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KEYLAND DEVELOPMENTS LTD

Land at Annat Royd Lane, Ingbirchworth

Phase II Environmental Assessment

February 2014

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KEYLAND DEVELOPMENTS LTD

Land at Annat Royd Lane, Ingbirchworth
Phase II Environmental Assessment

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DRAWINGS

Drawing No	Title	Scale
SH11118-001	Site Location Plan	1:50,000
SH11118-003	Site Investigation Plan	1:1,250

1 INTRODUCTION

1.1 Instruction

- 1.1.1 This report is prepared in accordance with instruction from Mr M Naylor of KeyLand Developments Ltd dated 4th September 2013 and in accordance with our standard terms and conditions as attached at Appendix I. This follows a proposal dated 23 August 2013 by Wardell Armstrong.

1.2 Site Location

The site is Land off Annat Royd Lane, Ingbirchworth, and is located as shown on the site location plan, Drawing No. SH11118-001 (1:50,000 plan) and more detailed site plan SH11118-003 (1:1,250 plan). The site is located in the village of Ingbirchworth approximately 3km north west of Penistone, South Yorkshire. The site comprises grassed pasture land and is bounded by a public house to the north, by residential housing to the east and by woodland, agricultural land and Ingbirchworth Reservoir and associated infrastructure to the south and west.

1.3 Purpose and Basis of Report

- 1.3.1 The purpose of this report is to present the findings of an intrusive investigation that was carried out to determine geotechnical information of relevance to the proposed use of the site and to examine any potential contamination issues that may arise in connection with present use or proposed use of the site.

1.4 Proposed Site Use

- 1.4.1 It is proposed that the site is redeveloped as residential properties with gardens.

2 PREVIOUS INVESTIGATIONS

2.1.1 The history of the site has been described in a Phase I Environmental Assessment completed by Wardell Armstrong in August 2013. A summary of findings from this report is presented below.

2.2 General History

2.2.1 The desk study part of the report indicated that the site has predominantly been agricultural land with the exception of a quarry that encroached onto the south of the site.

2.3 Summary

2.3.1 The Phase I Environmental Assessment found that the site had a low potential for contamination from both on site past use and adjacent operations that may have impinged upon the site. However, the sandstone quarry shown to be present to the south of the site on historical plans may require further investigation in order to determine the infilling materials used and also whether a quarry highwall is present on site. This information will be required to inform foundation design for any buildings proposed in that area of the site.

2.3.2 A limited geotechnical site investigation was recommended to determine the following:

- presence of the quarry in the south of the site;
- presence of made ground and general geological/geotechnical setting across the site but in the southern quarry area in particular – if made ground is found it would be prudent to test for contamination; and
- presence of a high wall on site in the vicinity of the quarry.

2.4 Preliminary Conceptual Site Model

2.4.1 A preliminary conceptual site model was presented in the WA Phase I report (August 2013) and is presented below as Table I. The table outlines potential sources, pathways and receptors and was based on information provided by statutory sources and a preliminary site investigation. As the Phase I report was largely based on desk study information a number of uncertainties existed in the

conceptual model. These have been updated and a revised conceptual site model is presented in Section 8.

TABLE I		
SOURCE (CONTAMINANT)	PATHWAY	RECEPTOR
No. 1 Former quarry in south of the site. Potential made ground from infilling.	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Surface runoff. 5. Groundwater migration. 6. Direct contact (aggressive attack). 7. Gas migration.	2. Future occupiers. 3. Construction workers. 4. Groundwater. 5. Surface water. 6. Subsurface building materials and plastic service pipes. 7. Flora and Fauna.
No. 2 Former cement works	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Surface runoff. 5. Groundwater migration. 6. Direct contact (aggressive attack). 7. Gas migration.	2. Future occupiers. 3. Construction workers. 4. Groundwater. 5. Surface water. 6. Subsurface building materials and plastic service pipes. 7. Flora and Fauna.

3 GEOLOGICAL AND HYDROGEOLOGICAL SETTING

3.1 Geology

3.1.1 The assessment of the geology of the site is based on the published geological mapping sheet (Yorkshire Sheet 273 NW, Solid and Drift Edition, 1:10,560 scale) supplemented by the geological memoir, topographical plans and site visit. A typical conjectured section of strata is provided in Table II below along with other geological data.

TABLE II	
Strata	Description
Made ground.	Made ground of an unknown nature, thickness and extent may be present on site associated with the former quarry present in the south of the site.
Natural superfcials.	None.
Solid strata.	Sandstone (20 Ft. Flags) of Lower Coal Measures.
Dip and dip direction.	None.
Evidence of faulting.	None on site. A small fault is seen approx. 300m north west of site.
Evidence of other structural geology of relevance, folds, fissures, unconformity etc.	None.
Natural cavities.	None.
Landslides.	Very low potential.
Ground stability.	British Geological Information Services via the Envirocheck data indicate a low/ no potential for all stability hazards on site.

3.2 Hydrogeology

3.2.1 Hydrogeological information from the Environment Agency changed in April 2010 in order to comply with the Water Framework Directive. Where possible, this report considers both the old and new information obtained from:

- a Landmark Envirocheck report;
- Groundwater Protection Policy and Groundwater Vulnerability maps published by the Environment Agency;

- Hydrogeological maps published by the British Geological Survey; and
- Groundwater Protection: Policy and Practice (Environment Agency, 2006).

3.2.2 This information indicates the site to be underlain by Pennine Lower Coal Measures (sandstone unit) which is classified as a Secondary A Aquifer.

3.2.3 Secondary A aquifers are generally fractured or potentially fractured formations and do not have a high primary permeability. Although not producing large quantities of water for abstraction, they are important for local supplies and may supply base flow to rivers.

3.2.4 There are 12 active groundwater abstraction licences within a 2km radius of the site. The closest is 287m north (NGR:421700 406500) and is operated by Phillip Holmes and Jeremy Holmes who are licensed to abstract 23m³ of groundwater per day for 'General Farming and Domestic' purposes. A further groundwater abstraction licence is listed within 2km of the site but has been revoked.

3.2.5 The site does not lie within a source protection zone.

3.3 Soil Vulnerability Classification – Leaching Potential

3.3.1 The soil vulnerability classification groups the many different soil types of England and Wales into three soil vulnerability classes and six sub-classes. Each is based on the physical and chemical properties of the soil, which affect the downward passage of water and contaminants. This classification is not applied to soil above non-aquifers. Soil information for urban areas is based on fewer observations than elsewhere. A worst case vulnerability is therefore assumed until proved otherwise.

3.3.2 The soil has a low leaching potential (L), which indicates that the pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants. Lateral flow from these soils may contribute to groundwater recharge elsewhere in the catchment.

3.4 Hydrology

3.4.1 The nearest graded surface watercourse is Scout Dyke (Ingbirchworth Dike), which is approximately 100m south of the site. The Environment Agency has given Scout Dyke a General Quality Assessment (Chemistry) rating of C (Fairly Good). Ingbirchworth reservoir is located 30m south west of the site.

Infrastructure associated with the reservoir including spillway is located to the south of the site.

- 3.4.2 The Environment Agency completed a national flood risk assessment in 2004, which used ground levels, predicted flood levels, information on flood defences and local knowledge. The assessment predicts the likelihood of flooding in an area as low, medium or high based on zones identified in Technical Guidance to the National Planning Policy Framework (2012).
- 3.4.3 The site is within Zone 1 and has a low probability of flooding. The chance of flooding each year is less than 0.1% (1 in 1,000).
- 3.4.4 There are three surface water abstraction licences within 2km of the site. The closest is 247m south west (NGR: 421700 406500) and is operated by Yorkshire Water Services Ltd, which is licensed to abstract 3,637,000m³ of surface water per year for Public Water Supply purposes.

3.5 Mining

Surface Workings

- 3.5.1 Research of topographical, geological and other archive mining records has indicated a sandstone quarry immediately south of the site which encroached onto the southern area of the site. Further sandstone quarries are shown in the vicinity of the site on historical plans.
- 3.5.2 Four mineral sites for extraction of sandstone are recorded within 250m of the site. The closest is 12m south west of site at Ingbirchworth Reservoir where extraction has now ceased. No further details are given.

4 SITE INVESTIGATION

4.1 Introduction

- 4.1.1 A physical site investigation has been carried out to assess the geotechnical nature of the ground. The site investigation comprised of ten trial pits across the site area. Locations were positioned to provide complete coverage of the whole site and to locate the potential former quarry high wall to the south of the site. Site investigation locations are shown on Drawing No. SH11118-003 (1:1,250 scale). The investigation was also designed with consideration for the preliminary conceptual site model, shown as Table I, that identified all potential sources, pathways and receptors. This allowed a targeted sampling approach to be undertaken and provide general coverage of the site.
- 4.1.2 Results of the investigation are used to revise the conceptual site model, establish whether linkages identified are plausible and establish the level of risk associated with the site.
- 4.1.3 The investigation including sampling techniques was carried out in accordance with BS10175:2011 Investigation of potentially contaminated sites – code of practice.

4.2 Scope

- 4.2.1 The investigation was designed as a series of tasks that are summarised below in Table III.

TABLE III – Summary of Tasks		
Task	Summary	Date(s)
Preparatory Work	Setting up site investigation, including services enquiries, health & safety documents and meeting with client.	August-October 2013
Intrusive site investigation	10 trial pits to a maximum depth of 2.6m below ground level (bgl).	7 th October 2013
Service Location	Accurate location and survey of existing water main on site.	7 th October 2013
Laboratory analysis	Chemical / geotechnical testing in accredited laboratory – 12 soil samples.	8 th – 24 th October 2013

4.2.2 The investigation was completed in accordance with Construction (Design and Management) (CDM) Regulations 2007 and a site specific Health & Safety plan. Contractors used during this project include; George A. Siddons Plant Hire Excavations (trial pits), ALcontrol Laboratories (geochemical analysis) and Professional Soils Laboratory (geotechnical analysis). Drilling was completed using a variety of methods and these are discussed in more detail below.

4.3 Trial Pit Excavations

4.3.1 Trial pit excavations were completed under the full-time supervision of a Wardell Armstrong engineer. Ten trial pits (TP101 to TP110) were excavated to depths of between 0.8m and 2.6m below ground level (bgl) using a JCB 3CX Sitemaster hydraulic excavator. Excavations beyond these depths were not possible due to shallow rockhead. Locations (see Drawing No. SH11118-003) were positioned to provide widespread coverage of the site and to locate the potential former quarry high wall to the south of the site. .

4.3.2 Trial pit logs are included at Appendix II.

4.4 Sampling and Testing

Sampling and Chemical Analysis of Soils

4.4.1 Seven disturbed samples of material from beneath the site were collected for laboratory analysis. Samples were taken at regular depths, changes in strata and any discrete horizons with a high potential to retain contaminants and logged in general accordance with BS14686:2002. Samples were obtained using a fresh pair of nitrile gloves.

4.4.2 Samples scheduled for analysis of organic contaminants were placed in amber bottles with a minimum of headspace. The bottles were immediately sealed with polytetrafluoroethylene (PTFE) lined caps and labelled. The remaining small disturbed samples were placed in polypropylene tubs with a minimum of headspace, sealed with airtight polypropylene 'snap-on' lids and labelled. The labels detailed individual sample number, location, depth and sampler identity.

4.4.3 Collected samples were stored away from sunlight in temperature controlled conditions and transported by courier to ALcontrol Laboratories. Chain of custody forms were completed for all samples sent to the laboratory. The forms detailed individual bottle identification number and sample location. The forms were signed on release by the Wardell Armstrong field engineer and upon receipt by the laboratory.

4.4.4 The laboratory analyses scheduled were selected to establish the type, level and distribution of the possible harmful contaminants that may be present on the site given its past and current uses. In order to provide cost effective analysis, solid samples were analysed for a number of determinands depending on depth, matrix and a visual assessment of ground conditions. The analysis scheduled is presented in Table IV.

TABLE IV – Summary of Sample Analysis	
Substance	No. Soil Samples
A standard suite of industrial pollutants including common metals (arsenic, water-soluble boron, cadmium, chromium, chromium ^{VI} , copper, lead, mercury, nickel, selenium, and zinc), pH, sulphate, sulphide, sulphur, thiocyanate, total cyanide and phenols.	7
Speciated PAHs (USEPA 16).	5
Petroleum hydrocarbons (C ₅ – C ₄₀ with aliphatic/aromatic class separation and carbon banding), BTEX, MTBE (TPHCWG).	2
Total Petroleum Hydrocarbons (TPH).	2
Volatile Organic Compounds (VOCs).	2
Semi-Volatile Organic Compounds (SVOCs).	2
Soluble Sulphate.	7
Total Organic Carbon (TOC).	4
Asbestos Screen and Identification.	4

4.4.5 The results of the chemical analyses are attached at Appendix III.

Geotechnical Sampling and Testing

4.4.6 Four soil samples were taken for geotechnical testing. Geotechnical results are attached at Appendix V.

4.5 Quality Assurance and Quality Control

4.5.1 The soil samples were collected, transferred to the laboratory under chain of custody and analysed to ensure traceability and reliability of analytical results. Based on the laboratory QA data the analytical results are considered acceptable for interpretative use.

4.6 Limitations of Site Investigation

4.6.1 It should be noted that the interpretation of the results of the physical site investigation is based on a limited number of investigation points. The locations and numbers of the investigation locations were governed by the physical state of the site and the location of known services at the time of the investigation. Although reasonable inferences have been made during the interpretation, it is possible that variances in the thickness, distribution and physical/chemical characteristics of the strata present will exist.

5 RESULTS OF SITE INVESTIGATION

5.1 Ground Conditions

Topsoil

- 5.1.1 Topsoil was encountered in all trial pit locations and varied in thickness from 0.15m to 0.5m. The topsoil encountered was either loose, dark grey to black, locally slightly gravelly, clayey sand or soft black, locally slightly gravelly, sandy clay.

