



GEO

Environmental Engineering



PHASE 2: GROUND INVESTIGATION REPORT

**PROPOSED RESIDENTIAL DEVELOPMENT OF
LAND OFF WINDERMERE ROAD & FELL VIEW AVENUE**

WHITEHAVEN, CUMBRIA

FOR:

HOME GROUP LTD & THOMAS ARMSTRONG

GEO Environmental Engineering

DOCUMENT CONTROL SHEET

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1.0 Introduction

1.1 Brief

GEO Environmental Engineering Ltd (GEO) were commissioned by RG Parkins & Partners Ltd on behalf of the Client, Home Group Ltd & Thomas Armstrong to carry out a ground investigation on land at Windermere Road and Fell View Avenue in Whitehaven, Cumbria.

The investigation was carried out to determine the ground conditions across the site to aid the design of foundations, roads and drainage and to assess the risk to human health and environmental receptors from possible contamination and ground gas. The investigation also includes a preliminary risk assessment of possible shallow coal mine workings.

The scope of the investigation was determined by the Consultant based on recommendations included in the Phase I Geoenvironmental Site Assessment by e3p (see section 1.4 for more information).

1.2 Site Location and Description

The site encompasses two development areas in the south east part of Whitehaven, one to the east of Windermere Road and the other to the east of Fell View Avenue as indicated on the site location plan included in Appendix I.

The sites occupy an area of c.0.63ha and c.0.56ha respectively. Both areas were open with easy access from the road.

- National Grid Reference: Windermere Road: 297203,515981
 Fell View Avenue: 297166,516291

The development areas comprise elongated strips of well-maintained grass with occasional areas of dense scrub vegetation. The land was previously occupied by housing, and it is understood that the buildings were demolished between 2010 and 2016. The reason for demolition is unknown. Two semi-detached houses remain in the area adjacent to Windermere Road, however, it is unclear if these are still occupied.

The development areas undulate gently with an overall fall in levels to the east. A topographical survey has not been provided, however, Ordnance Survey data suggests that the sites are at an elevation of between 90m and 100m OD.

1.3 Proposed Development

It is understood that the Client plans to develop the site for residential end use. A plan of the proposed site layout has been provided and a copy is included in Appendix I. The plan indicates conventional houses with private gardens, soft landscaping, car parking and other associated infrastructure.

The Client is also considering the use of a soak-away drainage system if the ground conditions prove suitable.

1.4 Other Reports/Studies

A Phase I Geoenvironmental Site Assessment has been completed for the site by e3p, details of which are included below:

- Phase I Geoenvironmental Site Assessment by e3p, ref: 15-861-R1-1, dated: April 2022.

A summary of the site assessment is included below, however, it is recommended that the assessment is read in conjunction with this report.

Historical records indicate that the land comprised agricultural fields and a golf course prior to development with housing during the 1930s. The housing was demolished between 2010 and 2016.

Geological records indicate that the south western part of Windermere Road and the north eastern part of Fell View Avenue are underlain by Glacial Till. The rest of the development areas are recorded as being devoid of drift deposits. Solid strata is recorded as Pennine Middle Coal Measures and Whitehaven Sandstone Formation.

With regards to coal mining, the e3p report indicates that the site is not located within a development high-risk area. However, the report does indicate a high risk of coal mining within the No.8 and No.3 coal seams at depths exceeding c.44m bgl. The seams are recorded as having an extraction thickness of c.0.65m. e3p do not indicate a risk of shallow (<30m) unrecorded coal mining within their report.

The report indicated a former landfill c.67m north east at the former Woodhouse Quarry. This accepted up to 75,000 tonnes of non-biodegradable waste until 2019.

With regards to radon, the report indicates that the site is in an area where less than 1% of homes are above the "Action Level" and that the BGS reports that full radon protective measures are not necessary in the construction of new dwellings or extensions.

With regards to environmental sensitivity, the e3p report indicates there is a low risk to controlled waters as significant sources of mobile contamination were not anticipated. The site is not located within a groundwater source protection zone and there are no groundwater abstractions within c.1km of the site. There are no surface water features within c.50m of the site boundary. The solid strata is recorded as a Secondary Aquifer.

With regards to human health, the e3p report indicated that there are limited potential sources of contamination. However, localised areas may be impacted by heavy metals and hydrocarbon compounds. The report also mentions a potential for asbestos material associated with the former buildings which may have impacted the underlying soils during demolition.

The e3p report indicates that the CA will require a 'probing exercise' in the locality of the mine shaft in the northern sector of the site. It is considered likely that this comment was included in error (possibly from a previous template) as no mine shafts are indicated in the northern part of the site or within c.20m of the site boundary.

The e3p report also refers to a previous intrusive ground investigation report by Curtins Consulting Ltd for the wider Woodhouse and Green Bank Estate areas although no factual data has been provided. The report concluded that no evidence of shallow coal workings was recorded within the two rotary boreholes but recommended further investigations with respect to possible shallow mining (across the wider area). The report also mentioned a possibility of shallow bell pits/adits being present along the outcrop position of coal seams.

2.0 Ground Investigation Reporting

2.1 Ground Investigation Aims and Objectives

The overall objective of this Ground Investigation is to provide information relating to the geotechnical and environmental properties of the ground and groundwater across the development area in order to facilitate foundation and drainage design and determine any risks to human health or the surrounding environment.

2.2 Guidelines, Codes of Practice and Third-Party Accreditations

This report contains information relating to the geotechnical properties of the soils encountered on site to aid foundation and highway design by a Structural Engineer. The report also incorporates a Level 1 Ground Contamination and Ground Gas Risk Assessment for Human Health (Generic Quantitative Risk Assessment – GQRA).

