12	Pollution Incidents to Controlled Waters Property Type: Mixed Agricultural Location: WHALLEY Authority: Environment Agency, North West Region Pollutant: Organic Wastes: Animal Carcasses Note: Dead Sheep In Stream Incident Date: 7th April 1998 Incident Reference: CE980409 Catchment Area: Calder - Lancs Receiving Water: Freshwater Stream/River Cause of Incident: Unknown Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A8SW (S)	781	1	372500 436500
13	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Location Description Not Available Authority: Environment Agency, North West Region Pollutant: Miscellaneous - Unknown Note: Tributary River Calder Incident Date: 7th February 1992 Incident Reference: 92330035 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Unknown Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A14SE (E)	799	1	373400 437200

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
13	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Lancashire Authority: Environment Agency, North West Region Pollutant: Not Given Note: None Pollution Found Incident Date: 25th March 1992 Incident Reference: 92330085 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A14SE (E)	800	1	373400 437195
14	Pollution Incidents to Controlled Waters Property Type: Spillage; Accident - Static Site Location: Location Description Not Available Authority: Environment Agency, North West Region Pollutant: Filter Backwash Water Note: Tributary Calder Incident Date: 14th June 1993 Incident Reference: 93330180 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Unknown Incident Severity: Category 2 - Significant Incident Positional Accuracy: Located by supplier to within 100m	A14NE (E)	826	1	373400 437600
15	Pollution Incidents to Controlled Waters Property Type: Connection To Surface Drains Location: Location Description Not Available Authority: Environment Agency, North West Region Pollutant: Other Sewage Note: Tributary River Calder; Wrong Connections Incident Date: 25th April 1995 Incident Reference: 95330097 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Wrong Connection Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A7NW (SW)	860	1	371700 436900
16	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Lancashire Authority: Environment Agency, North West Region Pollutant: Not Given Note: River Calder; None Pollution Found Incident Date: 9th August 1993 Incident Reference: 93330246 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A8SW (S)	880	1	372500 436400
17	Pollution Incidents to Controlled Waters Property Type: Pollution Found Source Not Determined Location: Location Description Not Available Authority: Environment Agency, North West Region Pollutant: Miscellaneous - Unknown Note: Tributary River Calder Incident Date: 15th July 1993 Incident Reference: 93330217 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Unknown Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A14NE (E)	921	1	373500 437595
17	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Location Description Not Available Authority: Environment Agency, North West Region Pollutant: Oils - Other Oil Note: Tributary Calder; Oil/Silt Incident Date: 12th June 1993 Incident Reference: 93330178 Catchment Area: Calder - Lancs Receiving Water: Not Given Cause of Incident: Unknown Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A14NE (E)	922	1	373500 437600

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
18	Prosecutions Relating to Controlled Waters Location: River Calder, Calderstone Park, Whalley Prosecution Text: A blocked sewer led to backed-up effluent spilling out into a nearby watercourse Prosecution Act: Wra91 S85(1) Hearing Date: 8th September 2004 Verdict: Guilty Fine: 10000 Cost: 1610 Positional Accuracy: Manually positioned within the geographical locality	A7NE (SW)	632	1	371983 436890
	River Quality Name: Calder GQA Grade: River Quality C Reach: Whalley Weir To Ribble Estimated Distance (km): 4.2 Flow Rate: Flow less than 20 cumecs Flow Type: River Year: 2000	A7NE (SW)	705	1	371949 436820
19	Substantiated Pollution Incident Register Authority: Environment Agency - North West Region, North Area Incident Date: 19th September 2003 Incident Reference: 191160 Water Impact: Category 2 - Significant Incident Air Impact: Category 4 - No Impact Land Impact: Category 4 - No Impact Positional Accuracy: Located by supplier to within 10m Pollutant: Crude Sewage	A7SE (SW)	747	1	372107 436649
20	Water Abstractions Operator: Clitheroe Golf Club Ltd Licence Number: 2671309037 Permit Version: Not Supplied Location: Clitheroe Golf Club, CLITHEROE Authority: Environment Agency, North West Region Abstraction: Not Supplied Abstraction Type: Not Supplied Source: Unknown Daily Rate (m3): 0 Yearly Rate (m3): 0 Details: Impoundment Of Unnamed Stream Authorised Start: Not Supplied Authorised End: Not Supplied Permit Start Date: Not Supplied Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A14NW (E)	606	1	373200 437500
	Water Abstractions Operator: Colin And Vivien Middleton Licence Number: 2671310010 Permit Version: 100 Location: Borehole At Clitheroe Authority: Environment Agency, North West Region Abstraction: General Agriculture; General Use (Medium Loss) Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): 18 Yearly Rate (m3): 6570 Details: Land At Little Mitton Farm, Mitton Authorised Start: 01 January Authorised End: 31 December Permit Start Date: 15th May 1998 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A17NW (NW)	1057	1	371800 438200
	Water Abstractions Operator: Clitheroe Golf Club Ltd Licence Number: 2671309036 Permit Version: Not Supplied Location: Barrow Brook, Pendleton, CLITHEROE Authority: Environment Agency, North West Region Abstraction: Industrial & Transfer Abstraction Type: Not Supplied Source: Surface Daily Rate (m3): 11 Yearly Rate (m3): 3404 Details: Additional Purpose: Transfer of water; Licence Status: Revoked Authorised Start: Not Supplied Authorised End: Not Supplied Permit Start Date: Not Supplied Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A19NE (NE)	1237	1	373400 438300