Made Ground

- 5.1.2 Made Ground was present in trial pits TP108, TP109 and TP110 beneath the south and south east of the site. The made ground on site comprised two units and varied in thickness from 0.65m and 2.45m, where present. The first unit of made ground consisted of a soft to firm, dark grey or greyish brown, sandy, gravelly clay. The gravel fraction consisted of mudstone, sandstone and rare brick and pebbles with rare cobbles of brick and sandstone. The second unit of made ground consisted of a loose to medium dense, brown, slightly cobbly, sandy, gravelly clay interpreted as reworked natural materials used to infill the former quarry. The gravel and cobbles in this unit comprised angular to subangular mudstone.
- 5.1.3 The thickness of the made ground was unproven in TP108 and TP109 which are located to the south of the quarry highwall.

Natural Strata

- 5.1.4 The natural materials encountered during the intrusive investigation comprised a 0.25m to 1.05m thickness of firm to stiff, orange or brown, sandy, gravelly clay or a medium dense, orange brown, clayey, sandy gravel. The gravel fraction consisted of angular to subangular mudstone.
- 5.1.5 Across the majority of the site area, rockhead was encountered and consisted of very weak to weak, thinly laminated, greyish brown or brownish grey, weathered mudstone. All natural strata were interpreted as the weathering profile of the underlying Pennine Lower Coal Measures geology. Rockhead was not encountered in TP108 and TP109 within the quarry.
- 5.1.6 A summary of the strata beneath the site is shown in Table V.

Table V – Summary of strata beneath the site				
Depth to base of strata (mbgl)			Mean Thickness (m)	Typical Description
Max.	Min.	Mean		
0.50	0.15	0.32	0.32	Topsoil.
2.60*	0.80*	1.70*	1.52*	Made Ground.
1.50	0.60	0.93	0.57	Weathered Coal Measures.
*	*	*	*	Mudstone.
* Base of strata not always proven.				

5.2 Groundwater

5.2.1 Groundwater was not encountered during the intrusive investigation works.

5.3 Ground Gas

5.3.1 There are several regulatory authorities that require the assessment of ground gas on potentially contaminated sites. The main stakeholders are Building Control, Local Authority Planning and Environmental Health (Contaminated Land Officers). CIRIA have published guidance (C665, 2007) on risk assessment for new buildings and existing structures on ground with potentially hazardous gassing regimes. This guidance indicates that a semi-quantitative risk assessment for ground gas can be completed using Gas Screening Values (GSV) and consideration of the conceptual site model.

5.3.2 Consideration of the conceptual site model and observation of the ground conditions during the intrusive investigation have indicated that there is unlikely to be potentially hazardous ground gas affecting the site.

5.4 Observations of contamination

5.4.1 No visual or olfactory evidence of soil contamination was noted during the site investigation.

6 GUIDANCE ON CONTAMINATION RISK ASSESSMENT

6.1 Introduction

6.1.1 The following section aims to assess the magnitude and significance of potential risks to human health, surface water, groundwater, ecosystems and buildings from contaminated soil and groundwater. The assessment provides information that is fit for purpose given the regulatory context and completed in accordance with UK best practice. A summary of the risk assessment process is presented below. More detailed information on risk assessments is contained in various reports published by the Environment Agency and DEFRA including:

- Contaminated Land Science Reports (SR2 to 4); and
- Model Procedures for the Management of Land Contamination (CLR 11).

6.2 General Soil Contamination Guidance

6.2.1 The Environment Agency (EA) has a statutory duty to ensure the protection of the environment and the remediation of contaminated land and groundwater. In order to achieve this, the EA employs the principle of risk assessment - the risk of a contaminant source causing harm or pollution via a given pathway to an identified receptor. If one of the source-pathway-receptor linkages is not considered to be present then there is deemed to be no risk. However, if a contaminant source is present and there is a pathway for that contaminant to reach a receptor then there is a potential risk of significant harm to the receptor. Therefore, if the source-pathway-receptor linkages are complete, there is a requirement to undertake a risk assessment related to the receptor of concern, be it human health, surface water, groundwater, buildings or other property or ecological issues.

6.2.2 The first stage in the assessment of a site is development of a conceptual model. This includes consideration of all possible sources of contamination on the site, the potential receptors and whether there is a plausible pathway between the two. This allows evaluation of whether further more complicated risk assessment for an identified receptor is necessary. A site-specific conceptual model is presented in Table I and is revised here in Section 8 based on the findings of the site investigations.

6.2.3 In March 2002 the Environment Agency and the Department of Environment, Food and Rural Affairs (DEFRA) released a package of guidance to assess the

health risks posed by contaminated land as part of the statutory framework for contaminated land. The Contaminated Land Exposure Assessment (CLEA) model is a framework for estimating the likely exposure to contaminants in soil as part of the wider approach of the UK's assessment of risk and suitability for use. The methodology adopted for CLEA builds upon the source-pathway-receptor model for the assessment of risk. Following the CLEA model, generic Soil Guideline Values (SGVs) were developed to act as triggers for intervention in a number of end-use scenarios. The Environment Agency commenced a programme looking at 55 contaminants. The CLEA methodology has been updated and the SGVs were withdrawn from use in August 2008. New SGVs have been published by the EA since March 2009 and further SGVs are expected to be published as part of an on-going programme. For the purposes of risk assessment in this report and in the absence of more appropriate screening criteria we have continued to use the pre-2009 SGV for lead as a measure of significance for contamination as no replacement SGV has been published.

- 6.2.4 The CLEA SGVs are derived using specific parameters, which may not be relevant to each site. The CLEA software allows parameters to be changed and site specific assessment criteria (SSAC) can be developed. The CLEA methodology also uses a statistical evaluation of all the data collected in order to give an overall impression of the site and therefore the exposure to a modelled receptor rather than using individual contaminant values, which may vary dramatically across the site. The statistical tests calculate a normalised upper bound value for the site as a whole and also give an indication of whether a particular data value is a statistical outlier (potential hotspot) or whether it is part of the whole population of samples.
- 6.2.5 The Soil Guideline Values derived from the CLEA model are intended for use in assessing the risk to long term human users of the site. There is also a requirement to consider the potential for harm from short-term exposure to contaminants at the site, e.g. to construction workers who may be exposed to risk via inhalation of dust or dermal contact with the contaminated material.
- 6.2.6 In the absence of SGVs published under the new CLEA methodology, Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) published generic assessment criteria (GAC) for over seventy inorganic and organic substances in July 2009. In addition, GAC values for 30 separate organic compounds were published in December 2009 by the Environmental Industries

Commission (EIC), the Association of Geotechnical and Geoenvironmental Specialists (AGS) and CL:AIRE. These GAC values have been derived in the same vein as SGVs and are intended to be used in the same manner. Additionally, the GAC values have been produced for varying soil organic matter content (i.e. 1%, 2.5% and 6%).

6.3 Statistical analysis

6.3.1 Statistical analysis has been completed to identify if the data set for each substance tested contains outliers, has a normal or non-normal distribution and if there is significant evidence that the mean concentration, as defined by the 95% upper confidence level (UCL), is less than the adopted screening value. This process follows the CL:AIRE/CIEH Guidance on Comparing Soil Contamination Data with a Critical Concentration, May 2008. Results from this statistical testing can be used to inform decisions on whether land is suitable for use under the land use planning system without mitigation to break identified pollutant linkages.

7 GENERIC QUANTITATIVE RISK ASSESSMENT

7.1 Soil Contamination Results

7.1.1 Soil samples taken from the site have been tested for potential chemicals of concern appropriate to the former land use. As the proposed redevelopment is for residential housing with gardens, the most appropriate end use for assessment is that of residential with home-grown produce. Results from the chemical testing have been evaluated with reference to each of the plausible receptors identified in the conceptual model. The results are evaluated differently for each receptor.

7.2 Human Health - occupiers

7.2.1 As the receptor is human health, the most relevant risk assessment model is the CLEA model. The model estimates child and adult exposures to soil contaminants for those potentially living, working and/or playing on contaminated sites over long time periods and has been used to produce the SGVs for the United Kingdom.

7.2.2 The principal pathways of concern for human health are dermal contact, ingestion, and inhalation. Generally, in the assessment of risk to site users, only samples taken in the top 1m are considered as contact with deeper samples is unlikely.

7.2.3 The geometric mean soil organic matter content at the site is 1.15%. Therefore GAC values derived using 1% SOM have been selected in this assessment. The pH of the soil ranged from 6.18 in TP106-0.7m to 8.14 in TP108-0.4m.

Metals

7.2.4 The mean concentration (95% UCL) for all metals (arsenic, cadmium, chromium III and VI, copper, lead, mercury, nickel, selenium, vanadium and zinc) were below their respective SGV or GAC. Therefore, it may be considered that the concentrations of metals in soil on site do not present a significant risk to long-term human health.

7.2.5 Statistical analysis of the laboratory results is attached at Appendix IV.

Volatile Petroleum Hydrocarbons

7.2.6 Volatile Petroleum Hydrocarbon (VPH) testing represents the short chain-length aliphatic and aromatic petroleum hydrocarbons detected within the carbon band range C5 to C10.

- 7.2.7 All samples recorded concentrations of VPH at or below the Limit of Detection (LOD) and no visual or olfactory evidence of petroleum hydrocarbons was noted during the intrusive investigation. Therefore, the concentrations of VPH are not considered to present a risk to long term human health.

Extractable Petroleum Hydrocarbons

- 7.2.8 Extractable Petroleum Hydrocarbon (EPH) testing represent the medium to long chain-length aliphatic and aromatic petroleum hydrocarbons detected within the carbon band range C10 to C44.
- 7.2.9 The site investigation identified no visual or olfactory evidence of petroleum hydrocarbons. All recorded concentrations were less than the adopted GAC. Therefore, TPH contamination is considered unlikely to present a significant risk to long term human health at the site.

Semi-Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons

- 7.2.10 None of the samples tested contained concentrations of Semi-Volatile Organic Compounds (SVOC) above the Limit of Detection (LOD). In addition, no visual or olfactory evidence of SVOC contamination was recorded during site investigation works. Therefore, SVOC contamination is unlikely to present a significant risk to future site occupiers.
- 7.2.11 The mean concentrations (95% UCL) for all PAH compounds analysed (acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenz(ah)anthracene, fluoranthene, fluorene, indeno(123cd)pyrene, naphthalene, phenanthrene and pyrene) were below their respective GAC. Therefore, PAHs are unlikely to present a significant risk to long term human health.
- 7.2.12 Statistical analysis of the laboratory results is attached at Appendix IV.

Volatile Organic Compounds

- 7.2.13 The recorded concentrations of Volatile Organic Compounds (VOC) were all below their respective limits of detection (LOD). Therefore, these compounds are unlikely to present a significant risk to long term human health.

Tentatively Identified Compounds (TIC)

- 7.2.14 No Tentatively Identified Compounds (TIC) were detected during sample analysis. Therefore, these compounds are unlikely to present a significant risk to long term human health.

Other Substances

- 7.2.15 Statistical analysis for monohydric phenol, total cyanide and sulphide was carried out to identify the 95% confidence limits of the measured mean and to compare the upper 95th percentile with the respective screening criteria.
- 7.2.16 The upper bound values (US95) for phenol, cyanide and sulphide were below their respective screening values. Therefore, it may be considered that the concentrations of these substances in soil on site do not present a significant risk to long-term human health.
- 7.2.17 Statistical analysis of the laboratory results is attached at Appendix IV.

Asbestos

- 7.2.18 Four samples were screened for asbestos and no fibres were detected. In addition, no visual evidence of asbestos was recorded during site investigation works. Therefore, asbestos contamination is unlikely to pose a risk to future site occupiers.

7.3 Human Health – Construction Workers

- 7.3.1 The CLEA Soil Guideline Values only apply to the protection of health for long term chronic exposure. Construction workers are more likely to be at risk from a high single exposure, i.e. an acute dose, which can result in contaminant poisoning. Suggested values for acute lethal doses of arsenic, cadmium, chromium, inorganic mercury, nickel and selenium is outlined in the Environment Agency R&D SGV reports from 2002.
- 7.3.2 None of the samples contained concentrations of cadmium, chromium, inorganic mercury, nickel or selenium that are elevated with respects to an acute lethal dose. No acute lethal dose value is given for lead.

Asbestos Containing Material and Asbestos Fibres in Soil

- 7.3.3 Four samples were screened for asbestos and no fibres were detected. In addition, no visual evidence of asbestos was recorded during site investigation works. Therefore, asbestos contamination is unlikely to pose a risk to construction workers.

7.4 Ecology – Future Landscaped Areas

- 7.4.1 Ecological Soil Screening Levels (Eco-SSL) have been published by the USEPA for a range of metals. The Eco-SSLs present indicative values for assessing potential risk to plants and other ecological receptors. As no relevant UK guidance exists

for assessing risk to ecology, the recorded metal concentrations have been compared on an individual basis to Eco-SSLs.

- 7.4.2 The mean concentrations (95% UCL) for arsenic, cadmium, copper, lead, nickel and zinc were below the Eco-SSLs for plants. Therefore, it may be considered that the concentrations of these metals in soil on site do not present a risk to sensitive plants.

7.5 Groundwater Contamination Results

Data Sources

- 7.5.1 Groundwater was not sampled during the intrusive investigation. Therefore, our assessment of the risk to controlled waters is guided by the measured soil contamination.
- 7.5.2 None of the contaminants of concern were identified at elevated concentrations in soil samples from across the site. This suggests that significant impact to the underlying Secondary A aquifer or Scout Dyke is unlikely.

7.6 Radon Gas

- 7.6.1 An initial assessment for radon gas has been carried out. The determination follows the two-stage procedure outlined in *BR211 Radon: Guidance on protective measures for new dwellings (2007)*. The site is shown to lie in an area where no protection against radon is needed should development of residential dwellings or new structures of similar form of construction and compartmentation occur.