The laboratory testing (geotechnical and ground contamination) was completed by UKAS and MCERTS accredited laboratories with details given in Sections 6, with copies of the test reports contained within Appendix III.

This Ground Investigation Report has generally been completed in accordance with the following documents:

- Land Contamination Risk Management Stages 1 to 4 (LCRM – www.gov.uk) – April 2021.
- BS10175: 2017: Code of Practice for the Investigation of Potentially Contaminated Sites.
- BS5930: 2020: Code of Practice for Site Investigations.
- BS1377: 1990: Methods of test for soils for civil engineering purposes.
- BS8485: 2019: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.
- BS8576: 2013: Guidance on Ground Gas Investigations.
- CIRIA Report C665: 2015.
- Eurocode 7 – Geotechnical Design (Part 1: General Rules and; Part 2: Ground Investigation and Testing).
- UK Specification for Ground Investigation, 2nd Edition. Site Investigation Steering Group, 2011.
- Effective Site Investigation. Site Investigation Steering Group, 2013.
- SP1010 Development of Category 4 Screening Levels Main Report, 2014.
- The LQM/CIEH S4UL's for Human Health Risk Assessment, 2015.
- CIRIA C758D 2019 - Abandoned Mine Workings Manual

2.3 Ground Investigation Limitations of Use

Although every effort is made to ensure a full and comprehensive investigation has been completed, it should always be borne in mind that ground conditions have the potential to vary between exploratory hole locations and it is recommended that the developer adopt a “watching brief” during the redevelopment works to ensure that any potential variations encountered are identified and dealt with in an appropriate manner.

The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/or other key stakeholders, including warranty providers in order to seek their approval of the findings prior to commencing any development works.

The Ground Investigation Report and its contents are limited to the boundaries of the site, as indicated on the Plans in Appendix I. Reliance on the report is for the named Client only. No reliance, copying or use of this report (in part or whole) by any Third Party is permitted without prior written approval from Geo Environmental Engineering Ltd, with intellectual copyright remaining the sole property of the author. Reliance on the report and its associated information is strictly in accordance with Geo Environmental Engineering Ltd Terms and Conditions, copies of which are available on request.

2.4 Consideration for Residential End Use

It is understood that the site will be developed for residential end use with houses, gardens, car parking, access roads, and other associated infrastructure. Consequently, when considering the intended development, the site is considered suitable for assessment using a Level 1 Generic Quantitative Risk Assessment (GQRA).

A GQRA provides details of potential future risks to Human Health (proposed end users) from any contamination which may be identified on site in made ground or natural soils. For the Human Health Risk Assessment, it is considered that the future residents will be subjected to the greatest exposure periods and consequently the most risk. Therefore, in accordance with current guidance and legislation a CLEA end use classification of *residential* has been considered most appropriate.

3.0 Ground Investigation Fieldwork

3.1 Intrusive Investigation Fieldworks Summary

The ground investigation works were completed in two phases between 6th June and the 20th July 2022. The exploratory holes were located across the site to provide general site coverage taking into consideration the locations of buried utilities and surface obstructions. The scope of works was specifically requested based on the findings and recommendations of the previous Geoenvironmental Site Assessment by e3p. Therefore any items not specifically mentioned cannot be assumed to be covered.

The exploratory hole location plan is provided in Appendix I. The ground investigation works comprised:

Windermere Road Development Area:

- 4 No. Mini-percussive Boreholes (BH01 to BH04) to depths of between c.2.00m and c.3.20m bgl.
- 8 No. Mechanically Excavated Trial Pits (TP01 to TP08) to depths of between c.1.60m and c.2.40m bgl.
- 4 No. shallow hand dug pits (HP01 to HP04)
- Installation of 4 No. ground gas monitoring wells (BH01 to 04).
 - Gas and groundwater monitoring (6 visits completed).
- 2 No. Falling Head Tests (BH02 and 03)
- 4 No. In-Situ Dynamic Cone Penetrometer (DCP) Tests (TP02, 04, 05 and 07).
- 1 No. rotary open-holed bore to c.28.5m bgl using water flush (RBH01).

Fell View Avenue:

- 5 No. Mini-percussive Boreholes (BH05 to BH09) to depths of between c.1.50m and c.4.40m bgl.
- 9 No. Mechanically Excavated Trial Pits (TP09 to TP17) to depths of between c.1.60m and c.2.30m bgl.
- Installation of 3 No. ground gas monitoring wells (BH06, 08 and 09).
 - Gas and groundwater monitoring (6 visits completed).
- 2 No. Falling Head Tests (BH05 and 07)
- 3 No. In-Situ Dynamic Cone Penetrometer (DCP) Tests (TP09, 11 and 16).
- 2 No. rotary open-holed bore to depths of between c.16.6m and c.25.5m bgl using water flush (RBH02 and 03).

The fieldworks were supervised by a suitably qualified and experienced Geo-Environmental Engineer. The investigation fieldworks were undertaken in accordance with BS5930:2020, BS1377:1990 and Eurocode 7 (Part I and II).

Representative soil samples were recovered from the exploratory holes for geotechnical testing and chemical screening. The laboratory tests results are provided in Appendix III.

In-situ Standard Penetration Tests (SPT) were completed in all of the boreholes at c.1m intervals. In-situ hand shear vane tests in the trial pits as necessary and where safe to do so. The results of the in-situ tests are presented on the logs included in Appendix II.

At each exploratory hole location, the surfacing type, made ground, natural ground and groundwater conditions were observed, with in-situ testing undertaken and samples recovered. Details of the ground conditions are included on the exploratory hole logs which are included in Appendix II together with other relevant ground investigation data.