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Water Abstractions Operator: Clitheroe Golf Club Ltd Licence Number: 2671309037 Permit Version: Not Supplied Location: Clitheroe Golf Club, CLITHEROE Authority: Environment Agency, North West Region Abstraction: Not Supplied Abstraction Type: Not Supplied Source: Unknown Daily Rate (m3): 0 Yearly Rate (m3): 0 Details: Impoundment Of Unnamed Stream Authorised Start: Not Supplied Authorised End: Not Supplied Permit Start Date: Not Supplied Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A24SW (NE)	1290	1	373200 438500
	Water Abstractions Operator: Pendle View Fisheries Ltd Licence Number: 2671309044 Permit Version: 102 Location: Reservoir At Barrow , Blackburn Authority: Environment Agency, North West Region Abstraction: Aquaculture: Fish Farm/Cress Pond Throughflow Abstraction Type: Water may be abstracted from a single point Source: Surface Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Land & Premises-Whalley Trout Fisher Authorised Start: 01 January Authorised End: 31 December Permit Start Date: 26th October 2001 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	(NE)	1847	1	374300 438100
	Water Abstractions Operator: Howard Rayner & Associates Licence Number: 2671309044 Permit Version: 101 Location: Reservoir At Barrow , Blackburn Authority: Environment Agency, North West Region Abstraction: Aquaculture: Fish Farm/Cress Pond Throughflow Abstraction Type: Water may be abstracted from a single point Source: Surface Daily Rate (m3): 655 Yearly Rate (m3): 238938 Details: Land & Premises-Whalley Trout Fisher Authorised Start: 01 January Authorised End: 31 December Permit Start Date: 11th October 1999 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	(NE)	1847	1	374300 438100
	Water Abstractions Operator: Pendle View Fisheries Ltd Licence Number: 2671309052 Permit Version: 2 Location: Land At Pendle View Fisheries, Clitheroe Authority: Environment Agency, North West Region Abstraction: Other Industrial/Commercial/Public Services: General Use (Medium Loss) Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Not Supplied Authorised Start: 01 January Authorised End: 31 December Permit Start Date: 29th June 2004 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	(NE)	1891	1	374240 438310
	Groundwater Vulnerability Geological Classification: Minor Aquifer (Variably permeable) - These can be fractured or potentially fractured rocks, which do not have a high primary permeability, or other formations of variable permeability including unconsolidated deposits. Although not producing large quantities of water for abstraction, they are important for local supplies and in supplying base flow to rivers Soil Classification: Soils of Low Leaching Potential - Soils in which pollutants are unlikely to penetrate the soil layer because water movement is largely horizontal or they have large ability to attenuate diffuse pollutants. Lateral flow from these soils contribute to groundwater recharge elsewhere in the catchment Map Sheet: Sheet 10 Central Lancashire Scale: 1:100,000	A7NE (SW)	0	1	371993 436819

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Drift Deposits Drift Deposit: Low permeability drift deposits occurring at the surface and overlying Major and Minor Aquifers are head, clay-with-flints, brickearth, peat, river terrace deposits and marine and estuarine alluvium Map Sheet: Sheet 10 Central Lancashire Scale: 1:100,000	A8NW (S)	0	1	372350 436711
	Extreme Flooding from Rivers or Sea without Defences None				
	Flooding from Rivers or Sea without Defences None				
	Areas Benefiting from Flood Defences None				
	Flood Water Storage Areas None				
	Flood Defences None				

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
21	Historical Landfill Sites Licence Holder: Not Supplied Location: Off Mitton Road, Whalley Moor, Blackburn, Lancashire Name: Calderstones Hospital A Operator Location: Not Supplied Boundary Accuracy: As Supplied Provider Reference: EAHLD07479 First Input Date: Not Supplied Last Input Date: 31st December 1974 Specified Waste Type: Deposited Waste included Inert, Commercial and Household Waste EA Waste Ref: Not Supplied Regis Ref: Not Supplied WRC Ref: 2300/0173 BGS Ref: Not Supplied Other Ref: K1/01/021	A13NW (NW)	144	1	372374 437489
22	Historical Landfill Sites Licence Holder: Not Supplied Location: Off Mitton Road, Whalley Moor, Blackburn, Lancashire Name: Calderstones Hospital B Operator Location: Not Supplied Boundary Accuracy: As Supplied Provider Reference: EAHLD07517 First Input Date: 31st December 1960 Last Input Date: 31st December 1992 Specified Waste Type: Deposited Waste included Inert, Commercial and Household Waste EA Waste Ref: Not Supplied Regis Ref: Not Supplied WRC Ref: 2300/0173 BGS Ref: Not Supplied Other Ref: K1/03/021	A13NW (NW)	222	1	372320 437546
23	Historical Landfill Sites Licence Holder: Not Supplied Location: Riding Lane, Whalley, Blackburn, Lancashire Name: Whalley Sewage Works Operator Location: Not Supplied Boundary Accuracy: As Supplied Provider Reference: EAHLD07127 First Input Date: Not Supplied Last Input Date: 31st December 1973 Specified Waste Type: Deposited Waste included Commercial and Household Waste EA Waste Ref: Not Supplied Regis Ref: Not Supplied WRC Ref: 2300/0174 BGS Ref: Not Supplied Other Ref: K1/03/022	A8SW (S)	974	1	372304 436345
	Local Authority Landfill Coverage Name: Ribble Valley Borough Council - Had landfill data but passed it to the relevant environment agency		0	2	373752 435574
	Local Authority Landfill Coverage Name: Lancashire County Council - Had landfill data but passed it to the relevant environment agency		0	8	369315 431789
24	Registered Waste Treatment or Disposal Sites Licence Holder: Burnley Pendle & Rossendale H.A. Licence Reference: L 417 Site Location: Calderstones Hospital, Mitton Road, Whalley, Clitheroe, Lancashire Operator Location: As Site Address Authority: Environment Agency - North West Region, Central Area Site Category: Storage Max Input Rate: Very Small (Less than 10,000 tonnes per year) Waste Source: No known restriction on source of waste Restrictions: Licence Status: Licence has completion certificateSurrendered Dated: 1st July 1992 Preceded By: Not Given Licence: Superseded By: Not Given Licence: Positional Accuracy: Manually positioned to the address or location Boundary Quality: Not Supplied Authorised Waste: Clinical - As In Coll/Disp.Reg's Of '88 Max.Storage Of Ash Max.Storage Of Clinical Max.Waste Permitted By Licence	A13SW (W)	252	1	372226 437207