7.7 Building Materials

Concrete

- 7.7.1 Chemical attack of concrete is influenced by several factors including the concentration and solubility of the substance, the groundwater table and the pH of the groundwater.
- 7.7.2 Concrete is in particular at risk from acidic groundwater and elevated concentrations of sulphates and chlorides in soil and groundwater. Sulphate reacts with the minerals (e.g. calcium hydroxide) within the cement which causes a breakdown in the structure of the concrete. Chloride attack tends to be significant with regards the corrosion of reinforcing steel leading to deterioration of the concrete.

- 7.7.3 Concentrations of total sulphate were measured in order to indicate the potential for concrete attack. Concentrations on site ranged between 0.0065% and 0.0628% indicating that there is potential for concrete attack on site.
- 7.7.4 Results from sulphate (2:1 extract) for materials on site ranged between <0.004g/l and 0.0329g/l. These results indicate that a worst case design sulphate class of DS-1 and Aggressive Chemical for Concrete (ACEC) class of AC-1^d may be appropriate for the site. Relevant guidelines are given in BRE Special Digest 1: Concrete in Aggressive Ground.

Water Supply Pipes

- 7.7.5 Permeation and accelerated deterioration of pipe material can occur due to chemical reactions between the pipe and contaminants in the ground in which it is laid. This can lead to premature failures resulting in leakage and loss of water quality.
- 7.7.6 The Water Supply (Water Quality) Regulations in England and Wales, the Byelaws in Scotland and the Northern Ireland Water Regulations include a requirement to use only suitable materials when laying water pipes and the laying of unprotected water supply pipes through contaminated land is not permitted.
- 7.7.7 A table of threshold values for various contaminants has been produced by UKWIR in their report Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (ref: 10/WM/03/21). These threshold values allow an assessor to select an appropriate pipe material where the contaminant concentrations are below the threshold values.
- 7.7.8 The selection of an appropriate pipe material based on the worst case (maximum) contaminant concentrations at the site is presented below in Table VI. Based on the available chemical test results, polyethylene (PE), polyvinylchloride (PVC), barrier pipe and wrapped ductile iron may be suitable materials for water supply pipes to the site. Further information regarding the selection of materials for water supply pipes is given in the UKWIR Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites.

TABLE VI – UKWIR Pipe Material and Threshold Value (mg/kg)							
Contaminant	Max / Range Concentration	PE	PVC	Barrier Pipe (PE-AL-PE)	Wrapped Steel	Wrapped Ductile Iron	Copper
VOC's	<0.1mg/kg	0.5	0.125	Pass	Pass	Pass	Pass
BTEX +MTBE	<0.024mg/kg	0.1	0.03	Pass	Pass	Pass	Pass
SVOC's including aliphatic and aromatic fraction C5-C10)	<1mg/kg	2	1.4	Pass	Pass	Pass	Pass
Phenols	<0.1mg/kg	2	0.4	Pass	Pass	Pass	Pass
Mineral Oil C11-C20	2.57mg/kg	10	Pass	Pass	Pass	Pass	Pass
Mineral Oil C21-C40	24.23mg/kg	500	Pass	Pass	Pass	Pass	Pass
Corrosive (conductivity, redox and pH)	6.18-8.14 pH range	Pass	Pass	Pass	Fail	Pass	Fail
Nitrobenzene	<0.1	0.5	0.4	Pass	Pass	Pass	Pass
Preferred Pipe Type		✓	✓	✓	X	✓	X

8 REVISED CONCEPTUAL SITE MODEL

- 8.1.1 A preliminary conceptual site model was presented in Wardell Armstrong Phase I Environmental Assessment report. This outlined potential sources, pathways and receptors and was based on information provided by statutory sources and observations during the site visit. As the Phase I report was largely based on desk study information a number of uncertainties in the conceptual model existed. These have been revised and, based on the findings of the intrusive investigation, no source-pathway-receptor linkage has been identified at the site.

9 GEOTECHNICAL RESULTS

9.1.1 Site investigation works have identified made ground to the south of the site. The depth of the made ground was unproven in the area of the former quarry. The majority of the site is underlain by natural deposits of Weathered Coal Measures described as brown, slightly clayey, sandy, very silty gravel or brown, mottled grey, slightly sandy slightly gravelly clay.

9.1.2 In total, four samples of made ground and natural superficial material were collected from various depths and tested for range of geotechnical parameters including:

- Moisture content;
- Particle Size Distribution; and
- Atterberg Limits.

9.1.3 All tests were performed in an accredited geotechnical laboratory and in accordance with the appropriate British Standard.

9.2 Made Ground

9.2.1 One sample of made ground, identified as reworked natural materials used as quarry backfill was sent to the laboratory for analysis. The made ground comprised brown slightly sandy, slightly clayey, silty gravel.

Particle Size Distribution Test

9.2.2 A Particle Size Distribution test was performed on the sample from the made ground. The quantities of each soil fraction are shown in Table VII.

Table VII: PSD Made Ground	
Soil Fraction	Total Percentage
Cobbles	0
Gravel	80
Sand	7
Silt/Clay	13

Moisture Content

- 9.2.3 The sample of made ground was tested for natural moisture content and recorded a result of 13%.

Atterberg Limits

- 9.2.4 The sample of made ground was tested for determination of Atterberg limits. The result of the test determined that the material was non-plastic.

9.3 Weathered Coal Measures - Gravel

Particle Size Distribution Test

- 9.3.1 Particle Size Distribution tests were performed on two samples from the clay weathered coal measures. The range in quantities of each soil fraction is shown in Table VIII.

Table VIII: PSD Weathered Coal Measures - Gravel	
Soil Fraction	Total Percentage
Cobbles	0
Gravel	59 - 64
Sand	14 - 18
Silt/Clay	18 - 27

Moisture Content

- 9.3.2 Two samples were tested for natural moisture content and the results varied between 12% and 14%.

Atterberg Limits

- 9.3.3 Two samples from the clay Weathered Coal Measures were tested for determination of Atterberg limits. The results were variable with the sample from TP101 being described as non-plastic and the sample from TP105 being described as low plasticity material with a plasticity index of 12%.

9.4 Weathered Coal Measures - Clay

Particle Size Distribution Test

- 9.4.1 A Particle Size Distribution test was performed on one sample from the gravel weathered coal measures. The quantities of each soil fraction are shown in Table IX.

Table IX: PSD Weathered Coal Measures - Clay	
Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	1
Silt/Clay	98

Moisture Content

- 9.4.2 The sample of clay weathered coal measures was tested for natural moisture content and recorded a result of 20%.

Atterberg Limits

- 9.4.3 The sample from the clay Weathered Coal Measures was tested for determination of Atterberg limits. The sample from TP103 was described as being high plasticity material with a plasticity index of 44%.

9.5 Former Quarry High-wall

- 9.5.1 The former quarry highwall was observed in two investigation locations, TP108 and TP109, to the south of the site and the conjectured position of the highwall between these locations is shown on Drawing No. SH11118-003. The highwall was defined by fill of reworked natural materials in the south of the trial pit consisting of loose to medium dense, brown, slightly cobbly, sandy, gravelly clay and natural material in the north consisting of firm, orange, sandy, gravelly clay overlying mudstone. The thickness of the quarry backfill was unproven.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 General

- 10.1.1 The site history, summarised from the Wardell Armstrong Phase I Environmental Assessment report dated August 2013, indicates that the site has predominantly been agricultural land with the exception of a quarry that encroached onto the south of the site.
- 10.1.2 A total of ten trial pits (0.9m to 2.6m deep) were completed as part of this Phase II investigation. Observations from the intrusive work have confirmed the presence of made ground to the south of the site associated with the infilling of the former quarry. The infilling was observed to be predominantly reworked natural materials. The majority of the site was underlain by Weathered Coal Measures which was in turn underlain by mudstone of the Pennine Lower Coal Measures.
- 10.1.3 Seven soil samples from across the site were tested for a suite of potential chemicals of concern comprising: volatile and semi-volatile organic compounds; aliphatic, aromatic and polyaromatic hydrocarbons; metals and other inorganic elements.

10.2 Human Health

- 10.2.1 Analytical results were analysed using CLEA methodology to assess the risk to human health in a residential scenario. The results indicate that none of the contaminants of concern would be a risk to future occupiers or construction workers.

Asbestos

- 10.2.2 No visual evidence of asbestos was recorded during site investigation works. In addition, four samples were screened for asbestos and no fibres were detected. Therefore, asbestos contamination is unlikely to pose a risk to human health.

10.3 Surface Water and Groundwater

- 10.3.1 The risk to surface water and groundwater is considered to be low due to the distance to the nearest sensitive surface water and groundwater receptors and the recorded concentrations of contaminants in soil beneath the site.

10.4 Buildings and Property

- 10.4.1 Results from sulphate (2:1 extract) testing indicate that a design sulphate class of DS-1 and Aggressive Chemical for Concrete (ACEC) class of AC-1^d may be appropriate for the site.
- 10.4.2 Gas monitoring was not carried out at the site. Consideration of the conceptual site model and observation of the ground conditions during the intrusive investigation have indicated that there is unlikely to be potentially hazardous ground gas affecting the site.
- 10.4.3 An initial assessment for radon gas has been carried out. The determination follows the two-stage procedure outlined in *BR211 Radon: Guidance on protective measures for new dwellings (2007)*. The assessment indicates no specific radon protection measures are required for new residential dwellings at the site.

10.5 Ecology

- 10.5.1 There is considered no risk to the health of plants on site from the levels of phytotoxic metals recorded in soil.

10.6 Geotechnical and foundation design

- 10.6.1 The geological conditions at the site are homogeneous across the site with the exception of a small area adjacent to the southern boundary of the site where the former quarry high wall has been observed. Rockhead has been encountered across the majority of the site at shallow depths (approximately 1mbgl) and it should be capable of withstanding the necessary loads for the proposed development type. This should allow the construction of conventional strip foundations directly onto the underlying rock.
- 10.6.2 Groundwater was not encountered during the intrusive investigation and it is assumed that groundwater levels will not affect the construction of foundations at the site.
- 10.6.3 Differential settlement is considered unlikely to be a significant risk at the site. However, the layout of dwellings at the site should be designed to avoid the former quarry high wall to the south of the site where differential settlement and/or the instability of the quarry high wall may be an issue.

A P P E N D I X I

Standard Terms and Conditions and Limitations to Reports

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APPENDIX II

Trial Pit Logs



Trial Pit Log

TP101

Project Name: Land at Annat Royd Lane, Ingbirchworth

Project No.
SH11118

Level:	258.47
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07/10/2013

Location: Annat Royd Lane, Ingbirchworth

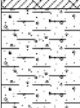
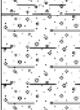
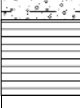
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(m):

1.6

Depth
1.10

0.6

Logged
M Kelly

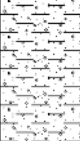
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.50	D		0.30	258.17		Loose black clayey SAND (TOPSOIL).	1
							Firm-Stiff orange brown sandy gravelly CLAY. Gravel of angular-subangular mudstone.	
							Medium Dense orange brown sandy clayey GRAVEL of angular-subangular mudstone.	
							Very Weak-Weak thinly laminated brownish grey weathered MUDSTONE (recovered as slightly cobbly gravel).	
							End of pit at 1.10 m	
	0.70	B		0.60	257.87		Very Weak-Weak thinly laminated brownish grey weathered MUDSTONE (recovered as slightly cobbly gravel).	2
							End of pit at 1.10 m	
							End of pit at 1.10 m	
							End of pit at 1.10 m	
							End of pit at 1.10 m	
				0.90	257.57		End of pit at 1.10 m	3
							End of pit at 1.10 m	
							End of pit at 1.10 m	
							End of pit at 1.10 m	
							End of pit at 1.10 m	
				1.10	257.37		End of pit at 1.10 m	4
							End of pit at 1.10 m	
							End of pit at 1.10 m	
							End of pit at 1.10 m	
							End of pit at 1.10 m	

Remarks:

Stability:



 Unit 5 Newton Business Centre Thorncliffe Park Estate Chapeltown Sheffield S35 2PH				Trial Pit Log				Trialpit No TP102 Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421735.25 - 406196.00 Level: 257.81		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m): Depth 1.40 0.6 1.6		Scale 1:20 Logged M Kelly	
Client: Nathaniel Lichfield & Partners									

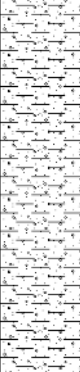
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.50	257.31		Loose black clayey SAND (TOPSOIL).	
				0.90	256.91		Firm orange sandy gravelly CLAY. Gravel of angular-subangular mudstone.	
				1.40	256.41		Very Weak-Weak thinly laminated light brownish grey weathered MUDSTONE (recovered as slightly cobbly gravel).	1
							End of pit at 1.40 m	2
								3
								4

Remarks:

Stability:



 Unit 5 Newton Business Centre Thorncliffe Park Estate Chapeltown Sheffield S35 2PH				Trial Pit Log				Trialpit No TP103 Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421762.39 - 406195.83 Level: 257.00		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m): Depth 1.70 0.6 1.8		Scale 1:20 Logged M Kelly	
Client: Nathaniel Lichfield & Partners									

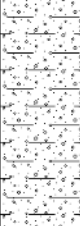
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.40	D		0.45	256.55		Loose dark grey slightly gravelly clayey SAND (TOPSOIL). Gravel of angular-subrounded mudstone and sandstone.	
	1.00	B					Firm orange brown mottled grey sandy gravelly CLAY. Gravel of angular-subangular mudstone.	1
				1.50	255.50		Very Weak-Weak thinly laminated light brownish grey weathered MUDSTONE (recovered as cobbly gravel).	
				1.70	255.30		End of pit at 1.70 m	2
								3
								4