The results of the Dynamic Cone Penetrometer (DCP) tests and the calculated CBR values are presented in Appendix II.

All depths included in the report are in metres below ground level (m bgl), unless stated otherwise.

4.0 Ground and Groundwater Conditions

The following section provides a summary of the ground conditions encountered across the site during the investigation. Reference should be made to the exploratory hole logs included in Appendix II for detailed descriptions of the strata and groundwater conditions. All depths are reported in metres below ground level (m bgl) unless stated otherwise.

4.1 Windermere Road Development Area

4.1.1 Made Ground, Topsoil and Relict Structures

Topsoil was encountered across the site at depths of between c.0.10m and c.0.30m bgl (typically less than c.0.20m thick). This was described as dark brown sandy gravelly loam with rare fragments of pottery, brick, glass and concrete.

Made ground was encountered in several exploratory holes to a maximum depth of c.0.70m bgl (typically less than c.0.60m bgl). The made ground generally comprised reworked firm to stiff slightly sandy gravelly clay with occasional brick, concrete, timber and wires noted.

Relict foundations were occasionally noted beneath the topsoil. The structures comprised brick on a concrete slab to depths of between c.0.60m and c.0.65m bgl.

During the investigation, GEO did not identify any visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) or any landfill type waste such as potentially biodegradable, decomposable or putrescible materials.

4.1.2 Natural Drift Deposits

Natural drift deposits were encountered from depths of between c.0.21m bgl and c.0.70m bgl. This typically comprised firm to stiff, becoming stiff brown slightly sandy, occasionally gravelly clay.

Hand shear vane tests were carried out in the trial pits at depths of between c.0.70m and c.1.10m bgl to confirm field descriptions and aid foundation design. Hand shear vane tests within the clay deposits gave undrained shear strengths of between 60kN/m² and 110kN/m² which is indicative of medium and high strength deposits.

In-situ Standard Penetration Tests (SPTs) were completed in the boreholes at depths of between c.1.00m and c.3.00m bgl. The tests within the clay deposits gave 'N' values of between 6 and 12 which is indicative of clays of medium strength. SPT tests within the weathered bedrock deposits gave N values of >50 indicating refusal (further penetration not possible).

4.1.3 Solid Geological Deposits (Bedrock)

Weathered bedrock was encountered from depths of between c.1.10m and c.2.50m bgl. The weathered rock was typically shallowest in the southern parts and comprised very weak siltstone/mudstone with occasional thin bands of coal. The bedrock was recovered as a silty gravel in the trial pits and mini-percussive boreholes.

A thick band of black coal and/or carbonaceous siltstone was encountered in exploratory pits TP01, TP03 and BH04. The seam varied between c.0.30m and c.0.60m thick and was encountered from depths of between c.1.10m and c.1.80m bgl. No evidence of mine workings was encountered.

Rotary borehole RBH01 was drilled in the southern part of the site and encountered bedrock of light brown sandstone and grey brown mudstone from a depth of c.2.20m bgl. Two coal seams were

encountered at c.14.70m (c.0.70m thick) and c.16.40m (c.0.40) bgl. No evidence of workings (voids, broken ground or loss of flush) was encountered.

4.1.4 Groundwater

During the intrusive ground investigation works, groundwater was occasionally encountered as a minor seep at depths of between c.1.10m and c.2.10m bgl within the weathered bedrock strata. Boreholes BH01 and BH02 had standing water at depths of between c.0.95m and c.2.10m bgl on completion.

Groundwater monitoring of installations placed in the boreholes has been carried out on six occasions between June and December 2022. Standing groundwater levels have been recorded between c.0.80m and c.2.30m bgl, however, several of the boreholes remained dry. Given the ground conditions, it is likely that the water has resulted from surface ingress which has been trapped/perched within the boreholes rather than a continuous groundwater table.

4.2 Fell View Avenue Development Area

4.2.1 Made Ground, Topsoil and Relict Structures

Topsoil was encountered across the site to depths of between c.0.10m and c.0.20m bgl. This was described as dark brown sandy gravelly loam with fragments of brick and concrete.

Made ground was encountered in several of the exploratory holes to a maximum depth of c.1.20m bgl (typically less than c.1.00m bgl). The made ground generally comprised reworked firm to stiff slightly sandy gravelly clay with occasional brick, pottery, concrete, scaffolding bars and paving slabs.

Trial pits TP14 and TP15 were located in the areas of dense vegetation at the request of the Consultant. The ground surface in these areas was noted as “very soft, wet and boggy”. The trial pits encountered made ground to a depth of between c.1.10m and c.1.20m bgl. The made ground comprised soft, locally very soft saturated dark grey to black gravelly silt with much organic material, brick (whole and part), sandstone, concrete and timber.

Relict foundations were occasionally noted beneath the topsoil. The structures comprised brick on a concrete slab to depths of between c.0.50m and c.1.20m bgl.

During the investigation, GEO did not identify any visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) or any landfill type waste such as potentially biodegradable, decomposable or putrescible materials.

4.2.2 Natural Drift Deposits

Natural drift deposits were encountered from depths of between c.0.40m and c.1.20m bgl. This typically comprised firm to stiff, becoming stiff brown slightly sandy, occasionally gravelly clay.

Dark red brown very silty/clayey angular to sub-rounded gravel and cobbles of sandstone were encountered in the northern part (TP16, TP17, BH08 and BH09) from depths of between c.0.40m and c.0.80m bgl.

Hand shear vane tests were carried out in the trial pits where feasible to confirm field descriptions and aid foundation design. The tests were completed at depths of between c.1.00m and c.1.30m bgl. The tests within the clay deposits gave undrained shear strengths in excess of 80kN/m² and 110kN/m² which is indicative of high strength deposits.