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
25	BGS Recorded Mineral Sites Site Name: Whalley Moor Brick Works Location: Whalley, Great Harwood, Lancashire Source: British Geological Survey, National Geoscience Information Service Reference: 92793 Type: Opencast Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Clitheroe Limestone Formation And Hodder Mudstone Formation (Undifferentiated) Commodity: Common Clay and Shale Positional Accuracy: Located by supplier to within 10m	A13NW (W)	77	3	372384 437338
26	BGS Recorded Mineral Sites Site Name: Whalley Moor Tile Works Location: Whalley, Great Harwood, Lancashire Source: British Geological Survey, National Geoscience Information Service Reference: 92792 Type: Opencast Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Clitheroe Limestone Formation And Hodder Mudstone Formation (Undifferentiated) Commodity: Common Clay and Shale Positional Accuracy: Located by supplier to within 10m	A17SE (NW)	452	3	372146 437696
27	BGS Recorded Mineral Sites Site Name: Whalley Brick & Tile Works Location: Whalley, Great Harwood, Lancashire Source: British Geological Survey, National Geoscience Information Service Reference: 92758 Type: Opencast Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Rad Brook Mudstone Member Commodity: Common Clay and Shale Positional Accuracy: Located by supplier to within 10m	A9NE (SE)	782	3	373235 436819
	BGS 1:625,000 Solid Geology Description: Tournaisian and Visean (Carboniferous Limestone Series)	A23SW (N)	0	3	372219 438599
	Coal Mining Affected Areas In an area which may not be affected by coal mining				
	Potential for Collapsible Ground Stability Hazards No Hazard				
	Potential for Compressible Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A8NW (S)	0	3	372375 436725
	Potential for Ground Dissolution Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NE (E)	68	3	372675 437375
	Potential for Landslide Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A8SE (S)	0	3	372600 436500
	Potential for Running Sand Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A8NW (S)	0	3	372375 436725
	Potential for Shrinking or Swelling Clay Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A7SE (SW)	0	3	371950 436350
	Radon Potential - Radon Affected Areas Affected Area: The property is not in a radon affected area, as less than 1% of homes are above the action level Source: British Geological Survey, National Geoscience Information Service	A13SE (SE)	0	3	372825 437000
	Radon Potential - Radon Protection Measures Protection Measure: No radon protective measures are necessary in the construction of new dwellings or extensions Source: British Geological Survey, National Geoscience Information Service	A13SE (SE)	0	3	372825 437000

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Shallow Mining Hazards No Hazard				

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
28	Contemporary Trade Directory Entries Name: Walmsley Location: 14, Pendle Drive, Whalley, Clitheroe, Lancashire, BB7 9JT Classification: Paper & Cardboard Products & Packaging - Manufacturers Status: Active Positional Accuracy: Automatically positioned to the address	A13NW (NW)	90	-	372403 437440
29	Contemporary Trade Directory Entries Name: Barnes & Tipping Ltd Location: Mitton Road, Whalley, Clitheroe, Lancashire, BB7 9JU Classification: Road Haulage Services Status: Active Positional Accuracy: Automatically positioned to the address	A13NE (E)	113	-	372727 437334
30	Contemporary Trade Directory Entries Name: Calderstone Nhs Trust Location: Mitton Road, Whalley, Clitheroe, Lancashire, BB7 9PE Classification: Hospitals Status: Active Positional Accuracy: Automatically positioned to the address	A13SW (SW)	306	-	372210 437127
31	Contemporary Trade Directory Entries Name: Appliance Repairs Location: 39, Beech Drive, Whalley, Clitheroe, Lancashire, BB7 9RA Classification: Washing Machines - Servicing & Repairs Status: Active Positional Accuracy: Automatically positioned to the address	A12NE (W)	347	-	372126 437420
32	Contemporary Trade Directory Entries Name: Whalley Corn Mills Ltd Location: Mitton Rd, Whalley, Clitheroe, Lancashire, BB7 9PF Classification: Pet Foods & Animal Feeds Status: Inactive Positional Accuracy: Manually positioned to the road within the address or location	A18SE (N)	405	-	372561 437790
33	Contemporary Trade Directory Entries Name: Crompton Location: 3, Kingsmill Avenue, Whalley, Clitheroe, Lancashire, BB7 9PG Classification: Fireplaces & Mantelpieces Status: Active Positional Accuracy: Automatically positioned to the address	A18SW (N)	471	-	372453 437859
34	Contemporary Trade Directory Entries Name: Hurst Green Plastics Ltd Location: Bowland House, The Sidings, Whalley, CLITHEROE, Lancashire, BB7 9SE Classification: Plastics - Vacuum Forming Status: Inactive Positional Accuracy: Automatically positioned to the address	A9NW (SE)	700	-	373074 436760
34	Contemporary Trade Directory Entries Name: Hurst Green Plastics Ltd Location: Bowland House, The Sidings, Whalley, Clitheroe, Lancashire, BB7 9SE Classification: Plastic Products - Manufacturers Status: Active Positional Accuracy: Automatically positioned to the address	A9NW (SE)	700	-	373074 436760
34	Contemporary Trade Directory Entries Name: Hurst Green Plastics Location: Bowland House, The Sidings, Whalley, Clitheroe, Lancashire, BB7 9SE Classification: Plastic Products - Manufacturers Status: Inactive Positional Accuracy: Automatically positioned to the address	A9NW (SE)	700	-	373074 436760
34	Contemporary Trade Directory Entries Name: Still Glorious Card Co Location: Marathan House, The Sidings, Whalley, Clitheroe, Lancashire, BB7 9SE Classification: Greeting Card Publishers & Wholesalers Status: Inactive Positional Accuracy: Automatically positioned to the address	A9NW (SE)	728	-	373071 436720
35	Contemporary Trade Directory Entries Name: Gilmartin Sheet Metal Ltd Location: Unit 16, The Sidings, Whalley, Clitheroe, Lancashire, BB7 9SE Classification: Sheet Metal Work Status: Active Positional Accuracy: Automatically positioned to the address	A9SW (SE)	798	-	373055 436620
35	Contemporary Trade Directory Entries Name: Sm Uk Solutions Location: Unit 12, The Sidings, Station Rd, Whalley, Clitheroe, Lancashire, BB7 9RH Classification: Staircase, Balustrade & Handrail Manufacturers Status: Active Positional Accuracy: Manually positioned to the address or location	A9SW (SE)	823	-	373054 436589