Remarks:

Stability:



 Unit 5 Newton Business Centre Thorncliffe Park Estate Chapeltown Sheffield S35 2PH				Trial Pit Log				Trialpit No TP104 Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421707.75 - 406168.08 Level: 257.59		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m): Depth 1.15 0.6 1.4		Scale 1:20 Logged M Kelly	
Client: Nathaniel Lichfield & Partners									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.40	D		0.30	257.29		Loose black slightly gravelly clayey SAND (TOPSOIL). Gravel of angular mudstone.	
				0.95	256.64		Medium Dense orange brown sandy clayey GRAVEL of angular-subangular mudstone.	
				1.15	256.44		Very Weak-Weak thinly laminated light grey weathered MUDSTONE (recovered as cobbly gravel).	1
End of pit at 1.15 m								
								2
								3
								4

Remarks:

Stability:



 Unit 5 Newton Business Centre Thorncliffe Park Estate Chapeltown Sheffield S35 2PH				Trial Pit Log				Trialpit No TP105 Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421732.54 - 406166.34 Level: 256.69		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m): 0.6 1.5		Scale 1:20	
Client: Nathaniel Lichfield & Partners						Depth 1.30		Logged M Kelly	

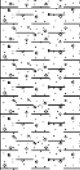
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
							Loose black slightly gravelly clayey SAND (TOPSOIL). Gravel of angular mudstone.	
	0.60 0.60	B D		0.45	256.24		Medium Dense orange brown sandy clayey GRAVEL of angular-subangular mudstone.	
				0.95	255.74		Very Weak-Weak thinly laminated light grey weathered MUDSTONE (recovered as cobbly gravel).	1
				1.30	255.39		End of pit at 1.30 m	
								2
								3
								4

Remarks:

 Stability:



 Unit 5 Newton Business Centre Thorncliffe Park Estate Chapeltown Sheffield S35 2PH				Trial Pit Log				Trialpit No TP106 Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421756.96 - 406164.14 Level: 255.61		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m): Depth 1.15 0.6 1.4		Scale 1:20 Logged M Kelly	
Client: Nathaniel Lichfield & Partners									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	D					Loose dark grey slightly gravelly clayey SAND (TOPSOIL). Gravel of angular-subrounded mudstone and sandstone.	
0.35			255.26		Firm orange mottled grey sandy gravelly CLAY. Gravel of angular-subangular mudstone.			
0.60			255.01		Firm orange sandy gravelly CLAY. Gravel of angular-subangular mudstone.			
1.05			254.56		Very Weak-Weak thinly laminated brownish grey weathered MUDSTONE (recovered as slightly cobbly gravel).	1		
			1.15	254.46		End of pit at 1.15 m		
								2
								3
								4

Remarks:

Stability:



 Unit 5 Newton Business Centre Thorncliffe Park Estate Chapeltown Sheffield S35 2PH				Trial Pit Log				Trialpit No TP107 Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421687.21 - 406139.33 Level: 256.64		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m): Depth 0.80		Scale 1:20 Logged M Kelly	
Client: Nathaniel Lichfield & Partners									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.35	256.29		Loose black clayey SAND (TOPSOIL). Gravel of angular mudstone.
				0.60	256.04		Firm orange sandy gravelly CLAY. Gravel of angular-subangular mudstone.
				0.80	255.84		Very Weak-Weak thinly laminated light grey weathered MUDSTONE (recovered as cobbly gravel).
							End of pit at 0.80 m

Remarks:

 Stability:



 Unit 5 Newton Business Centre Thorncliffe Park Estate Chapeltown Sheffield S35 2PH				Trial Pit Log				Trialpit No TP108A Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421711.29 - 406133.13 Level: 256.80		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m): Depth 1.70 0.6 2.2		Scale 1:20 Logged M Kelly	
Client: Nathaniel Lichfield & Partners									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.40	D		0.25	256.55		Loose black slightly gravelly clayey SAND (TOPSOIL). Gravel of angular mudstone.	1
			0.55	256.25	MADE GROUND: Soft dark grey sandy gravelly clay. Gravel of mudstone, sandstone and rare brick and pebbles with rare cobbles of brick.			
			1.70	255.10	MADE GROUND: Loose-Medium Dense brown slightly cobbly sandy gravelly clay. Gravel and cobbles of angular-subangular mudstone.			
							End of pit at 1.70 m	2
								3
								4

Remarks:

Stability:



 Unit 5 Newton Business Centre Thorncliffe Park Estate Chapeltown Sheffield S35 2PH				Trial Pit Log				Trialpit No TP108B Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421711.56 - 406135.18 Level: 256.80		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m): 0.6		Scale 1:20	
Client: Nathaniel Lichfield & Partners						Depth 0.90		Logged M Kelly	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
				0.25	256.55		Loose black clayey gravelly SAND (TOPSOIL). Gravel of angular mudstone. Firm orange sandy gravelly CLAY. Gravel of angular-subangular mudstone. Very Weak-Weak thinly laminated light brownish grey weathered MUDSTONE (recovered as gravelly cobbles). End of pit at 0.90 m		
				0.60	256.20				
				0.90	255.90				
Remarks: Stability: 									

 Unit 5 Newton Business Centre Thornccliffe Park Estate Chapelton Sheffield S35 2PH				Trial Pit Log				Trialpit No TP109A Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421737.97 - 406130.89 Level: 256.32		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m):		Scale 1:20	
Client: Nathaniel Lichfield & Partners						Depth 2.60		Logged M Kelly	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.15	256.17		Soft black slightly gravelly sandy CLAY (TOPSOIL). Gravel of angular mudstone.	
	0.60	D					MADE GROUND: Soft dark grey sandy gravelly clay. Gravel of mudstone, sandstone and rare brick and pebbles with rare cobbles of brick.	
				0.75	255.57		MADE GROUND: Loose-Medium Dense brown slightly cobbly sandy gravelly clay. Gravel and cobbles of angular-subangular mudstone.	1
	1.40	B						2
				2.60	253.72		End of pit at 2.60 m	3
								4

Remarks:

Stability:



Trial Pit Log

Trialpit No
TP109B
Sheet 1 of 1

Project Name:	Land at Annat Royd Lane, Ingbirchworth
---------------	--

Project No.
SH11118

Co-ords:	421738.43 - 406134.37
Level:	256.32

Date
07/10/2013

Location: Annat Royd Lane, Ingbirchworth

Dimensions
(m):

0.4

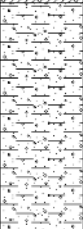
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Client: Nathaniel Lichfield & Partners

Depth
1.20

9.0

Logged
M Kelly

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30	256.02		Soft black slightly gravelly sandy CLAY (TOPSOIL). Gravel of angular mudstone.	1
							Firm orange sandy gravelly CLAY. Gravel of angular-subangular mudstone.	
				0.90	255.42		Very Weak-Weak thinly laminated light brownish grey weathered MUDSTONE (recovered as cobbly gravel).	
							End of pit at 1.20 m	
				1.20	255.12			2
								3
								4

Remarks:

Stability:



 Unit 5 Newton Business Centre Thorncliffe Park Estate Chapeltown Sheffield S35 2PH				Trial Pit Log				Trialpit No TP110 Sheet 1 of 1	
Project Name: Land at Annat Royd Lane, Ingbirchworth				Project No. SH11118		Co-ords: 421767.14 - 406126.75 Level: 254.90		Date 07/10/2013	
Location: Annat Royd Lane, Ingbirchworth						Dimensions (m): Depth 1.25 0.6 1.6		Scale 1:20 Logged M Kelly	
Client: Nathaniel Lichfield & Partners									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	D		0.15	254.75		Soft black sandy clay (TOPSOIL).	1 2 3 4
				0.45	254.45		MADE GROUND: Soft dark greyish brown sandy gravelly clay. Gravel of mudstone, sandstone and rare brick and pebbles with rare cobbles of brick and sandstone.	
				0.80	254.10		MADE GROUND: Firm grey sandy gravelly clay. Gravel of angular-subrounded sandstone and mudstone.	
				1.25	253.65		Very Weak-Weak thinly laminated greyish brown weathered MUDSTONE (recovered as gravelly cobbles).	
				End of pit at 1.25 m				

Remarks:

Stability:



A P P E N D I X I I I

Geochemical Laboratory Results



Wardell Armstrong LLP
Unit 4 Newton Business Centre
Thorncliffe Park
Sheffield
South Yorkshire
S35 2PH

Attention: Mike Kelly

CERTIFICATE OF ANALYSIS

Date: 17 October 2013
Customer: H_WARDELL_SHF
Sample Delivery Group (SDG): 131009-7
Your Reference: SH11118
Location: Ingbirchworth
Report No: 246252

We received 8 samples on Wednesday October 09, 2013 and 7 of these samples were scheduled for analysis which was completed on Thursday October 17, 2013. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager





SDG:	131009-7	Location:	Ingbirchworth	Order Number:	SH3936
Job:	H_WARDELL_SHF-87	Customer:	Wardell Armstrong LLP	Report Number:	246252
Client Reference:	SH11118	Attention:	Mike Kelly	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
8236806	TP101		0.50 - 0.50	07/10/2013
8236810	TP103		0.40 - 0.40	07/10/2013
8236814	TP104		0.40 - 0.40	07/10/2013
8236818	TP105		0.60 - 0.60	07/10/2013
8236822	TP106		0.70 - 0.70	07/10/2013
8236826	TP108		0.40 - 0.40	07/10/2013
8236830	TP109		0.60 - 0.60	07/10/2013
8236835	TP110		0.30 - 0.30	07/10/2013

Only received samples which have had analysis scheduled will be shown on the following pages.



SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

SOLID Results Legend X Test N No Determination Possible	Lab Sample No(s)		8236806	8236810	8236818	8236822	8236826	8236830	8236835
	Customer Sample Reference		TP101	TP103	TP105	TP106	TP108	TP109	TP110
	AGS Reference								
	Depth (m)		0.50 - 0.50	0.40 - 0.40	0.60 - 0.60	0.70 - 0.70	0.40 - 0.40	0.60 - 0.60	0.30 - 0.30
	Container		250g Amber Jar (AL 250g VOC (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)
Anions by Kone (soil)	All	NDPs: 0 Tests: 7	X	X	X	X	X	X	X
Asbestos ID in Solid Samples	All	NDPs: 0 Tests: 4		X	X			X	X
Chromium III	All	NDPs: 0 Tests: 7	X	X	X	X	X	X	X
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 7	X	X	X	X	X	X	X
EPH CWG (Aliphatic) GC (S)	All	NDPs: 0 Tests: 2					X		X
EPH CWG (Aromatic) GC (S)	All	NDPs: 0 Tests: 2					X		X
GRO by GC-FID (S)	All	NDPs: 0 Tests: 2						X	X
Hexavalent Chromium (s)	All	NDPs: 0 Tests: 7	X	X	X	X	X	X	X
Metals in solid samples by OES	All	NDPs: 0 Tests: 7	X	X	X	X	X	X	X
PAH by GCMS	All	NDPs: 0 Tests: 5	X		X	X	X		
pH	All	NDPs: 0 Tests: 7	X	X	X	X	X	X	X
Phenols by HPLC (S)	All	NDPs: 0 Tests: 7	X	X	X	X	X	X	X
Sample description	All	NDPs: 0 Tests: 7	X	X	X	X	X	X	X
Semi Volatile Organic Compounds	All	NDPs: 0 Tests: 2		X					X
Total Organic Carbon	All	NDPs: 0 Tests: 4	X		X		X		X



CERTIFICATE OF ANALYSIS

SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

SOLID Results Legend X Test N No Determination Possible	Lab Sample No(s)		8236835	8236830	8236826	8236822	8236818	8236810	8236806
	Customer Sample Reference		TP110	TP109	TP108	TP106	TP105	TP103	TP101
	AGS Reference								
	Depth (m)		0.30 - 0.30	0.60 - 0.60	0.40 - 0.40	0.70 - 0.70	0.60 - 0.60	0.40 - 0.40	0.50 - 0.50
	Container		60g VOC (ALE215)	60g VOC (ALE215)	400g Tub (ALE214)	400g Tub (ALE214)	400g Tub (ALE214)	400g Tub (ALE214)	250g Amber Jar (AL
			400g Tub (ALE214)	250g Amber Jar (AL	250g Amber Jar (AL	250g Amber Jar (AL	250g Amber Jar (AL	250g Amber Jar (AL	250g Amber Jar (AL
Total Sulphate	All	NDPs: 0 Tests: 7		X	X	X	X	X	X
TPH CWG GC (S)	All	NDPs: 0 Tests: 2		X					
VOC MS (S)	All	NDPs: 0 Tests: 2							



SDG:	131009-7	Location:	Ingbirchworth	Order Number:	SH3936
Job:	H_WARDELL_SHF-87	Customer:	Wardell Armstrong LLP	Report Number:	246252
Client Reference:	SH11118	Attention:	Mike Kelly	Superseded Report:	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm
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Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2
8236806	TP101	0.50 - 0.50	Dark Brown	Clay	0.063 - 0.1 mm	None	None
8236810	TP103	0.40 - 0.40	Dark Brown	Silt Loam	0.063 - 0.1 mm	Brick	None
8236818	TP105	0.60 - 0.60	Light Brown	Silt Loam	0.063 - 0.1 mm	Stones	None
8236822	TP106	0.70 - 0.70	Light Brown	Sandy Loam	0.1 - 2 mm	Stones	None
8236826	TP108	0.40 - 0.40	Dark Brown	Sandy Loam	0.1 - 2 mm	Vegetation	None
8236830	TP109	0.60 - 0.60	Black	Loamy Sand	0.1 - 2 mm	Brick	Stones
8236835	TP110	0.30 - 0.30	Light Brown	Sandy Silt Loam	0.1 - 2 mm	Vegetation	Stones