In-situ Standard Penetration Tests (SPTs) were completed in the boreholes at depths of between c.1.00m and c.4.00m bgl. The tests within the clay deposits gave 'N' values of between 6 and 27 which is indicative of clays of medium and high strength. SPT tests within the sandstone gravel gave 'N' values of between 26 and >50, which is indicative of medium dense and dense deposits. SPT tests within the weathered bedrock deposits gave 'N' values of between 36 and >50 indicating dense deposits and refusal (further penetration not possible).

4.2.3 Solid Geological Deposits (Bedrock)

Weathered bedrock was encountered from depths of between c.1.70m and c.3.00m bgl in trial pits TP12, and TP17, and boreholes BH05 to BH18. The bedrock generally became deeper to the north. This comprised very weak siltstone/mudstone with occasional very thin bands of coal. The bedrock was recovered as a silty gravel in the trial pits and percussive boreholes.

A thick band of black coal / carbonaceous siltstone was encountered in trial pit TP12. The seam was c.0.30m thick and was encountered at a depth of c.1.70m bgl. Only thin bands of coal were encountered in the other trial pits.

Rotary boreholes RBH02 and RBH03 were located at each end of the proposed development area. The boreholes encountered bedrock comprising sandstone and mudstone from depths of between c.2.90m and c.5.00m bgl, also confirming that bedrock becomes deeper to the north. Two seams of coal were encountered in both boreholes. The shallowest seam was between c.0.30m and c.0.40m thick and was encountered at a depth of between c.10.20m and c.12.50m bgl, becoming deeper to the north. The second, deeper seam was between c.0.60m and c.0.70m thick and was encountered at depths of between c.13.80m and c.22.80m bgl. The boreholes were terminated due to refusal on ironstone, with no further penetration possible. No evidence of workings (voids, broken ground or loss of flush) was encountered.

4.2.4 Groundwater

During the intrusive ground investigation works the boreholes and trial pits were typically dry on completion with the exception of TP14 and TP15. These exploratory holes were located in an area of dense vegetation where the ground was noted to be "wet and boggy". Significant groundwater ingress was noted from the surface and from the made ground.

Groundwater monitoring of installations placed in the boreholes has been carried out on six occasions between June and December 2022. Standing groundwater was encountered in BH06 and 08 at depths of between c.1.85 and c.3.3.20m and c.3.20m bgl. BH09 was recorded as dry at c.1.00m bgl throughout. Given the ground condition, it is likely that the water has resulted from surface ingress which has been trapped/perched within the boreholes rather than a continuous groundwater table.

5.0 Exploratory Hole Testing

In-situ site testing and monitoring was generally undertaken in accordance with BS5930:1999, BS1377:1990 and Eurocode 7 (Part I and II).

5.1 Standard Penetration Tests

5.1.1 Standard Penetration Test Methodology

To determine the relative density and strength of the underlying soils, Standard Penetration Tests (SPT's) were completed within the boreholes. The test uses a "split spoon" sample tube (external diameter of c.50mm, internal diameter of c.35mm and a length of around c.650mm) driven from the base of the borehole as it is progressed, usually at c.1.00m spacing's/intervals.

The sample tube is driven by blows of a slide hammer with a weight of c.63.5kg falling over a c.760mm drop. The sample tube is driven c.150mm into the ground (seating blows) and then the number of blows needed for the tube to penetrate each c.75mm increment up to a depth of c.450mm is recorded.

The number of blows for the final c.300mm of penetration is referred to as the "standard penetration resistance" or "N" value, which are presented on the exploratory hole logs adjacent to each sample depth. Where 50 blows are insufficient to advance the test through a c.75mm interval the amount of penetration after 50 blows is recorded and the test is referred to as a "refusal".

5.1.2 Standard Penetration Test Results

In-situ Standard Penetration Tests (SPTs) were completed in the boreholes at c.1m intervals at depths of between c.1.00m and c.4.00m bgl.

The tests within the clay deposits gave 'N' values of between 6 and 12 within the Windermere Road area (indicative of clays of medium strength) and between 6 and 27 within the Fell View Avenue area (indicative of clays of medium and high strength).

SPT tests within the sandstone gravel encountered across the northern part of the Fell View Area gave 'N' values of between 26 and >50, which is indicative of medium dense and dense deposits.

SPT tests within the weathered bedrock deposits gave 'N' values of between 36 and >50 indicating dense deposits and refusal (further penetration not possible).

The results of the standard penetration tests are presented on the borehole logs which are included in Appendix II.

5.2 Hand Shear Vane Tests

Hand shear vane tests were carried out in the trial pits at depths of between 0.70m and 1.30m bgl where feasible to confirm field descriptions and aid foundation design. Hand shear vane tests within the clay deposits gave undrained shear strengths of between 60kN/m² and 110kN/m² which is indicative of high strength deposits.

The results of the hand shear vane tests are presented on the trial pit logs which are included in Appendix II.

5.3 Dynamic Cone Penetrometer Tests (DCP)

The Dynamic Cone Penetration (DCP) Test provides a measure of a material's in-situ resistance to penetration. The test is performed by driving a metal cone into the ground by repeated striking it with an 8kg weight dropped from a distance of 575 mm. The penetration of the cone is measured after each blow and is recorded to provide a continuous measure of shearing resistance up to c.0.85m below the ground surface. Test results can be correlated to California Bearing Ratio to aid pavement design by a Civil Engineer.

The results of the Dynamic Cone Penetrometer tests and the calculations of the equivalent CBR values are included in Appendix II (Dynamic Cone Penetrometer Calculation Sheet).