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
35	Contemporary Trade Directory Entries Name: Coco Moyo Location: Unit 12, The Sidings, Whalley, Clitheroe, Lancashire, BB7 9SE Classification: Confectionery Manufacturers Status: Active Positional Accuracy: Automatically positioned to the address	A9SW (SE)	823	-	373054 436589
35	Contemporary Trade Directory Entries Name: Station Press Location: Unit 14, The Sidings, Whalley, Clitheroe, Lancashire, BB7 9SE Classification: Printers Status: Inactive Positional Accuracy: Automatically positioned to the address	A9SW (SE)	834	-	373067 436585
35	Contemporary Trade Directory Entries Name: Mantle Packaging Machinery Ltd Location: Unit 5, The Sidings, Whalley, Clitheroe, Lancashire, BB7 9SE Classification: Packaging & Wrapping Equipment & Supplies Status: Active Positional Accuracy: Automatically positioned to the address	A9SW (SE)	857	-	373059 436551
36	Contemporary Trade Directory Entries Name: B & H Transport Location: Clitheroe Rd, Barrow, Clitheroe, Lancashire, BB7 9AQ Classification: Road Haulage Services Status: Active Positional Accuracy: Manually positioned to the road within the address or location	A14SE (E)	868	-	373481 437308
37	Contemporary Trade Directory Entries Name: Farnsworth'S Location: Cumberland House, The Sidings, Whalley, Clitheroe, Lancashire, BB7 9SE Classification: Sausage Manufacturers Status: Active Positional Accuracy: Automatically positioned to the address	A9SW (SE)	873	-	373052 436528
38	Fuel Station Entries Name: Pendle Garage Location: Clitheroe Road, Barrow, CLITHEROE, Lancashire, BB7 9AQ Brand: UNBRANDED Premises Type: Petrol Station Status: Open Positional Accuracy: Automatically positioned to the address	A15NW (E)	973	-	373559 437575

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
39	Nitrate Vulnerable Zones Name: Not Supplied Description: Surface Water - Designated 2002 Source: Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	A13NE (E)	0	7	372600 437350
40	Nitrate Vulnerable Zones Name: Not Supplied Description: Surface Water - Designated 2006 Source: Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	A13NE (E)	2	7	372600 437350

Agency & Hydrological	Version	Update Cycle
Contaminated Land Register Entries and Notices Pendle Borough Council - Environmental Health Department Hyndburn Borough Council - Environmental Health Department Ribble Valley Borough Council - Environmental Health Department	December 2009 September 2009 September 2009	Annual Rolling Update Annual Rolling Update Annual Rolling Update
Discharge Consents Environment Agency - North West Region	October 2009	Quarterly
Enforcement and Prohibition Notices Environment Agency - North West Region	January 2010	As notified
Integrated Pollution Controls Environment Agency - North West Region	October 2008	Not Applicable
Integrated Pollution Prevention And Control Environment Agency - North West Region	October 2009	Quarterly
Local Authority Integrated Pollution Prevention And Control Pendle Borough Council - Environmental Health Department Hyndburn Borough Council - Environmental Health Department Ribble Valley Borough Council - Environmental Health Department	August 2009 February 2009 October 2009	Annual Rolling Update Annual Rolling Update Annual Rolling Update
Local Authority Pollution Prevention and Controls Pendle Borough Council - Environmental Health Department Hyndburn Borough Council - Environmental Health Department Ribble Valley Borough Council - Environmental Health Department	August 2009 February 2009 October 2009	Annual Rolling Update Annual Rolling Update Annual Rolling Update
Local Authority Pollution Prevention and Control Enforcements Pendle Borough Council - Environmental Health Department Hyndburn Borough Council - Environmental Health Department Ribble Valley Borough Council - Environmental Health Department	August 2009 February 2009 October 2009	Annual Rolling Update Annual Rolling Update Annual Rolling Update
Nearest Surface Water Feature Ordnance Survey	November 2009	Quarterly
Pollution Incidents to Controlled Waters Environment Agency - North West Region	January 2000	Not Applicable
Prosecutions Relating to Authorised Processes Environment Agency - North West Region	January 2010	As notified
Prosecutions Relating to Controlled Waters Environment Agency - North West Region	January 2010	As notified
Registered Radioactive Substances Environment Agency - North West Region	October 2009	Quarterly
River Quality Environment Agency - Head Office	November 2001	Not Applicable
River Quality Biology Sampling Points Environment Agency - Head Office	January 2009	Annually
River Quality Chemistry Sampling Points Environment Agency - Head Office	January 2009	Annually
Substantiated Pollution Incident Register Environment Agency - North West Region - Central Area Environment Agency - North West Region - North Area	October 2009 October 2009	Quarterly Quarterly
Water Abstractions Environment Agency - North West Region	October 2009	Quarterly
Water Industry Act Referrals Environment Agency - North West Region	October 2009	Quarterly
Groundwater Vulnerability Environment Agency - Head Office	January 1999	Not Applicable
Drift Deposits Environment Agency - Head Office	January 1999	Not Applicable

Agency & Hydrological	Version	Update Cycle
Source Protection Zones Environment Agency - Head Office	October 2009	Variable
Extreme Flooding from Rivers or Sea without Defences Environment Agency - Head Office	December 2009	Quarterly
Flooding from Rivers or Sea without Defences Environment Agency - Head Office	December 2009	Quarterly
Areas Benefiting from Flood Defences Environment Agency - Head Office	December 2009	Quarterly
Flood Water Storage Areas Environment Agency - Head Office	December 2009	Quarterly
Flood Defences Environment Agency - Head Office	December 2009	Quarterly
Waste	Version	Update Cycle
BGS Recorded Landfill Sites British Geological Survey - National Geoscience Information Service	June 1996	Not Applicable
Historical Landfill Sites Environment Agency - North West Region - Central Area Environment Agency - North West Region - North Area	October 2009 October 2009	Quarterly Quarterly
Integrated Pollution Control Registered Waste Sites Environment Agency - North West Region	October 2008	Not Applicable
Licensed Waste Management Facilities (Landfill Boundaries) Environment Agency - North West Region - Central Area Environment Agency - North West Region - North Area	October 2009 October 2009	Quarterly Quarterly
Licensed Waste Management Facilities (Locations) Environment Agency - North West Region - Central Area Environment Agency - North West Region - North Area	October 2009 October 2009	Quarterly Quarterly
Local Authority Landfill Coverage Hyndburn Borough Council - Environmental Health Department Lancashire County Council - Waste Management Group Pendle Borough Council - Environmental Health Department Ribble Valley Borough Council - Environmental Health Department	May 2000 May 2000 May 2000 May 2000	Not Applicable Not Applicable Not Applicable Not Applicable
Local Authority Recorded Landfill Sites Pendle Borough Council - Environmental Health Department Hyndburn Borough Council - Environmental Health Department Lancashire County Council - Waste Management Group Ribble Valley Borough Council - Environmental Health Department	April 2003 May 2000 May 2000 May 2000	Not Applicable Not Applicable Not Applicable Not Applicable
Registered Landfill Sites Environment Agency - North West Region - Central Area Environment Agency - North West Region - North Area	March 2003 March 2003	Not Applicable Not Applicable
Registered Waste Transfer Sites Environment Agency - North West Region - Central Area Environment Agency - North West Region - North Area	March 2003 March 2003	Not Applicable Not Applicable
Registered Waste Treatment or Disposal Sites Environment Agency - North West Region - Central Area Environment Agency - North West Region - North Area	March 2003 March 2003	Not Applicable Not Applicable