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Order Number: SH3936
Report Number: 246252
Superseded Report:

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Order Number: SH3936
Report Number: 246252
Superseded Report:

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CERTIFICATE OF ANALYSIS

SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

PAH by GCMS

Results Legend		Customer Sample R	TP101	TP105	TP106	TP108	TP109		
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.50 - 0.50 Soil/Solid 07/10/2013	0.60 - 0.60 Soil/Solid 07/10/2013	0.70 - 0.70 Soil/Solid 07/10/2013	0.40 - 0.40 Soil/Solid 07/10/2013	0.60 - 0.60 Soil/Solid 07/10/2013	
M	mCERTS accredited.								
aq	Aqueous / settled sample.								
diss.filt	Dissolved / filtered sample.								
tot.unfilt	Total / unfiltered sample.								
*	Subcontracted test.								
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery								
(F)	Trigger breach confirmed								
1-4&\$#@	Sample deviation (see appendix)								
Component	LOD/Units	Method							
Naphthalene	<9 µg/kg	TM218	<9 M	<9 M	<9 M	19.7 M	15.3 M		
Acenaphthylene	<12 µg/kg	TM218	<12 M	<12 M	<12 M	<12 M	<12 M		
Acenaphthene	<8 µg/kg	TM218	<8 M	<8 M	<8 M	<8 M	<8 M		
Fluorene	<10 µg/kg	TM218	<10 M	<10 M	<10 M	<10 M	<10 M		
Phenanthrene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	72.6 M	88.1 M		
Anthracene	<16 µg/kg	TM218	<16 M	<16 M	<16 M	<16 M	<16 M		
Fluoranthene	<17 µg/kg	TM218	<17 M	<17 M	<17 M	108 M	120 M		
Pyrene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	103 M	103 M		
Benz(a)anthracene	<14 µg/kg	TM218	<14 M	<14 M	<14 M	53.9 M	76.9 M		
Chrysene	<10 µg/kg	TM218	<10 M	<10 M	<10 M	66 M	98.4 M		
Benzo(b)fluoranthene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	122 M	127 M		
Benzo(k)fluoranthene	<14 µg/kg	TM218	<14 M	<14 M	<14 M	43.7 M	33.8 M		
Benzo(a)pyrene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	68.4 M	66.2 M		
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218	<18 M	<18 M	<18 M	74.3 M	47.6 M		
Dibenzo(a,h)anthracene	<23 µg/kg	TM218	<23 M	<23 M	<23 M	<23 M	<23 M		
Benzo(g,h,i)perylene	<24 µg/kg	TM218	<24 M	<24 M	<24 M	91.1 M	55.1 M		
PAH, Total Detected USEPA 16	<118 µg/kg	TM218	<118	<118	<118	823	831		



CERTIFICATE OF ANALYSIS

SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

Semi Volatile Organic Compounds

Results Legend		Customer Sample R	TP103	TP110			
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference					
M	mCERTS accredited.						
aq	Aqueous / settled sample.						
diss.filt	Dissolved / filtered sample.						
tot.unfilt	Total / unfiltered sample.						
*	Subcontracted test.						
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery						
(F)	Trigger breach confirmed						
1-4&*\$@	Sample deviation (see appendix)						
Component	LOD/Units	Method					
Phenol	<100 µg/kg	TM157	<100	<100			
Pentachlorophenol	<100 µg/kg	TM157	<100	<100			
n-Nitroso-n-dipropylamine	<100 µg/kg	TM157	<100	<100			
Nitrobenzene	<100 µg/kg	TM157	<100	<100			
Isophorone	<100 µg/kg	TM157	<100	<100			
Hexachloroethane	<100 µg/kg	TM157	<100	<100			
Hexachlorocyclopentadiene	<100 µg/kg	TM157	<100	<100			
Hexachlorobutadiene	<100 µg/kg	TM157	<100	<100			
Hexachlorobenzene	<100 µg/kg	TM157	<100	<100			
n-Dioctyl phthalate	<100 µg/kg	TM157	<100	<100			
Dimethyl phthalate	<100 µg/kg	TM157	<100	<100			
Diethyl phthalate	<100 µg/kg	TM157	<100	<100			
n-Dibutyl phthalate	<100 µg/kg	TM157	<100	<100			
Dibenzofuran	<100 µg/kg	TM157	<100	<100			
Carbazole	<100 µg/kg	TM157	<100	<100			
Butylbenzyl phthalate	<100 µg/kg	TM157	<100	<100			
bis(2-Ethylhexyl) phthalate	<100 µg/kg	TM157	<100	<100			
bis(2-Chloroethoxy)methane	<100 µg/kg	TM157	<100	<100			
bis(2-Chloroethyl)ether	<100 µg/kg	TM157	<100	<100			
Azobenzene	<100 µg/kg	TM157	<100	<100			
4-Nitrophenol	<100 µg/kg	TM157	<100	<100			
4-Nitroaniline	<100 µg/kg	TM157	<100	<100			
4-Methylphenol	<100 µg/kg	TM157	<100	<100			
4-Chlorophenylphenylether	<100 µg/kg	TM157	<100	<100			
4-Chloroaniline	<100 µg/kg	TM157	<100	<100			
4-Chloro-3-methylphenol	<100 µg/kg	TM157	<100	<100			
4-Bromophenylphenylether	<100 µg/kg	TM157	<100	<100			
3-Nitroaniline	<100 µg/kg	TM157	<100	<100			
2-Nitrophenol	<100 µg/kg	TM157	<100	<100			
2-Nitroaniline	<100 µg/kg	TM157	<100	<100			
2-Methylphenol	<100 µg/kg	TM157	<100	<100			
1,2,4-Trichlorobenzene	<100 µg/kg	TM157	<100	<100			



CERTIFICATE OF ANALYSIS

SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

Semi Volatile Organic Compounds

Results Legend		Customer Sample R	TP103	TP110				
#	ISO17025 accredited.							
M	mCERTS accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.40 - 0.40 Soil/Solid 07/10/2013	0.30 - 0.30 Soil/Solid 07/10/2013				
aq	Aqueous / settled sample.							
dis.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-4&+5@	Sample deviation (see appendix)							
Component	LOD/Units	Method						
2-Chlorophenol	<100 µg/kg	TM157	<100	<100				
2,6-Dinitrotoluene	<100 µg/kg	TM157	<100	<100				
2,4-Dinitrotoluene	<100 µg/kg	TM157	<100	<100				
2,4-Dimethylphenol	<100 µg/kg	TM157	<100	<100				
2,4-Dichlorophenol	<100 µg/kg	TM157	<100	<100				
2,4,6-Trichlorophenol	<100 µg/kg	TM157	<100	<100				
2,4,5-Trichlorophenol	<100 µg/kg	TM157	<100	<100				
1,4-Dichlorobenzene	<100 µg/kg	TM157	<100	<100				
1,3-Dichlorobenzene	<100 µg/kg	TM157	<100	<100				
1,2-Dichlorobenzene	<100 µg/kg	TM157	<100	<100				
2-Chloronaphthalene	<100 µg/kg	TM157	<100	<100				
2-Methylnaphthalene	<100 µg/kg	TM157	<100	<100				
Acenaphthylene	<100 µg/kg	TM157	<100	<100				
Acenaphthene	<100 µg/kg	TM157	<100	<100				
Anthracene	<100 µg/kg	TM157	<100	<100				
Benzo(a)anthracene	<100 µg/kg	TM157	<100	<100				
Benzo(b)fluoranthene	<100 µg/kg	TM157	<100	<100				
Benzo(k)fluoranthene	<100 µg/kg	TM157	<100	<100				
Benzo(a)pyrene	<100 µg/kg	TM157	<100	<100				
Benzo(g,h,i)perylene	<100 µg/kg	TM157	<100	<100				
Chrysene	<100 µg/kg	TM157	<100	<100				
Fluoranthene	<100 µg/kg	TM157	<100	<100				
Fluorene	<100 µg/kg	TM157	<100	<100				
Indeno(1,2,3-cd)pyrene	<100 µg/kg	TM157	<100	<100				
Phenanthrene	<100 µg/kg	TM157	<100	<100				
Pyrene	<100 µg/kg	TM157	<100	<100				
Naphthalene	<100 µg/kg	TM157	<100	<100				
Dibenzo(a,h)anthracene	<100 µg/kg	TM157	<100	<100				
TIC report	-	TM157	Not Detected	Not Detected				



CERTIFICATE OF ANALYSIS

SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

TPH CWG (S)

Results Legend		Customer Sample R	TP109	TP110				
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.60 - 0.60 Soil/Solid 07/10/2013 09/10/2013 131009-7 8236830	0.30 - 0.30 Soil/Solid 07/10/2013 09/10/2013 131009-7 8236835			
M	mCERTS accredited.							
aq	Aqueous / settled sample.							
diss.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-4&*\$\$@	Sample deviation (see appendix)							
Component	LOD/Units	Method						
GRO Surrogate % recovery**	%	TM089	78	74				
GRO TOT (Moisture Corrected)	<44 µg/kg	TM089	<44 M	186 M				
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089	<5 M	<5 M				
Benzene	<10 µg/kg	TM089	<10 M	<10 M				
Toluene	<2 µg/kg	TM089	2.36 M	<2 M				
Ethylbenzene	<3 µg/kg	TM089	<3 M	<3 M				
m,p-Xylene	<6 µg/kg	TM089	<6 M	<6 M				
o-Xylene	<3 µg/kg	TM089	<3 M	<3 M				
sum of detected mpo xylene by GC	<9 µg/kg	TM089	<9	<9				
sum of detected BTEX by GC	<24 µg/kg	TM089	<24	<24				
Aliphatics >C5-C6	<10 µg/kg	TM089	<10	<10				
Aliphatics >C6-C8	<10 µg/kg	TM089	<10	<10				
Aliphatics >C8-C10	<10 µg/kg	TM089	<10	<10				
Aliphatics >C10-C12	<10 µg/kg	TM089	<10	96				
Aliphatics >C12-C16	<100 µg/kg	TM173	216	209				
Aliphatics >C16-C21	<100 µg/kg	TM173	<100	516				
Aliphatics >C21-C35	<100 µg/kg	TM173	3170	5390				
Aliphatics >C35-C44	<100 µg/kg	TM173	<100	620				
Total Aliphatics >C12-C44	<100 µg/kg	TM173	3390	6740				
Aromatics >EC5-EC7	<10 µg/kg	TM089	<10	<10				
Aromatics >EC7-EC8	<10 µg/kg	TM089	<10	<10				
Aromatics >EC8-EC10	<10 µg/kg	TM089	<10	<10				
Aromatics >EC10-EC12	<10 µg/kg	TM089	<10	63.6				
Aromatics >EC12-EC16	<100 µg/kg	TM173	607	<100				
Aromatics >EC16-EC21	<100 µg/kg	TM173	1750	486				
Aromatics >EC21-EC35	<100 µg/kg	TM173	18400	9220				
Aromatics >EC35-EC44	<100 µg/kg	TM173	2660	2560				
Aromatics >EC40-EC44	<100 µg/kg	TM173	<100	516				
Total Aromatics >EC12-EC44	<100 µg/kg	TM173	23400	11500				
Total Aliphatics >C5-35	<100 µg/kg	TM173	3390	6230				
Total Aromatics >C5-35	<100 µg/kg	TM173	20700	9020				
Total Aliphatics & Aromatics >C5-35	<100 µg/kg	TM173	24100	15200				

Order Number: SH3936
Report Number: 246252
Superseded Report:

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CERTIFICATE OF ANALYSIS

SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

VOC MS (S)

Results Legend		Customer Sample R	TP109	TP110				
#	ISO17025 accredited.							
M	mCERTS accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.60 - 0.60 Soil/Solid 07/10/2013 . 09/10/2013 131009-7 8236830	0.30 - 0.30 Soil/Solid 07/10/2013 . 09/10/2013 131009-7 8236835				
aq	Aqueous / settled sample.							
diss.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-4&*\$@	Sample deviation (see appendix)							
Component	LOD/Units	Method						
Dibromofluoromethane**	%	TM116	110	118				
Toluene-d8**	%	TM116	95.9	96.1				
4-Bromofluorobenzene**	%	TM116	134	134				
Dichlorodifluoromethane	<4 µg/kg	TM116	<4 M	<4 M				
Chloromethane	<7 µg/kg	TM116	<7	<7				
Vinyl Chloride	<10 µg/kg	TM116	<10	<10				
Bromomethane	<13 µg/kg	TM116	<13 M	<13 M				
Chloroethane	<14 µg/kg	TM116	<14 M	<14 M				
Trichlorofluoromethane	<6 µg/kg	TM116	<6 M	<6 M				
1,1-Dichloroethene	<10 µg/kg	TM116	<10 #	<10 #				
Carbon Disulphide	<7 µg/kg	TM116	<7 M	<7 M				
Dichloromethane	<10 µg/kg	TM116	<10 #	<10 #				
Methyl Tertiary Butyl Ether	<11 µg/kg	TM116	<11 M	<11 M				
trans-1,2-Dichloroethene	<11 µg/kg	TM116	<11 M	<11 M				
1,1-Dichloroethane	<8 µg/kg	TM116	<8 M	<8 M				
cis-1,2-Dichloroethene	<5 µg/kg	TM116	<5 M	<5 M				
2,2-Dichloropropane	<12 µg/kg	TM116	<12 M	<12 M				
Bromochloromethane	<14 µg/kg	TM116	<14 M	<14 M				
Chloroform	<8 µg/kg	TM116	<8 M	<8 M				
1,1,1-Trichloroethane	<7 µg/kg	TM116	<7 M	<7 M				
1,1-Dichloropropene	<11 µg/kg	TM116	<11 M	<11 M				
Carbontetrachloride	<14 µg/kg	TM116	<14 M	<14 M				
1,2-Dichloroethane	<5 µg/kg	TM116	<5 M	<5 M				
Benzene	<9 µg/kg	TM116	<9 M	<9 M				
Trichloroethene	<9 µg/kg	TM116	<9 M	<9 M				
1,2-Dichloropropane	<12 µg/kg	TM116	<12 M	<12 M				
Dibromomethane	<9 µg/kg	TM116	<9 M	<9 M				
Bromodichloromethane	<7 µg/kg	TM116	<7 M	<7 M				
cis-1,3-Dichloropropene	<14 µg/kg	TM116	<14 M	<14 M				
Toluene	<5 µg/kg	TM116	<5 M	<5 M				
trans-1,3-Dichloropropene	<100 µg/kg	TM116	<100	<100				
1,1,2-Trichloroethane	<10 µg/kg	TM116	<10 M	<10 M				