It should be borne in mind that the results of the Dynamic Cone Penetrometer tests can be influenced by the coarse content (gravel, cobbles, etc...) within the materials tested, therefore, it is always recommended that the appropriate CBR value is confirmed by way of plate load testing at formation level.

5.4 Ground Permeability (Falling Head Tests)

It is understood that the Client is considering the use of soak-away style drainage as part of the proposed development. In order to facilitate the soak-away design, falling head tests were completed in boreholes BH02, BH03, BH05 and BH07.

The test involved partially filling the boreholes with water and recording the water level on frequent occasions until the water had drained sufficiently. The water level is monitored at regular intervals until the water has drained away or until sufficient time has elapsed to confirm that soak away drainage is not feasible.

The tests in each of the boreholes were completed over a duration of 300 minutes (5 hours). Over this duration, the water level in borehole BH02 dropped from c.0.25m to c.0.93m bgl. Although the water level did not drain completely, a preliminary calculation has been completed which indicates an infiltration rate of 1.7×10^{-8} m/s. This equates to a 'very low' permeability classification and a 'practically impervious' drainage characteristic.

The water levels in boreholes BH03, BH05 and BH07 dropped between c.90mm and c.160mm which is insufficient to calculate a meaningful infiltration rate.

Based on the ground conditions encountered across the site, the groundwater levels and the results of the falling head tests presented above, soak away drainage is not considered suitable and an alternative drainage solution should be sought.

5.5 Ground Gas Monitoring

To assess the on-site potential for hazardous ground gases, boreholes BH01 to BH04 (Windermere Road Development) and boreholes BH06, BH08 and BH09 (Fell View Avenue Development) were installed with ground gas monitoring wells to facilitate a period of ground gas monitoring.

The boreholes were installed to depths of between c.2.00m and c.3.50m bgl with a 50mm diameter HDPE standpipe. The top section of the well comprised solid pipe surrounded by a bentonite seal and the lower section comprised slotted pipe with a gravel filter. A plastic cap was fitted at the base of the well and a rubber bung and gas valve were fitted at the surface. The installation details are presented on the borehole logs in Appendix II.

The monitoring and assessment has been completed in accordance with BS8485: 2015: Code of practice for the characterisation and remediation from ground gas affected developments, CIRIA Report C665, November 2015 and the NHBC Document; Guidance on the evaluation of development proposals on site where methane and carbon dioxide are present, March 2015.

As the site will be developed for residential end use, the monitoring of ground gas monitoring must comprise at least six site visits over a minimum period of three months.

The wells have been monitored on six occasions between June and December 2022 in general accordance with CIRIA C665 (Table 5.5a and 5.5b) using a GFM436 Gas Analyser with Integral Flow Pod.

The results of monitoring are included on the Ground Gas Monitoring Record Sheets included in Appendix II. The ground gas risk assessment is presented in Section 8.3 of this report.

6.0 Laboratory Testing

6.1 Geotechnical Testing

Geotechnical testing was completed in general accordance with BS1377:1990: Part 1 to 4 by the following UKAS and MCERTS accredited laboratory:

- Northumberland County Council Highways Laboratory, Cramlington, Northumberland (NCC).

9 No. samples of the natural drift deposits recovered from the exploratory holes at depths of between c.0.70m and c.1.50m bgl were subjected to the following laboratory based geotechnical tests:

- Moisture Content
- Atterberg - Liquid and Plastic Limits

6.2 Chemical Screening

6.2.1 Determination of pH and Water-Soluble Sulphate

In order to determine the correct concrete classification for buried structures (foundations), the following samples were scheduled for laboratory pH and water-soluble sulphate (SO₄) screening:

- 9 No. samples of topsoil (c.0.10m bgl)
- 5 No. samples of made ground (c.0.30m to c.0.40m bgl)
- 6 No. samples of the natural drift deposits (c.0.90m to c.1.50m bgl)

The testing was completed in general accordance with BS1377:1990: Part 1 to 4 by the following UKAS and MCERTS accredited laboratory:

- Chemtech Environmental Testing of Stanley, County Durham.

The results of the testing are summarised in Section 8 and presented in the Chemtech report (ref: 110347) contained in Appendix III.

6.2.2 Contamination Testing for Human Health

To enable the completion of a Level 1 Generic Quantitative Risk Assessment (GQRA) for Human Health, the following samples were scheduled for chemical screening:

- 9 No. samples of topsoil (c.0.10m bgl)
- 5 No. samples of made ground (c.0.30m to c.0.40m bgl)

The samples were subjected to analysis at the following UKAS and MCERTS accredited laboratory:

- Chemtech Environmental Testing of Stanley, County Durham.

Potential Contaminants of Concern (PCOC's) have been determined for the development area based on the descriptions of the materials encountered within the exploratory holes and the potential for made ground of an unknown source. The samples were screened for the contaminants detailed below:

- **Inorganic Soil Suite (Human Health Risk Assessment):** Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium and Zinc), Cyanide and Total Organic Carbon.

- **Organic Soil Suite (Human Health Risk Assessment):** Speciated Polycyclic Aromatic Hydrocarbons (PAH – USEPA 16).
- **Other:** Asbestos

1 No. sample of suspected coal / carbonaceous siltstone recovered from trial pit TP01 at c.1.50m bgl was scheduled to calorific value test to determine the potential for combustion.

The full catalogue of soil screening results and test detection limits can be seen in the Chemtech report (ref: 110347) contained in Appendix III.

No visual or olfactory evidence of organic contamination was identified during the fieldworks as expected given the site history. Therefore, the samples were not screened for TPH's, BTEX, MTBE, SVOC's or VOC'S.

No evidence of contamination was noted within the natural drift geological deposits, therefore, no samples of the drift were scheduled for chemical screening.