Hazardous Substances	Version	Update Cycle
Control of Major Accident Hazards Sites (COMAH) Health and Safety Executive	October 2009	Bi-Annually
Explosive Sites Health and Safety Executive	January 2009	Bi-Annually
Notification of Installations Handling Hazardous Substances (NIHHS) Health and Safety Executive	November 2000	Not Applicable
Planning Hazardous Substance Enforcements Hyndburn Borough Council - Planning Ribble Valley Borough Council Pendle Borough Council - Planning Lancashire County Council	April 2009 July 2009 March 2009 September 2009	Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update
Planning Hazardous Substance Consents Hyndburn Borough Council - Planning Ribble Valley Borough Council Pendle Borough Council - Planning Lancashire County Council	April 2009 July 2009 March 2009 September 2009	Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update
Geological	Version	Update Cycle
BGS Recorded Mineral Sites British Geological Survey - National Geoscience Information Service	October 2009	Bi-Annually
BGS 1:625,000 Solid Geology British Geological Survey - National Geoscience Information Service	August 1996	Not Applicable
Brine Compensation Area Cheshire Brine Subsidence Compensation Board	November 2002	As notified
Coal Mining Affected Areas The Coal Authority - Mining Report Service	January 2006	As notified
Mining Instability Ove Arup & Partners	October 2000	Not Applicable
Natural and Mining Cavities Peter Brett Associates	November 2009	Variable
Potential for Collapsible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Compressible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Ground Dissolution Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Landslide Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Running Sand Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Shrinking or Swelling Clay Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Radon Potential - Radon Affected Areas British Geological Survey - National Geoscience Information Service	May 2007	As notified
Radon Potential - Radon Protection Measures British Geological Survey - National Geoscience Information Service	May 2007	As notified
Shallow Mining Hazards British Geological Survey - National Geoscience Information Service	August 2002	Not Applicable

Industrial Land Use	Version	Update Cycle
Contemporary Trade Directory Entries Thomson Directories	November 2009	Quarterly
Fuel Station Entries Catalist Ltd - (Fuel Station Data)	October 2009	Quarterly
Sensitive Land Use	Version	Update Cycle
Areas of Adopted Green Belt Hyndburn Borough Council Pendle Borough Council Ribble Valley Borough Council	December 2009 December 2009 December 2009	As notified As notified As notified
Areas of Unadopted Green Belt Hyndburn Borough Council Pendle Borough Council Ribble Valley Borough Council	December 2009 December 2009 December 2009	As notified As notified As notified
Areas of Outstanding Natural Beauty Natural England	December 2009	Bi-Annually
Environmentally Sensitive Areas Natural England	December 2009	Annually
Forest Parks Forestry Commission	April 1997	Not Applicable
Local Nature Reserves Natural England	December 2009	Bi-Annually
Marine Nature Reserves Natural England	September 2009	Bi-Annually
National Nature Reserves Natural England	December 2009	Bi-Annually
National Parks Natural England	December 2009	Bi-Annually
Nitrate Sensitive Areas Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	December 2009	Not Applicable
Nitrate Vulnerable Zones Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	February 2009	Annually
Ramsar Sites Natural England	December 2009	Bi-Annually
Sites of Special Scientific Interest Natural England	December 2009	Bi-Annually
Special Areas of Conservation Natural England	December 2009	Bi-Annually
Special Protection Areas Natural England	December 2009	Bi-Annually

A selection of organisations who provide data within this report

Data Supplier	Data Supplier Logo
Ordnance Survey	
Environment Agency	
Scottish Environment Protection Agency	
The Coal Authority	
British Geological Survey	
Centre for Ecology and Hydrology	
Countryside Council for Wales	
Scottish Natural Heritage	
Natural England	
Health Protection Agency	
Ove Arup	
Peter Brett Associates	

Contact	Name and Address	Contact Details
1	Environment Agency - National Customer Contact Centre (NCCC) PO Box 544, Templeborough, Rotherham, S60 1BY	Telephone: 08708 506 506 Email: enquiries@environment-agency.gov.uk
2	Ribble Valley Borough Council - Environmental Health Department Council Offices, Church Walk, Clitheroe, Lancashire, BB7 2RA	Telephone: 01200 425111 Fax: 01200 26339 Website: www.ribblevalley.gov.uk
3	British Geological Survey - Enquiry Service British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, Nottinghamshire, NG12 5GG	Telephone: 0115 936 3143 Fax: 0115 936 3276 Email: enquiries@bgs.ac.uk Website: www.bgs.ac.uk
4	Ribble Valley Borough Council Council Offices, Church Walk, Clitheroe, Lancashire, BB7 2RA	Telephone: 01200 425111 Fax: 01200 414488 Website: www.ribblevalley.gov.uk
5	Hyndburn Borough Council Development Services, Eagle Street, Accrington, Lancashire, BB5 1LN	Telephone: 01254 388111 Fax: 01254 391625 Website: www.hyndburnbc.gov.uk
6	Natural England Northminster House, Northminster Road, Peterborough, Cambridgeshire, PE1 1UA	Telephone: 0845 600 3078 Fax: 01733 455103 Email: enquiries@naturalengland.org.uk Website: www.naturalengland.org.uk
7	Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA) Government Buildings, Otley Road, Lawnswood, Leeds, West Yorkshire, LS16 5QT	Telephone: 0113 2613333 Fax: 0113 230 0879
8	Lancashire County Council - Waste Management Group Environment Directorate, Guild House, Cross Street, Preston, Lancashire, PR1 8RD	Website: www.lancashire.gov.uk
-	Health Protection Agency - Radon Survey, Centre for Radiation, Chemical and Environmental Hazards Chilton, Didcot, Oxfordshire, OX11 0RQ	Telephone: 01235 822622 Fax: 01235 833891 Email: radon@hpa.org.uk Website: www.hpa.org.uk
-	Landmark Information Group Limited The Smith Centre, Henley On Thames, Oxfordshire, RG9 6AB	Telephone: 0844 844 9952 Fax: 0844 844 9951 Email: customerservices@landmarkinfo.co.uk Website: www.landmarkinfo.co.uk

Please note that the Environment Agency / SEPA have a charging policy in place for enquiries.