CERTIFICATE OF ANALYSIS

SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

VOC MS (S)

Results Legend			Customer Sample R		TP109	TP110			
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference		0.60 - 0.60	0.30 - 0.30			
M	mCERTS accredited.				Soil/Solid	Soil/Solid			
aq	Aqueous / settled sample.				07/10/2013	07/10/2013			
diss.filt	Dissolved / filtered sample.								
tot.unfilt	Total / unfiltered sample.				09/10/2013	09/10/2013			
*	Subcontracted test.				131009-7	131009-7			
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery				8236830	8236835			
(F)	Trigger breach confirmed								
1-4&\$@	Sample deviation (see appendix)								
Component	LOD/Units	Method							
1,3-Dichloropropane	<7 µg/kg	TM116			<7	<7			
					#	#			
Tetrachloroethene	<5 µg/kg	TM116			<5	<5			
					M	M			
Dibromochloromethane	<13 µg/kg	TM116			<13	<13			
					M	M			
1,2-Dibromoethane	<12 µg/kg	TM116			<12	<12			
					M	M			
Chlorobenzene	<5 µg/kg	TM116			<5	<5			
					M	M			
1,1,1,2-Tetrachloroethane	<10 µg/kg	TM116			<10	<10			
					M	M			
Ethylbenzene	<4 µg/kg	TM116			<4	<4			
					M	M			
p/m-Xylene	<14 µg/kg	TM116			<14	<14			
					#	#			
o-Xylene	<10 µg/kg	TM116			<10	<10			
					M	M			
Styrene	<10 µg/kg	TM116			<10	<10			
					M	M			
Bromoform	<10 µg/kg	TM116			<10	<10			
					M	M			
Isopropylbenzene	<5 µg/kg	TM116			<5	<5			
					M	M			
1,1,2,2-Tetrachloroethane	<10 µg/kg	TM116			<10	<10			
					#	#			
1,2,3-Trichloropropane	<17 µg/kg	TM116			<17	<17			
					M	M			
Bromobenzene	<10 µg/kg	TM116			<10	<10			
					M	M			
Propylbenzene	<11 µg/kg	TM116			<11	<11			
					M	M			
2-Chlorotoluene	<9 µg/kg	TM116			<9	<9			
					M	M			
1,3,5-Trimethylbenzene	<8 µg/kg	TM116			<8	<8			
					#	#			
4-Chlorotoluene	<12 µg/kg	TM116			<12	<12			
					M	M			
tert-Butylbenzene	<12 µg/kg	TM116			<12	<12			
					#	#			
1,2,4-Trimethylbenzene	<9 µg/kg	TM116			<9	<9			
					#	#			
sec-Butylbenzene	<10 µg/kg	TM116			<10	<10			
					M	M			
4-Isopropyltoluene	<11 µg/kg	TM116			<11	<11			
					M	M			
1,3-Dichlorobenzene	<6 µg/kg	TM116			<6	<6			
					M	M			
1,4-Dichlorobenzene	<5 µg/kg	TM116			<5	<5			
					M	M			
n-Butylbenzene	<10 µg/kg	TM116			<10	<10			
					M	M			
1,2-Dichlorobenzene	<12 µg/kg	TM116			<12	<12			
					M	M			
1,2-Dibromo-3-chloroprop ane	<14 µg/kg	TM116			<14	<14			
					M	M			
Tert-amyl methyl ether	<15 µg/kg	TM116			<15	<15			
1,2,4-Trichlorobenzene	<6 µg/kg	TM116			<6	<6			
					#	#			
Hexachlorobutadiene	<12 µg/kg	TM116			<12	<12			
Naphthalene	<13 µg/kg	TM116			<13	<13			
					M	M			

SDG:	131009-7
Job:	H_WARDELL_SHF-87
Client Reference:	SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

VOC MS (S)

[illegible]



SDG:	131009-7	Location:	Ingbirchworth	Order Number:	SH3936
Job:	H_WARDELL_SHF-87	Customer:	Wardell Armstrong LLP	Report Number:	246252
Client Reference:	SH11118	Attention:	Mike Kelly	Superseded Report:	

Asbestos Identification - Solid Samples

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP103 0.40 - 0.40 SOLID 07/10/2013 00:00:00 131009-7 8236810 TM048	15/10/13	Lauren Sargeant	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP105 0.60 - 0.60 SOLID 07/10/2013 00:00:00 131009-7 8236818 TM048	15/10/13	Lauren Sargeant	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP109 0.60 - 0.60 SOLID 07/10/2013 00:00:00 131009-7 8236830 TM048	15/10/13	Lauren Sargeant	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP110 0.30 - 0.30 SOLID 07/10/2013 00:00:00 131009-7 8236835 TM048	15/10/13	Lauren Sargeant	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected



SDG: 131009-7
Job: H_WARDELL_SHF-87
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Location: Ingbirchworth
Customer: Wardell Armstrong LLP
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Superseded Report:

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
ASB_PREP				
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material		
TM062 (S)	National Grid Property Holdings Methods for the Collection & Analysis of Samples from National Grid Sites version 1 Sec 3.9	Determination of Phenols in Soils by HPLC		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM116	Modified: US EPA Method 8260, 8120, 8020, 624, 610 & 602	Determination of Volatile Organic Compounds by Headspace / GC-MS		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser		
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser		
TM157	HP 6890 Gas Chromatograph (GC) system and HP 5973 Mass Selective Detector (MSD).	Determination of SVOC in Soils by GC-MS extracted by sonication in DCM/Acetone		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		
TM221	Inductively Coupled Plasma - Atomic Emission Spectroscopy. An Atlas of Spectral Information: Winge, Fassel, Peterson and Floyd	Determination of Acid extractable Sulphate in Soils by IRIS Emission Spectrometer		
TM243		Mixed Anions In Soils By Kone		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.



SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
Customer: Wardell Armstrong LLP
Attention: Mike Kelly

Order Number: SH3936
Report Number: 246252
Superseded Report:

Test Completion Dates

Lab Sample No(s)	8236806	8236810	8236818	8236822	8236826	8236830	8236835
Customer Sample Ref.	TP101	TP103	TP105	TP106	TP108	TP109	TP110
AGS Ref.							
Depth	0.50 - 0.50	0.40 - 0.40	0.60 - 0.60	0.70 - 0.70	0.40 - 0.40	0.60 - 0.60	0.30 - 0.30
Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
Anions by Kone (soil)	15-Oct-2013	16-Oct-2013	16-Oct-2013	15-Oct-2013	16-Oct-2013	16-Oct-2013	16-Oct-2013
Asbestos ID in Solid Samples		15-Oct-2013	15-Oct-2013			15-Oct-2013	15-Oct-2013
Chromium III	17-Oct-2013	17-Oct-2013	17-Oct-2013	17-Oct-2013	16-Oct-2013	17-Oct-2013	17-Oct-2013
Cyanide Comp/Free/Total/Thiocyanate	17-Oct-2013	16-Oct-2013	16-Oct-2013	16-Oct-2013	16-Oct-2013	16-Oct-2013	16-Oct-2013
EPH CWG (Aliphatic) GC (S)						16-Oct-2013	16-Oct-2013
EPH CWG (Aromatic) GC (S)						16-Oct-2013	16-Oct-2013
GRO by GC-FID (S)						15-Oct-2013	15-Oct-2013
Hexavalent Chromium (s)	16-Oct-2013	17-Oct-2013	17-Oct-2013	16-Oct-2013	16-Oct-2013	16-Oct-2013	17-Oct-2013
Metals in solid samples by OES	17-Oct-2013	17-Oct-2013	17-Oct-2013	17-Oct-2013	15-Oct-2013	17-Oct-2013	17-Oct-2013
PAH by GCMS	15-Oct-2013		16-Oct-2013	15-Oct-2013	15-Oct-2013	15-Oct-2013	
pH	15-Oct-2013	16-Oct-2013	15-Oct-2013	15-Oct-2013	15-Oct-2013	16-Oct-2013	15-Oct-2013
Phenols by HPLC (S)	16-Oct-2013	15-Oct-2013	16-Oct-2013	16-Oct-2013	16-Oct-2013	16-Oct-2013	16-Oct-2013
Sample description	09-Oct-2013	11-Oct-2013	11-Oct-2013	09-Oct-2013	09-Oct-2013	11-Oct-2013	11-Oct-2013
Semi Volatile Organic Compounds		15-Oct-2013					15-Oct-2013
Total Organic Carbon	16-Oct-2013		16-Oct-2013		16-Oct-2013		16-Oct-2013
Total Sulphate	15-Oct-2013	16-Oct-2013	16-Oct-2013	15-Oct-2013	11-Oct-2013	16-Oct-2013	16-Oct-2013
TPH CWG GC (S)						16-Oct-2013	16-Oct-2013
VOC MS (S)						15-Oct-2013	15-Oct-2013



SDG: 131009-7
Job: H_WARDELL_SHF-87
Client Reference: SH11118

Location: Ingbirchworth
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Order Number: SH3936
Report Number: 246252
Superseded Report:

Appendix General

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICS and SVOC TICS.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 2 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible. The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP -No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals -total metals must be requested separately.

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** -Most of our organic methods include surrogates, the recovery of which is monitored and reported. For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted. Acceptable limits for most organic methods are 70 -130 %.

14. **Product analyses** -Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill /made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
§	Sampled on date not provided
+	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than :
 -

Trace -Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

A P P E N D I X I V

Statistical Analysis of Geochemical Results



STATISTICAL ANALYSIS OF SOIL CONTAMINATION DATA - PLANNING SCENARIO

(Based on CL:AIRE/CIEH Guidance on Comparing Soil Contamination Data with a Critical Concentration, May 2008)

Job Number: **SH11118**

Job Name: **Annat Royd Lane, Ingbirchworth**

Assessor: **M Kelly**

Date: **17-Oct-13**

Proposed Land Use: **Residential with Home Grown Produce**

Zone: **Whole Site**

Key Question: Is there significant evidence that the true mean concentration of the contaminant is less than the screening value (critical concentration)?

Null Hypothesis (H0): The true mean concentration is equal to or greater than the screening value (critical concentration; $\mu \geq C_c$)

Alternative Hypothesis (H1): The true mean concentration is less than the screening value (critical concentration; $\mu < C_c$)

SAMPLE IDENTIFICATION / STATISTICAL TEST		RECORDED CONCENTRATION / STATISTICAL RESULT															
		Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Vanadium (V)	Zinc (Zn)	Cyanide (free)	Phenol (total-mono)	Sulphate (total)	Sulphate (2:1)	pH	Chromium VI
Location	Depth (mbgl)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/l	mg/kg
TP101	0.50	6.8	0.02	25.6	18.6	13.2	0.14	32.2	1.0	19.7	85.6	1	0.04	65	0.004	7.23	0.6
TP103	0.40	15.3	0.03	24.4	21.5	64.8	0.19	20.3	1.7	31.6	82.4	1	0.04	345	0.004	6.77	3.0
TP105	0.60	6.8	0.02	21.2	15.2	16.6	0.14	25.8	1.0	18.6	80.1	1	0.04	135	0.021	7.25	3.0
TP106	0.70	8.2	0.02	26.3	16.5	15.1	0.14	31.7	1.1	20.9	81.6	1	0.04	254	0.029	6.18	1.2
TP108	0.40	11.8	1.58	22.1	24.2	46.5	0.14	38.0	2.5	23.1	189.0	1	0.04	628	0.033	8.14	0.6
TP109	0.60	13.5	0.03	20.0	19.8	54.1	0.16	20.4	1.4	24.5	78.1	1	0.04	282	0.017	6.79	3.0
TP110	0.30	7.3	0.02	23.7	27.0	28.2	0.14	31.7	1.0	21.4	79.5	1	0.04	106	0.004	8.00	0.6
Number of samples (N)		7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Minimum		6.84	0.02	20	15.2	13.2	0.14	20.3	1	18.6	78.1	1	0.035	65	0.004	6.18	0.6
Maximum		15.3	1.58	26.3	27	64.8	0.191	38	2.47	31.6	189	1	0.035	628	0.0329	8.14	3
Standard Deviation		4	1	2	4	21	0	7	1	4	41	0	0	192	0	1	1
Screening Value (Critical Conc.; C _c)		32	10	627	2330	450	170	130	350	75	3750	20	420	n/a	n/a	n/a	4.3
Source of Screening Value																	
Outlier Identification																	
Standardised Value (T _n)		1.399	2.260	1.233	1.463	1.246	2.081	1.273	1.808	1.930	2.258	#DIV/0!	-0.926	1.455	1.108	1.313	1.018
Critical Value (T _{crit})		1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938
Is there an Outlier (T _n > T _{crit})		NO	YES	NO	NO	NO	YES	NO	NO	NO	YES	#DIV/0!	NO	NO	NO	NO	NO
Outlier location(s) and depth(s)																	
Outlier status																	
Does the Data have a Normal Distribution?																	
Visual Estimate (probability plot)		YES	NO	YES	YES	YES	NO	YES	NO	YES	NO	n/a stdev=0	n/a stdev=0	YES	YES	YES	NO
Shapiro-Wilk statistic (W)		0.85	0.46	0.96	0.97	0.88	0.62	0.90	0.78	0.86	0.51	n/a stdev=0	n/a stdev=0	0.89	0.86	0.94	0.73
Shapiro-Wilk Test (is W > Sig(0.05))		YES	NO	YES	YES	YES	NO	YES	NO	YES	NO	n/a stdev=0	n/a stdev=0	YES	YES	YES	NO
Mean Concentration (95% UCL)		13	n/a	25	23	49	n/a	33	n/a	26	n/a	1	0	400	0	8	n/a
Is there significant evidence that the mean concentration is less than the screening value (μ < C _c)?		YES	n/a	YES	YES	YES	n/a	YES	n/a	YES	n/a	YES	YES	YES	YES	YES	n/a
Level of Evidence (p ₁ , %)		100	n/a	100	100	100	n/a	100	n/a	100	n/a	#DIV/0!	#DIV/0!	n/a	n/a	n/a	n/a
Does the Data have a Non-normal Distribution?																	
Chebychev Theorem		NO	YES	NO	NO	NO	YES	NO	YES	NO	YES	NO	NO	NO	NO	NO	YES
Mean Concentration (95% UCL)		n/a	1	n/a	n/a	n/a	0	n/a	2	n/a	164	n/a	n/a	n/a	n/a	n/a	4
Is there significant evidence that the mean concentration is less than the screening value (μ < C _c)?		n/a	YES	n/a	n/a	n/a	YES	n/a	YES	n/a	YES	n/a	n/a	n/a	n/a	n/a	YES
Level of Evidence (p ₁ , %)		n/a	99	n/a	n/a	n/a	99	n/a	99	n/a	99	n/a	n/a	n/a	n/a	n/a	96

NB: 1) values shown in bold exceed the critical concentration (adopted generic screening value); 2) Non-detects have been entered as the limit of detection for that substance and these values are shown in italics.