6.3 Controlled Waters Risk Assessment

The e3p Phase I Desk Top Study indicated that the risk to Controlled Waters was low based on the site's history (fields and residential development) and the lack of sensitive receptors. During the intrusive site works, no evidence of hydrocarbon or potentially mobile contaminants were encountered. As such, the risk to offsite receptors and controlled waters was considered negligible.

During the monitoring visits, the water levels were monitored within the boreholes to determine if groundwater sampling could be undertaken. However, insufficient groundwater was present within the boreholes to allow the recovery of groundwater samples. To date, no groundwater sampling or chemical screening has been completed.

7.0 Geotechnical Analysis

7.1 Testing for Moisture Content, Liquid and Plastic Limits

9 No. samples of the natural clay deposits recovered from the exploratory holes at depths of between c.0.70m and c.1.50m bgl were scheduled for classification tests to determine their moisture content, liquid and plastic limits. The results of the testing are contained in the NCC report (ref: S1337) presented in Appendix III and summarised below.

Natural moisture contents of between 15.8% and 38.1% were observed, with liquid limits of between 37% and 77% and plasticity indices of between 11% and 44% being recorded. The results indicate clays of intermediate, high and very high plasticity. The modified plasticity index values (8.9% to 32.8%) indicate clays of low and medium volume change potential.

It is recommended that a medium volume change potential is adopted for the proposed development. In accordance with NHBC guidelines, the minimum foundation depth should be c.0.90m bgl.

Further deepening may be required where existing, former or proposed trees are located in the vicinity of the proposed development in accordance with NHBC Standards (Chapter 4.2, "Building Near Trees").

8.0 Generic Quantitative Risk Assessment (GQRA)

8.1 Methodology for Assessing Risks to Human Health

Within the UK, the current framework for assessing potential ground contamination is utilising the Contaminated Land Exposure Assessment (CLEA) model as set out by the Department of the Environment, Farming and Rural Affairs (DEFRA) and comprises of the established pollutant linkage model of *Source – Pathway – Receptor*. For a risk to be present to the proposed end user (*Receptor*) there must be an identified *Source* and a plausible *Pathway*. Where one or more of the links are missing then risk is negated. In order for the land to be classified as contaminated under Part IIa of the Environmental Protection Act (EPA) 1990 all three elements of the pollutant linkage must be present.

A human health risk assessment can be completed using the contamination levels recorded in the soils by comparing the values against published Generic Assessment Criteria (GAC), such as CLEA Soil Guideline Values (SGV's), CL:AIRE/DEFRA Category 4 Screening Levels (C4SLs), Land Quality Management (LQM) and Chartered Institute of Environmental Health (CIEH) S4UL Values and Atkins ATRISK^{SOIL} Soil Screening Values (SSV's). The guidelines are generally based on three main land uses as outlined below:

■ *Residential*
(with or without plant uptake)

■ *Allotments*

■ *Commercial*

Where these land uses are not deemed appropriate, other land use values can be considered with the DEFRA C4SLs, LQM S4UL's values and the ATRISK^{SOIL} SSV's (i.e. parks/playing fields/Public Open Space). Alternatively, it is possible to determine site specific intervention values as part of a Detailed Quantitative Risk Assessment (DQRA).

It is anticipated that the proposed development will incorporate a residential development with private gardens. Therefore, for the purposes of this basic Human Health ground contamination risk assessment, the maximum site recorded values for the soil samples have been compared to GAC for a CLEA end use classification of: *Residential with Plant Uptake End Use* to determine if a potential risk is present to the proposed end users.

Contaminant Analysis Sheets that include the results of the relevant Human Health Risk Assessment and the Generic Assessment Criteria (GAC) values are presented in Appendix IV.

8.2 Human Health Risk Assessment – Comparison with Guidance Levels

8.2.1 Inorganic Contaminants – Soil

The maximum concentration values for each inorganic analytes have been compared to the most relevant Generic Assessment Criteria (GAC) as part of the Maximum Value Test. The GAC have been selected using the following guidance documents:

- LQM/CIEH S4UL 2015 (Residential with Plant Uptake End Use).
- CL:AIRE/DEFRA Cat 4 Screening Levels C4SL (Residential with Plant Uptake End Use).
- Atkins ATRISK Screening Values (Residential with Consumption of Homegrown Produce).

As discussed in Section 8.1, the contaminant concentrations have been assessed against GAC for a residential with plant uptake end use as it is anticipated that the proposed development will incorporate private gardens.

The results of the contamination analysis sheet in Appendix IV indicates a single, marginally elevated concentration of Arsenic in the topsoil from trial pit TP11 (Fell View Avenue Development). The concentration of Arsenic was recorded at 40mg/kg, only marginally exceeding the GAC of 37mg/kg. At this concentration, the risk to the end user is considered very low. This is discussed further in Section 10.

The concentration of Arsenic in all of the other samples of topsoil and made ground did not exceed the GAC.

The concentration of all other inorganic analytes was below the GAC and do not pose a risk to human health.

An assessment of phytotoxic elements (copper, nickel and zinc) within the topsoil indicates that the concentrations are within the acceptable limits for topsoil (BS3882: Specification for Topsoil, 2015).

8.2.2 Organic Contaminants – Soil

The maximum concentration values for the organic analytes tested for (i.e. Speciated PAH) have been compared to published generic assessment criteria as part of the Maximum Value Test. The GAC have been selected using the following guidance documents:

- LQM/CIEH S4UL 2015 (Residential with Plant Uptake End Use).

Taking in to account the average TOC of the soils on the site, this assessment has been completed utilising a 2.5% SOM.