Envirocheck[®] Report:

Mining and Ground Stability Datasheet

Order Details:

Order Number:

29946638_1_1

Customer Reference:

16372

National Grid Reference:

372540, 437330

Slice:

A

Site Area (Ha):

1.25

Search Buffer (m):

1000

Site Details:

3 Pendle Drive

Whalley

CLITHEROE

Lancashire

BB7 9JT

Client Details:

MS G Harrison

RSK STATS Geoconsult Ltd

Spring Lodge

172 Chester Road

Helsby

Cheshire

WA6 0AR

Report Section and Details	Page Number
Summary	-
The Summary section provides an overview of the data contained within the report, detailing the number of data set features or the existence of a data set in relation to the buffer selected. For ease of reference, the report is broken down into 4 sections of data; Mining and Natural Cavities Data, Historical Land Use Information (1:2,500), Historical Land Use Information (1:10,000) and Ground Stability Data (1:50,000).	
Mining and Natural Cavities Data	1
The Mining and Natural Cavities Data section features data sets related to the existence of mining areas and their potential hazards; and details of naturally formed cavities. Data sets within this section are not plotted, with the exception of BGS Recorded Mineral Sites and Potential Mining Areas which feature on the Historical Land Use Information (1:10,000) map.	
Historical Land Use Information (1:2,500)	-
The Historical Land Use Information (1:2,500) section contains data captured from analysis carried out by Landmark of 1:1,250 and 1:2,500 scale historical Ordnance Survey mapping, identifying areas where, historically, the land uses were potentially contaminative. For the purpose of this Envirocheck module, only historical data relating to mining and ground stability has been included and plotted on the corresponding Historical Land Use Information (1:2,500) map. This section also includes the Subterranean Features data set, which details various man-made and man-used underground spaces obtained from the Subterranea Britannica society.	
Historical Land Use Information (1:10,000)	2
The Historical Land Use (1:10,000) section covers data captured from the systematic analysis carried out by Landmark of 1:10, 560 and 1:10,000 scale historical Ordnance Survey mapping dating back to the mid-19th century, identifying potentially contaminative past industrial land uses. For the purpose of this Envirocheck module, only data relating to mining and ground stability has been included and plotted on the accompanying Historical Land Use Information (1:10,000) map.	
Ground Stability Data (1:50,000)	4
The Ground Stability (1:50,000) section includes the BGS Geosure data suite, reporting features to 250m and plotted onto 3 separate maps. Also reported is brine subsidence, brine mining and salt mining data sets, of which Brine Pumping and Salt Mining Related Features are plotted, and subsidence insurance claims and insurance investigations data, which is not plotted.	
Motion Map Data (1:2,500)	5
The Motion Map Data (1:2,500) section contains data which is plotted to indicate long-term stability trends from analysis of satellite radar data.	
Historical Map List	8
The Historical Map List section details the historical mapping that has been analysed for your site, in relation to the Historical Land Use Information sections.	
Data Currency	9
Data Suppliers	10
Useful Contacts	11

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The brine subsidence data relating to the Driotwich area as provided in this report is derived from JPB studies and physical monitoring undertaken annually over more than 35 years. For more detailed interpretation contact enquiries@jpb.co.uk. JPB retain the copyright and intellectual rights to this data and accept no liability for any loss or damage, including in direct or consequential loss, arising from the use of this data.

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m
Mining and Natural Cavities Data					
BGS Recorded Mineral Sites	pg 1		1	1	1
Coal Mining Affected Areas			n/a	n/a	n/a
Man Made Mining Cavities					
Mining Instability			n/a	n/a	n/a
Natural Cavities					
Shallow Mining Hazards				n/a	n/a
Potential Mining Areas					
Historical Land Use Information (1:2,500)					
Extractive Industries or Potential Excavations from 1855-1909 (100m)				n/a	n/a
Extractive Industries or Potential Excavations from 1893-1915 (100m)				n/a	n/a
Extractive Industries or Potential Excavations from 1906-1937 (100m)				n/a	n/a
Extractive Industries or Potential Excavations from 1924-1949 (100m)				n/a	n/a
Extractive Industries or Potential Excavations from 1950-1980 (100m)				n/a	n/a
Subterranean Features (100m)				n/a	n/a
Historical Land Use Information (1:10,000)					
Air Shafts					
Disturbed Ground					
General Quarrying					
Heap, unknown constituents					
Mineral Railway	pg 2		2		
Mining & quarrying general					
Mining of coal & lignite					
Quarrying of sand & clay, operation of sand & gravel pits	pg 2	1			
Former Marshes					
Potentially Infilled Land (Non-Water)	pg 2	1	1	1	1
Potentially Infilled Land (Water)	pg 2		2	6	7

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m
Ground Stability Data (1:50,000)					
Brine Compensation Area			n/a	n/a	n/a
Brine Pumping Related Features					
Brine Subsidence Solution Area					
Potential for Collapsible Ground Stability Hazards				n/a	n/a
Potential for Compressible Ground Stability Hazards	pg 4	Yes		n/a	n/a
Potential for Ground Dissolution Stability Hazards	pg 4		Yes	n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 4	Yes		n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 4	Yes		n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 4	Yes		n/a	n/a
Salt Mining Related Features					
Subsidence Insurance Claims				n/a	n/a
Subsidence Investigations				n/a	n/a
Motion Map Data (1:2,500)					
Motion Map (100m)	pg 5		56	n/a	n/a