STATISTICAL ANALYSIS OF SOIL CONTAMINATION DATA - PLANNING SCENARIO

(Based on CL:AIRE/ClEH Guidance on Comparing Soil Contamination Data with a Critical Concentration, May 2008)

Job Number: **SH11118**

Job Name: **Annat Royd Lane, Ingbirchworth**

Assessor: **M Kelly**

Date: **17-Oct-13**

Proposed Land Use: **Residential with Home Grown Produce**

Zone: **Whole Site**

Key Question: Is there significant evidence that the true mean concentration of the contaminant is less than the screening value (critical concentration)?

Null Hypothesis (H0): The true mean concentration is equal to or greater than the screening value (critical concentration; $\mu \geq C_c$)

Alternative Hypothesis (H1): The true mean concentration is less than the screening value (critical concentration; $\mu < C_c$)

SAMPLE IDENTIFICATION / STATISTICAL TEST		RECORDED CONCENTRATION / STATISTICAL RESULT															
		Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(123cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Location	Depth (mbgl)	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
TP101	0.50	8.0	12.0	16.0	14.0	15.0	15.0	24.0	14.0	10.0	23.0	17.0	10.0	18.0	9.0	15.0	15.0
TP103	0.40	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
TP105	0.60	8.0	12.0	16.0	14.0	15.0	15.0	24.0	14.0	10.0	23.0	17.0	10.0	18.0	9.0	15.0	15.0
TP106	0.70	8.0	12.0	16.0	14.0	15.0	15.0	24.0	14.0	10.0	23.0	17.0	10.0	18.0	9.0	15.0	15.0
TP108	0.40	8.0	12.0	16.0	53.9	68.4	122.0	91.1	43.7	66.0	23.0	108.0	10.0	74.3	19.7	72.6	103.0
TP109	0.60	8.0	12.0	16.0	76.9	66.2	127.0	55.1	33.8	98.4	23.0	120.0	10.0	47.6	15.3	88.1	103.0
TP110	0.30	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of samples (N)		7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Minimum		8	12	16	14	15	15	24	14	10	23	17	10	18	9	15	15
Maximum		100	100	100.0	100	100	127	100	100	100	100	120	100	100	100	100	103
Standard Deviation		45	43	41	40	39	53	37	39	45	38	49	44	38	43	41	46
Screening Value (Critical Conc.; C _c)		210000	170000	2300000	3100	830	5600	44000	8500	6000	760	260000	160000	3200	1500	92000	560000
Source of Screening Value																	
Outlier Identification																	
Standardised Value (T _n)		1.464	1.464	1.464	1.013	1.004	0.919	1.014	1.255	0.887	1.464	0.920	1.464	1.082	1.406	0.913	0.816
Critical Value (T _{crit})		1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938	1.938
Is there an Outlier (T _n > T _{crit})		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Outlier location(s) and depth(s)																	
Outlier status																	
Does the Data have a Normal Distribution?																	
Visual Estimate (probability plot)		NO	NO	NO	YES	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO
Shapiro-Wilk statistic (W)		0.60	0.60	0.60	0.82	0.81	0.77	0.79	0.78	0.76	0.60	0.75	0.60	0.82	0.67	0.78	0.68
Shapiro-Wilk Test (is W > Sig(0.05))		NO	NO	NO	YES	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO
Mean Concentration (95% UCL)		n/a	n/a	n/a	83	83	n/a	n/a	n/a	n/a	n/a	n/a	n/a	81	n/a	n/a	n/a
Is there significant evidence that the mean concentration is less than the screening value ($\mu < C_c$)?		n/a	n/a	n/a	YES	YES	n/a	n/a	n/a	n/a	n/a	n/a	n/a	YES	n/a	n/a	n/a
Level of Evidence (p _v %)		n/a	n/a	n/a	100	100	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	n/a	n/a	n/a
Does the Data have a Non-normal Distribution?																	
Chebyshev Theorem.		YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES
Mean Concentration (95% UCL)		108	108	108	n/a	n/a	158	120	110	130	107	148	108	n/a	108	126	141
Is there significant evidence that the mean concentration is less than the screening value ($\mu < C_c$)?		YES	YES	YES	n/a	n/a	YES	YES	YES	YES	YES	YES	YES	n/a	YES	YES	YES
Level of Evidence (p ₁ %)		99	99	99	n/a	n/a	99	99	99	99	99	99	99	n/a	99	99	99

NB: 1) values shown in bold exceed the critical concentration (adopted generic screening value); 2) Non-detects have been entered as the limit of detection for that substance and these values are shown in italics.

APPENDIX V

Geotechnical Laboratory Results



LABORATORY REPORT



4043

Contract Number: PSL13/3816

Client's Reference:

Report Date: 24 October 2013

Client Name: Wardell Armstrong Sheffield
Unit 5
Newton Business Centre
Thorncliffe Park Estate
Sheffield
S35 2PH

For the attention of: Mike Kelly

Contract Title: Ingbirchworth

Date Received: 9/10/2013

Date Commenced: 9/10/2013

Date Completed: 24/10/2013

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]

Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	24/10/13		24/10/13		24/10/13
INGBIRCHWORTH.				Contract No:	PSL13/3816
				Client Ref:	SH3937

SUMMARY OF SOIL CLASSIFICATION TESTS

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

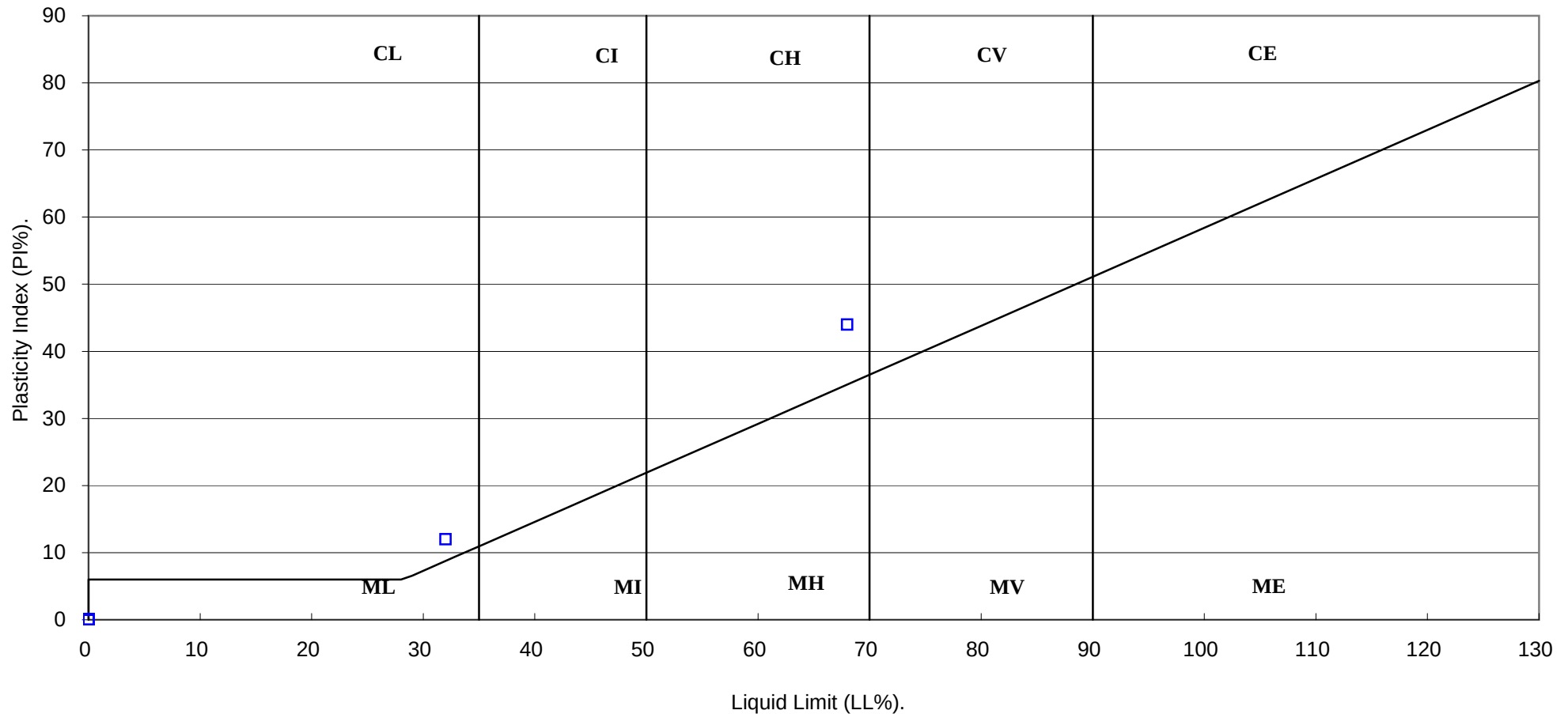
Hole Number	Sample Number	Sample Type	Depth m	Moisture Content % Clause 3.2	Bulk Density Mg/m ³ Clause 7.2	Dry Density Mg/m ³ Clause 7.2	Particle Density Mg/m ³ Clause 8.	Liquid Limit % Clause 4.3/4.4	Plastic Limit % Clause 5.	Plasticity Index % Clause 5.4	% Passing .425mm	Remarks
TP101		B	0.70	12					NP			
TP103		B	1.00	20				68	24	44	100	High plasticity CH.
TP105		B	0.60	14				32	20	12	34	Low plasticity CL.
TP109		B	1.40	13					NP			

SYMBOLS : NP : Non Plastic

	Compiled by	Date	Checked by	Date	Approved by	Date
		24/10/13		24/10/13		24/10/13
	INGBIRCHWORTH.					Contract No: PSL13/3816
						Client Ref: SH11118

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



PSL

Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	24/10/13		24/10/13		24/10/13
INGBIRCHWORTH.				Contract No:	PSL13/3816
				Client Ref:	SH11118

Particle Size Distribution Test

BS1377 : Part 2 : 1990

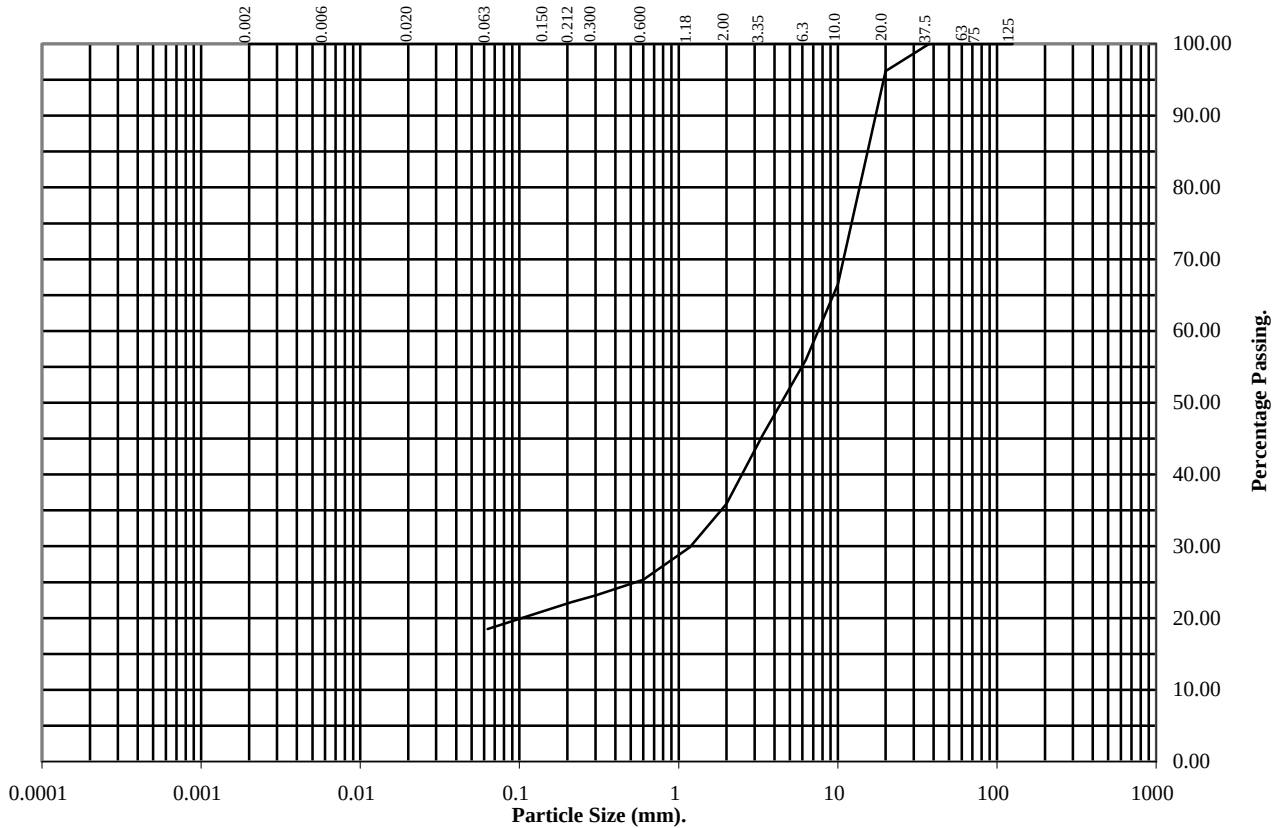
Wet Sieve, Clause 9.2

Hole Number: TP101

Depth (m): 0.70

Sample Number:

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	96
10	67
6.3	56
3.35	45
2	36
1.18	30
0.6	25
0.3	23
0.212	22
0.15	21
0.063	18

Soil Fraction	Total Percentage
Cobbles	0
Gravel	64
Sand	18
Silt / Clay	18

Remarks:
See summary of soils descriptions.