Based on the results of the contaminant analysis sheet contained in Appendix IV it can be seen that a single, marginally elevated concentration of PAH (Dibenz(ah)anthracene) is present within the topsoil from TP16 (Fell View Avenue Development). The concentration of Dibenz(ah)anthracene at this location was recorded at 0.31mg/kg, only marginally exceeding the GAC value of 0.28mg/kg. At this concentration, the risk to the end user is considered very low. This is discussed further in Section 10.

None of the other organic contaminant concentrations exceed the assessment criteria, and as such do not pose a risk to human health.

8.2.3 Asbestos Containing Materials (ACM's) – Soil

12 No. samples of the topsoil and made ground have been subjected to laboratory microscopic analysis to determine the presence or not of Asbestos Containing Materials (ACM's) in accordance with the methodology within HSG 248.

Of the samples tested, all returned a negative result for ACM's and were recorded as NAD (no asbestos detected), i.e. no asbestos was encountered.

8.2.4 Calorific Value – Soil

1 No. sample of the weathered carbonaceous bedrock (coal / carbonaceous siltstone) recovered from trial pit TP01 at 1.50m bgl was subjected to Calorific Value testing due to the potential for potentially combustible materials. The result was recorded as 11MJ/kg.

It is understood that a material with a calorific value of less than 2MJ/kg is unlikely to smoulder and a material with a value of more than 10MJ/kg is almost certainly able to smoulder with right conditions present. Therefore, a calorific value of 11MJ/kg indicates a potential for the material to smoulder and potentially combust if sufficient oxygen and heat are present.

The results indicate a potential for combustion wherever coal seams are present at or near to the surface where there is a heat source such as utility trenches (i.e. electrical cables), bonfires, etc.... There is also a potential for spontaneous combustion where sufficient oxygen is present. Therefore, it would be prudent to remove any significant deposits of coal present at shallow depth (<1.00m bgl), in the corridor of the proposed utility trenches or beneath proposed buildings unless suitable protection measures are installed.

Removal of the coal will require an appropriate license from the Coal Authority.

As such, it would be prudent to carefully inspect all foundation excavations to ensure no coal deposits are present at formation. Any coal present should be excavated and replaced with suitably compacted gravel or concrete.

8.2.5 Human Health Risk Assessment – Summary

The following is a summary of the Human Health risk assessment based on a *Residential with Plant Uptake End Use*:

- **Generic Contamination:** Marginally elevated Arsenic in the topsoil at one location.
- **Organic Contamination:** Marginally elevated PAH in the topsoil at one location.
- **Other Contamination:** None.

Based on the Human Health risk assessment above, marginally elevated concentrations of Arsenic and PAH have been identified in the topsoil from trial pits TP11 and TP16, both of which were located within the proposed Fell View Avenue Development. As the concentrations only marginally exceeded the GAC, the risk to the end user is considered very low and widespread remediation is not considered necessary. However, it would be prudent to excavate the topsoil in the vicinity of both trial pits to mitigate the risks entirely.

No remediation is deemed necessary within the proposed Windermere Road Development.

Any imported materials required on site should be screened prior to placement on site to ensure contaminated materials are not being brought to site and that they are suitable for use within a residential setting.

Where topsoil is brought on to site, the materials should be as specified in BS 3882:2015 as 'suitable for the intended purpose'. BS3882:2015 relates to nutrient content of topsoil and phytotoxic contamination and does not consider contaminants that pose a risk specifically to human health. Soils should be tested for contaminants that are considered to pose a risk to human health in addition to BS3882:2015 to ensure that they are suitable for their intended use. All materials brought on to site that are to be used as part of soft landscaped areas should be assessed with regards to human health criteria.

8.3 Ground Gas Risk Assessment

As indicated in Section 5.5, gas and groundwater monitoring wells have been installed in boreholes BH01 to BH04 (Windermere Road Development) and borehole BH06, BH8 and BH09 (Fell View Avenue Development) and monitoring has been completed on six occasions between June and December 2022.

During the monitoring, atmospheric air pressures varied between 982mb and 1022mb and included both rising and falling pressure trends.

Methane was only detected on one occasion in borehole BH01 (Windermere Road development area) where it reached a maximum concentration of 0.9%v/v.

The concentration of carbon dioxide (CO₂) was recorded at a maximum concentration of 8.5% within the Windermere Road development area and 8.6% within the Fell View Avenue area. The flow rate was recorded as negligible throughout.

The minimum Oxygen (O₂) concentration was 11.3% within the Windermere Road area and 10.9% within the Fell View Avenue area.

In accordance with CIRIA C665 the maximum recorded CH₄ and CO₂ concentrations have been converted to Gas Screening Values (GSV), summarised as follows.

In this instance, the CH₄ GSV is:

- **CH₄ GSV = (Max CH₄ (%) / 100) x Max Flow (l/hr),**
- **Therefore; (0.9 / 100) x 0.1 = 0.009 l/hr GSV**

In this instance, the CO₂ GSV is:

- **CO₂ GSV = (Max CO₂ (%) / 100) x Max Flow (l/hr),**
- **Therefore; (8.5 / 100) x 0.1 = 0.0085 l/hr GSV**

Therefore, in accordance with CIRIA C665 Table 8.5, taking into consideration the GSV and the maximum gas concentrations, the site falls into Characteristic Situation 2 (CS2) or the Amber 1 Classification when utilising the NHBC Characterisation System.

This indicates that basic gas protection measures are required. The following statement refers to NHBC Amber 1 protection measures from CIRIA C665:

"Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414 (Johnson, 2001). Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours."

Depleted Oxygen (O₂) levels have also been noted. Whilst these levels are unlikely to pose a risk to above ground structures, they may potentially pose a risk to the construction workforce for any below

ground works (i.e. installing utilities etc.). As a result of this, the information presented in this report should be passed to the Principal Contractor (PC) as a Workforce Health and Safety risk assessment lies out-with the scope of this report.