Report Version v47.0

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
1	BGS Recorded Mineral Sites Site Name: Whalley Moor Brick Works Location: Whalley, Great Harwood, Lancashire Source: British Geological Survey, National Geoscience Information Service Reference: 92793 Type: Opencast Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Clitheroe Limestone Formation And Hodder Mudstone Formation (Undifferentiated) Commodity: Common Clay and Shale Positional Accuracy: Located by supplier to within 10m	A13NW (W)	77	1	372384 437338
2	BGS Recorded Mineral Sites Site Name: Whalley Moor Tile Works Location: Whalley, Great Harwood, Lancashire Source: British Geological Survey, National Geoscience Information Service Reference: 92792 Type: Opencast Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Clitheroe Limestone Formation And Hodder Mudstone Formation (Undifferentiated) Commodity: Common Clay and Shale Positional Accuracy: Located by supplier to within 10m	A17SE (NW)	452	1	372146 437696
3	BGS Recorded Mineral Sites Site Name: Whalley Brick & Tile Works Location: Whalley, Great Harwood, Lancashire Source: British Geological Survey, National Geoscience Information Service Reference: 92758 Type: Opencast Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Rad Brook Mudstone Member Commodity: Common Clay and Shale Positional Accuracy: Located by supplier to within 10m	A9NE (SE)	782	1	373235 436819
	Coal Mining Affected Areas In an area which may not be affected by coal mining				
	Shallow Mining Hazards No Hazard				

Historical Land Use Information (1:10,000)

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
4	Mineral Railway Use: Not Supplied Date of Mapping: 1914	A13NW (NW)	78	-	372396 437390
5	Mineral Railway Use: Not Supplied Date of Mapping: 1914	A13NW (NW)	160	-	372324 437434
6	Quarrying of sand & clay, operation of sand & gravel pits Use: Not Supplied Date of Mapping: 1914	A13NW (W)	0	-	372492 437335
7	Potentially Infilled Land (Non-Water) Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1975	A13NW (W)	0	-	372492 437335
8	Potentially Infilled Land (Non-Water) Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1975	A13NW (NW)	102	-	372454 437488
9	Potentially Infilled Land (Non-Water) Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1975	A12NE (NW)	420	-	372122 437613
10	Potentially Infilled Land (Non-Water) Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1975	A9NW (SE)	698	-	373135 436828
11	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1914	A13NE (NE)	54	-	372649 437387
12	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1914	A13SW (SW)	208	-	372428 437103
13	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1895	A13SE (SE)	253	-	372701 437043
14	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1914	A13SW (SW)	289	-	372198 437179
15	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1914	A13SW (S)	290	-	372408 437023
16	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1914	A13NE (NE)	352	-	372819 437631
17	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1895	A12SE (W)	430	-	372028 437266
18	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1895	A7NE (SW)	494	-	372082 436986
19	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1955	A8NE (S)	557	-	372692 436725
20	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1955	A18SE (N)	580	-	372741 437928
21	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1955	A14SE (E)	691	-	373270 437111
22	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1955	A9SW (SE)	792	-	372935 436558
23	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1955	A9SW (SE)	876	-	373080 436543
24	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1955	A14SE (E)	887	-	373459 437058

Historical Land Use Information (1:10,000)

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
25	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1955	A14SE (E)	934	-	373540 437226

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Brine Compensation Area The site does not fall within the brine compensation area.				
	Brine Subsidence Solution Area The site does not fall within the brine subsidence solution area.				
	Potential for Collapsible Ground Stability Hazards No Hazard				
	Potential for Compressible Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A8NW (S)	0	1	372375 436725
	Potential for Ground Dissolution Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NE (E)	68	1	372675 437375
26	Potential for Landslide Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A8SE (S)	0	1	372600 436500
27	Potential for Running Sand Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A8NW (S)	0	1	372375 436725
28	Potential for Shrinking or Swelling Clay Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A7SE (SW)	0	1	371950 436350

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
29	Motion Map Average Velocity -0.7 Gradient (mmyear):	A13NE (NE)	21	-	372605 437370
29	Motion Map Average Velocity -0.8 Gradient (mmyear):	A13NE (NE)	22	-	372608 437369
29	Motion Map Average Velocity -0.3 Gradient (mmyear):	A13NE (NE)	25	-	372608 437373
29	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13NE (NE)	25	-	372605 437374
30	Motion Map Average Velocity -0.1 Gradient (mmyear):	A13SE (E)	30	-	372640 437324
30	Motion Map Average Velocity -0.2 Gradient (mmyear):	A13SE (E)	32	-	372643 437328
31	Motion Map Average Velocity 0.5 Gradient (mmyear):	A13SE (SE)	31	-	372630 437270
31	Motion Map Average Velocity -0.4 Gradient (mmyear):	A13SE (SE)	34	-	372630 437262
31	Motion Map Average Velocity -0.1 Gradient (mmyear):	A13SE (SE)	34	-	372632 437269
32	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13SE (E)	31	-	372636 437297
32	Motion Map Average Velocity -0.1 Gradient (mmyear):	A13SE (E)	31	-	372634 437293
32	Motion Map Average Velocity -0.3 Gradient (mmyear):	A13SE (SE)	31	-	372633 437289
33	Motion Map Average Velocity -0.4 Gradient (mmyear):	A13SE (SE)	34	-	372629 437258
33	Motion Map Average Velocity -0.2 Gradient (mmyear):	A13SE (SE)	36	-	372630 437258
34	Motion Map Average Velocity -0.4 Gradient (mmyear):	A13SE (SE)	45	-	372621 437235
34	Motion Map Average Velocity -0.2 Gradient (mmyear):	A13SE (SE)	48	-	372620 437231
34	Motion Map Average Velocity -0.2 Gradient (mmyear):	A13SE (SE)	50	-	372623 437231
34	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13SE (SE)	52	-	372621 437227
35	Motion Map Average Velocity -0.2 Gradient (mmyear):	A13NW (NW)	61	-	372428 437425
35	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13NW (NW)	63	-	372428 437429