Checked By	Date	Approved By	Date
<i>[Signature]</i>	24/10/13	<i>[Signature]</i>	24/10/13

Particle Size Distribution Test

BS1377 : Part 2 : 1990

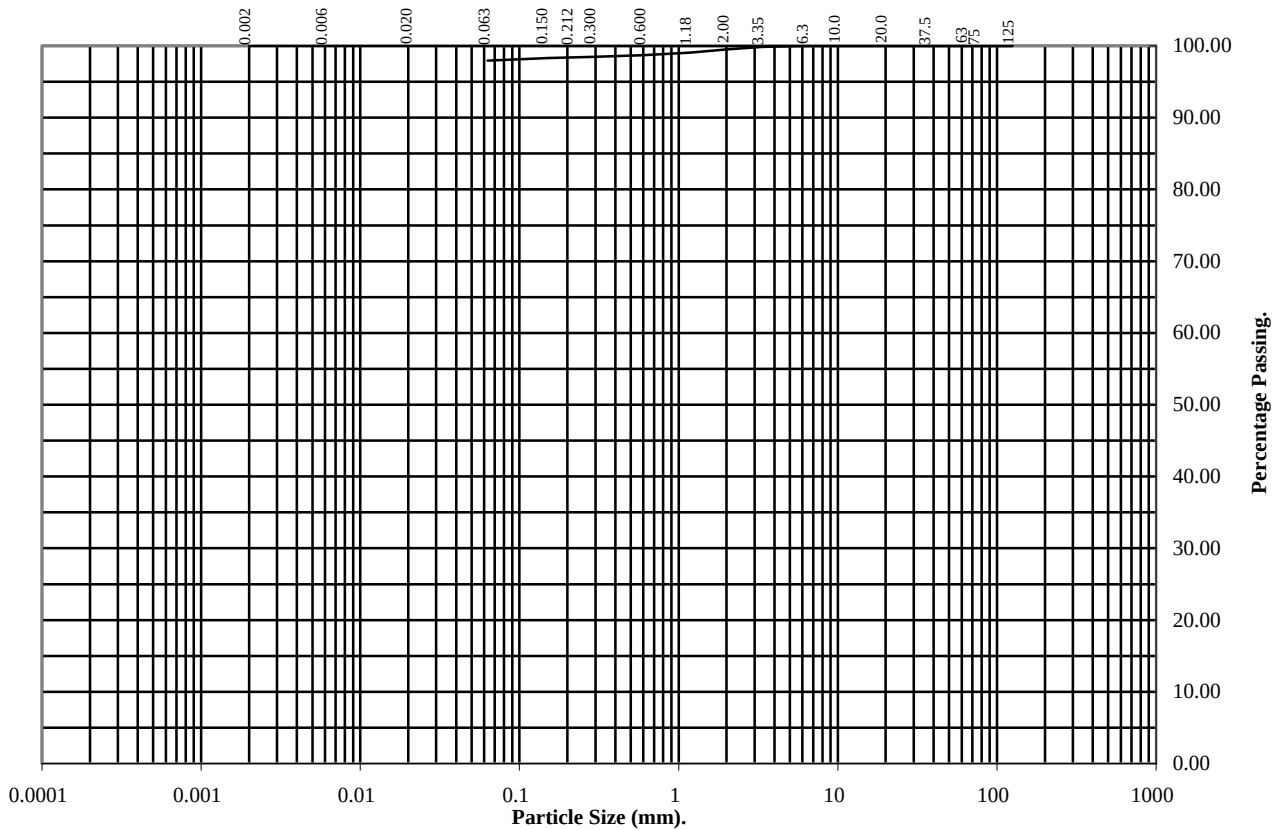
Wet Sieve, Clause 9.2

Hole Number: TP103

Depth (m): 1.00

Sample Number:

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	99
1.18	99
0.6	99
0.3	99
0.212	98
0.15	98
0.063	98

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	1
Silt / Clay	98

Remarks:
See summary of soils descriptions.

Checked By	Date	Approved By	Date
<i>[Signature]</i>	24/10/13	<i>[Signature]</i>	24/10/13

Particle Size Distribution Test

BS1377 : Part 2 : 1990

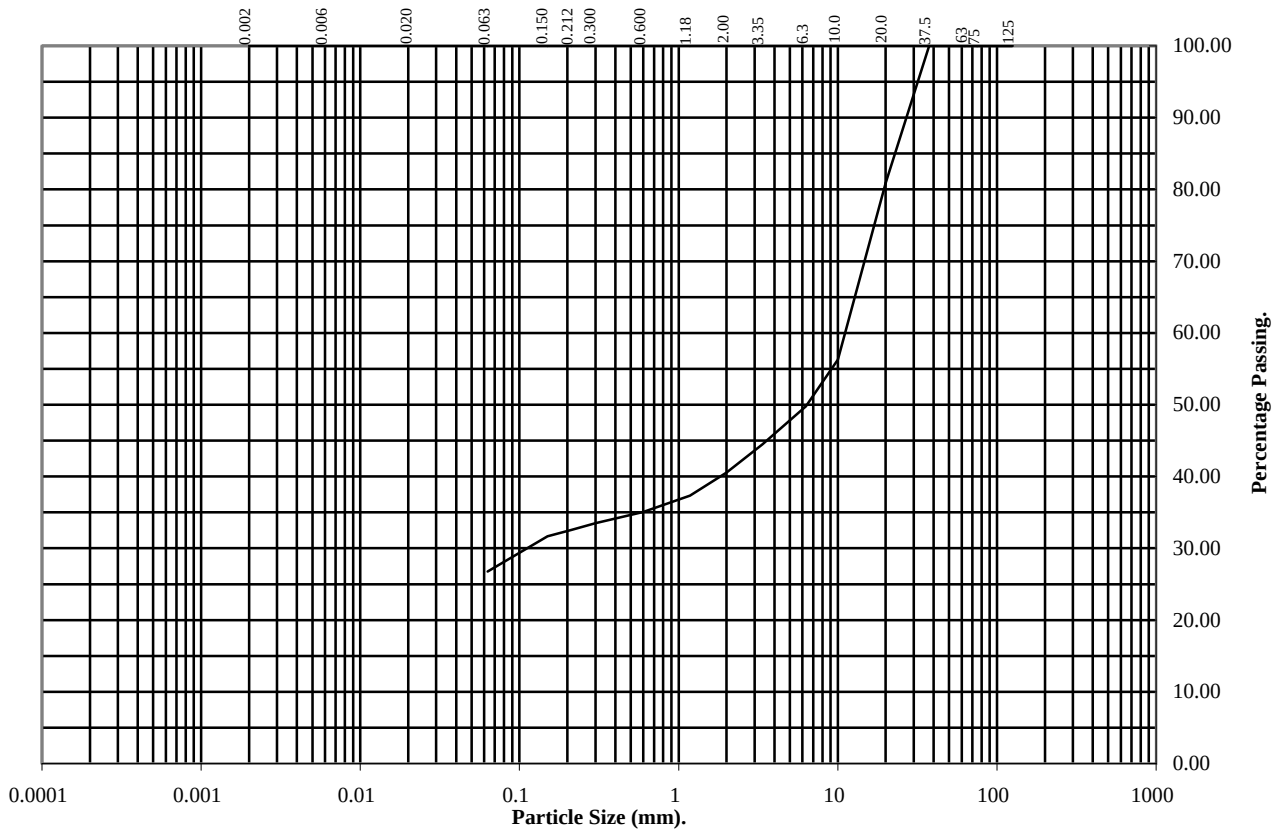
Wet Sieve, Clause 9.2

Hole Number: TP105

Depth (m): 0.60

Sample Number:

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	81
10	56
6.3	50
3.35	44
2	41
1.18	37
0.6	35
0.3	33
0.212	33
0.15	32
0.063	27

Soil Fraction	Total Percentage
Cobbles	0
Gravel	59
Sand	14
Silt / Clay	27

Remarks:
See summary of soils descriptions.

Checked By	Date	Approved By	Date
<i>[Signature]</i>	24/10/13	<i>[Signature]</i>	24/10/13

Particle Size Distribution Test

BS1377 : Part 2 : 1990

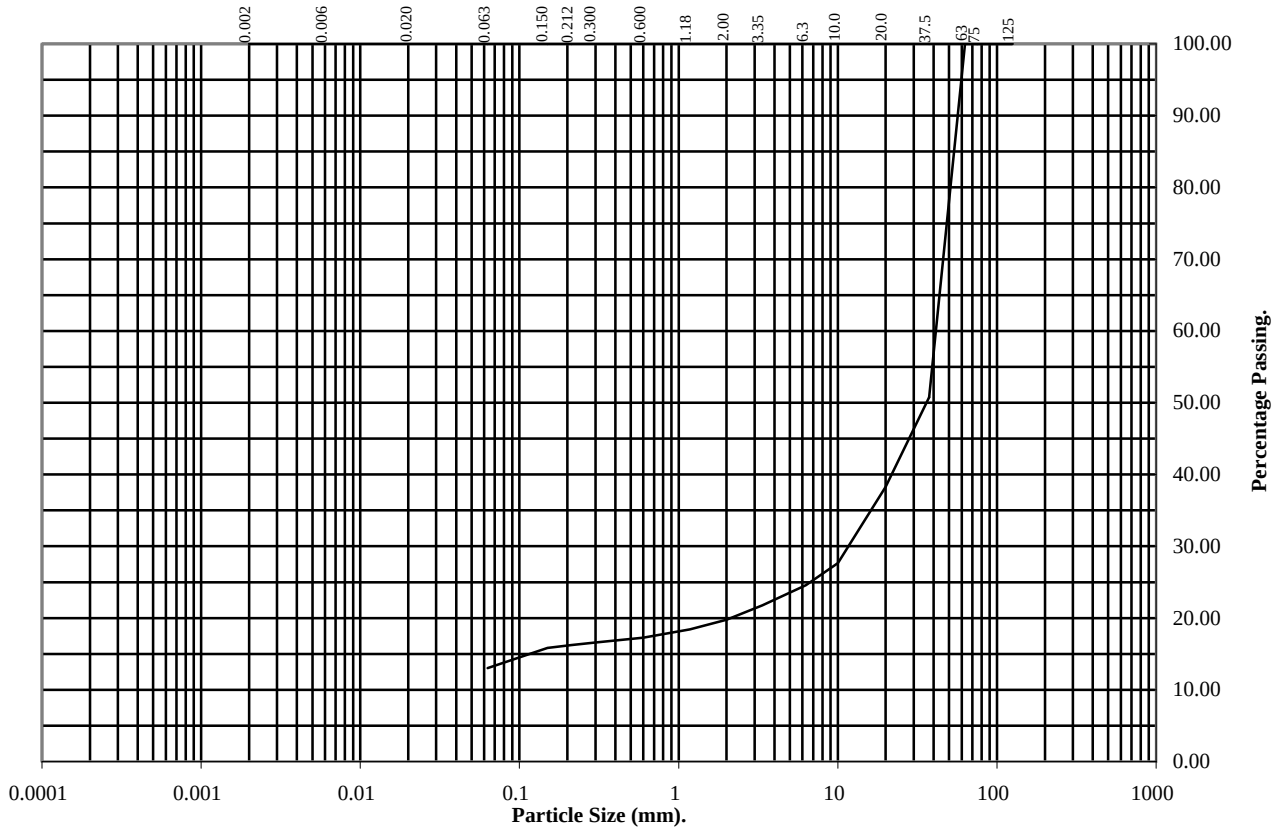
Wet Sieve, Clause 9.2

Hole Number: TP109

Depth (m): 1.40

Sample Number:

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	51
20	38
10	28
6.3	25
3.35	22
2	20
1.18	18
0.6	17
0.3	17
0.212	16
0.15	16
0.063	13

Soil Fraction	Total Percentage
Cobbles	0
Gravel	80
Sand	7
Silt / Clay	13

Remarks:
See summary of soils descriptions.

Checked By	Date	Approved By	Date
<i>[Signature]</i>	24/10/13	<i>[Signature]</i>	24/10/13

DRAWINGS