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
36	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13SE (SE)	65	-	372616 437212
37	Motion Map Average Velocity -0.9 Gradient (mmyear):	A13NW (W)	70	-	372390 437336
37	Motion Map Average Velocity 0.5 Gradient (mmyear):	A13NW (W)	72	-	372389 437336
37	Motion Map Average Velocity -0.1 Gradient (mmyear):	A13NW (W)	73	-	372387 437332
37	Motion Map Average Velocity 0.1 Gradient (mmyear):	A13SW (W)	75	-	372384 437329
38	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13NW (NW)	72	-	372402 437386
38	Motion Map Average Velocity -0.2 Gradient (mmyear):	A13NW (W)	72	-	372399 437379
38	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13NW (W)	73	-	372400 437383
38	Motion Map Average Velocity 0.7 Gradient (mmyear):	A13NW (NW)	74	-	372402 437394
38	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13NW (W)	74	-	372399 437383
39	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13NW (NW)	84	-	372394 437404
39	Motion Map Average Velocity 0.1 Gradient (mmyear):	A13NW (NW)	87	-	372391 437405
39	Motion Map Average Velocity 0.1 Gradient (mmyear):	A13NW (NW)	88	-	372389 437401
39	Motion Map Average Velocity 0.2 Gradient (mmyear):	A13NW (NW)	89	-	372387 437398
39	Motion Map Average Velocity -0.6 Gradient (mmyear):	A13NW (NW)	89	-	372389 437405
40	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13NW (W)	87	-	372378 437351
41	Motion Map Average Velocity -0.2 Gradient (mmyear):	A13NW (NW)	92	-	372406 437447
41	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13NW (NW)	96	-	372404 437451
42	Motion Map Average Velocity 1.0 Gradient (mmyear):	A13NE (NE)	92	-	372636 437440
42	Motion Map Average Velocity 1.0 Gradient (mmyear):	A13NE (NE)	95	-	372636 437444

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
43	Motion Map Average Velocity 0.5 Gradient (mmyear):	A13SW (W)	94	-	372362 437314
43	Motion Map Average Velocity 0.5 Gradient (mmyear):	A13SW (W)	95	-	372362 437310
43	Motion Map Average Velocity 0.3 Gradient (mmyear):	A13SW (W)	96	-	372360 437306
43	Motion Map Average Velocity 0.6 Gradient (mmyear):	A13SW (W)	97	-	372359 437315
43	Motion Map Average Velocity 0.2 Gradient (mmyear):	A13SW (W)	98	-	372358 437311
43	Motion Map Average Velocity -0.1 Gradient (mmyear):	A13SW (W)	98	-	372358 437307
43	Motion Map Average Velocity 0.4 Gradient (mmyear):	A13SW (W)	98	-	372358 437307
44	Motion Map Average Velocity 0.1 Gradient (mmyear):	A13SW (W)	96	-	372361 437302
44	Motion Map Average Velocity -0.2 Gradient (mmyear):	A13SW (W)	98	-	372359 437303
44	Motion Map Average Velocity -0.1 Gradient (mmyear):	A13SW (W)	99	-	372358 437299
45	Motion Map Average Velocity 0.0 Gradient (mmyear):	A13NW (NW)	96	-	372383 437411
45	Motion Map Average Velocity 0.1 Gradient (mmyear):	A13NW (NW)	99	-	372381 437415
45	Motion Map Average Velocity 0.3 Gradient (mmyear):	A13NW (NW)	100	-	372382 437419
46	Motion Map Average Velocity 0.1 Gradient (mmyear):	A13SW (W)	98	-	372362 437281
46	Motion Map Average Velocity 0.3 Gradient (mmyear):	A13SW (W)	99	-	372360 437286
47	Motion Map Average Velocity 0.1 Gradient (mmyear):	A13NW (W)	98	-	372365 437350

The following mapping has been analysed for Historical Land Use Information (1:2,500):

1:2,500	Mapsheet	Published Date
Lancashire And Furness	055_10	1912
Lancashire And Furness	055_10	1932
Ordnance Survey Plan	SD7236	1968
Ordnance Survey Plan	SD7237	1968

The following mapping has been analysed for Historical Land Use Information (1:10,000):

1:10,560	Mapsheet	Published Date
Lancashire And Furness	055_00	1848
Yorkshire	198_00	1848
Lancashire And Furness	055_NW	1895
Lancashire And Furness	055_SW	1895
Yorkshire	198_00	1896
Yorkshire	198_NW	1911
Lancashire And Furness	055_SW	1913
Lancashire And Furness	055_NW	1914
Lancashire And Furness	055_NW	1932
Lancashire And Furness	055_SW	1932
Ordnance Survey Plan	SD73NW	1955
1:10,000	Mapsheet	Published Date
Ordnance Survey Plan	SD73NW	1975

Mining and Cavities Data	Version	Update Cycle
BGS Recorded Mineral Sites British Geological Survey - National Geoscience Information Service	October 2009	Bi-Annually
Coal Mining Affected Areas The Coal Authority - Mining Report Service	January 2006	As notified
Man Made Mining Cavities Peter Brett Associates	November 2009	Variable
Mining Instability Ove Arup & Partners	October 2000	Not Applicable
Natural Cavities Peter Brett Associates	November 2009	Variable
Shallow Mining Hazards British Geological Survey - National Geoscience Information Service	August 2002	Not Applicable
Historical Land Use Information (1:2,500)	Version	Update Cycle
Subterranean Features Landmark Information Group Limited	November 2009	Bi-Annually
Ground Stability Data (1:50,000)	Version	Update Cycle
Brine Compensation Area Cheshire Brine Subsidence Compensation Board	November 2002	As notified
Potential for Collapsible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Compressible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Ground Dissolution Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Landslide Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Running Sand Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Potential for Shrinking or Swelling Clay Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2009	Annually
Subsidence Insurance Claims SP Property Services	August 2009	Quarterly
Subsidence Investigations CET Group	August 2009	Quarterly
Brine Subsidence Solution Area Johnson Poole & Bloomer	October 2008	As notified
Motion Map Data (1:2,500)	Version	Update Cycle
Motion Map Nigel Press Associates - Preston	May 2009	As notified

A selection of organisations who provide data within this report

Data Supplier	Data Supplier Logo
Ordnance Survey	
British Geological Survey	 British Geological Survey NATURAL ENVIRONMENT RESEARCH COUNCIL
The Coal Authority	
Ove Arup	
Peter Brett Associates	
Wardell Armstrong	 Wardell Armstrong Engineering & Environmental Solutions
Johnson Poole & Bloomer	

Contact	Name and Address	Contact Details
1	British Geological Survey - Enquiry Service British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, Nottinghamshire, NG12 5GG	Telephone: 0115 936 3143 Fax: 0115 936 3276 Email: enquiries@bgs.ac.uk Website: www.bgs.ac.uk
-	Landmark Information Group Limited The Smith Centre, Henley On Thames, Oxfordshire, RG9 6AB	Telephone: 0844 844 9952 Fax: 0844 844 9951 Email: customerservices@landmarkinfo.co.uk Website: www.landmarkinfo.co.uk