GEO recommend a Ground Gas Remediation Strategy and Verification Plan for approval by the Planning Authority prior to installation in the proposed properties. This will provide details of the necessary protection measures that are required, the appropriate method of installation and details regarding the inspections and checks (verification) that will be required.

During and upon completion, the protection measures will require third party independent verification to confirm that appropriate protection measures have been installed as per the Ground Gas Remediation Strategy and Verification Plan.

It is beyond the scope of this report to provide details of suitable protection measures, however, as a preliminary overview, the proposed residential development (Type A) will require a minimum point score of 3.5. This will require a combination of elements to achieve the appropriate level of gas protection to mitigate the risks to the end user. The combination of elements is dependent upon the final floor slab solution adopted for the site and should be determined by the Structural Engineer.

It is understood from discussions with the Consultant that the proposed development will incorporate a suspended floor slab. The 3.5 points can be achieved with the following protection measures:

- Block and Beam Floor (0 points).
- Construction of appropriate sub-floor void and vents (minimum 1.5 points for “good performance” and up to 2.5 points for “very good performance”).
- Installation of Gas Resistant Membrane (2.0 points).

8.4 Determination of pH and Water-Soluble Sulphate

As indicated in Section 6, selected samples of topsoil, made ground and natural soil have been screened to determine their pH and soluble sulphate potential to aid the design of buried concrete. The results of the chemical screening are presented in the Chemtech report (ref: 110347) contained in Appendix III.

From the results, the following observations can be seen:

- pH values in the soils ranged from 5.7 to 8.8 (slightly acidic to slightly alkali).
- Water Soluble Sulphate (SO₄) levels were recorded as ranging from <10mg/l to 1744mg/l.

In accordance with BRE Special Digest 1: 2005 the results recorded equate to a Design Sulphate classification of DS-2 and an ACEC classification of AC-3z.

The made ground in trial pits TP06 and TP14 both contained high levels of water-soluble sulphate (579mg/l and 1744mg/l) that exceeded the assessment criteria for standard DS-1 concrete (500mg/l). The Client may wish to consider removing the made ground from the vicinity of the foundations in order to reduce the concrete specification.

9.0 Construction Related Excavations and Off-Site Disposal

During the construction works it is likely that materials will be excavated on site (i.e. future foundations and buried utilities, etc.) that will not be able to be accommodated on site during to space and level constraints, ultimately requiring removal off site.

During the construction works, different materials should be stockpiled separately, and an appropriate waste disposal classification should be determined by the Design Team prior to removal. It may be the case that WAC testing is required to aid the assessment.

Where made ground materials or disturbed natural strata is to be removed, the results of the soil testing undertaken within this report can be used as a preliminary assessment and the anticipated waste disposal facility should be provided with a copy of the results for review. It may be the case that the waste facility requires additional contamination screening to aid the characterisation of the made ground for off-site disposal (i.e. Waste Acceptance Criteria – WAC) and it is recommended that this be confirmed by the design team prior to commencing on site.

During the construction phase, it may be the case that WAC screening is required to aid classification for disposal, and it is recommended that all materials are classified prior to excavation and disposal off site.

Conversely, if materials are required to be brought to site to raise site levels or as part of a clean cover system then certification and/or soil testing results should be reviewed by a suitably experienced and qualified geo-environmental engineer to ensure that potentially contaminated materials are not being brought to site.

Any material movements may require a Material Management Plan (MMP) in accordance with CL:AIRE.

10.0 Discussion and Recommendations

10.1 Ground and Groundwater Conditions Summary

The ground investigation has encountered topsoil overlying shallow made ground which typically comprised reworked clays with occasional anthropogenic materials including brick and concrete. Relict foundations have also been encountered that appear to be based at shallow depth.

The made ground was typically underlain by firm to stiff slightly sandy clay that becomes stiff with depth. The only exception to this was the northern part of the Fell View Avenue development area which is underlain by medium dense to dense angular gravel of sandstone (possible completely weathered bedrock).

Bedrock of sandstone and mudstone with occasional coal seams was encountered from depths of between c.1.10m and c.5.00m bgl. The weathered rock was typically shallowest in the southern parts, becoming deeper to the north.

Coal or carbonaceous siltstone was encountered in trial pits TP01, TP03, TP12 and borehole BH04. The seam was between c.0.30m and c.0.60m thick and was encountered at depth of between c.1.10m and c.1.80m bgl. Only thin bands of coal were encountered in the other trial pits suggesting that it may have been locally eroded at the surface. No evidence of workings was encountered.

The rotary boreholes encountered bedrock of light brown sandstone and grey brown mudstone from depths of between c.2.20m and c.5.00m bgl which typically became deeper to the north. Two coal seams were encountered. The shallowest seam was between c.0.30m and c.0.70m thick and was encountered at a depth of between c.10.20m and c.14.70m bgl. The second, deeper seam was between c.0.40m and c.0.70m thick and was encountered at depths of between c.13.80m and c.22.80m bgl. No evidence of workings (voids, broken ground or loss of flush) was encountered.

Groundwater was encountered as a minor seep at depths of between c.1.10m and c.2.10m bgl within the weathered bedrock strata. Boreholes BH01 and BH02 had standing water at depths of between c.0.95m and c.2.10m bgl on completion. Trial pits TP14 and TP15 were located in an area of dense vegetation where the ground was noted to be "wet and boggy". Significant groundwater ingress was noted from the surface and from the made ground.

Groundwater monitoring of installations placed in the boreholes has been carried out on six occasions between June and December 2022. Standing groundwater levels have been recorded between c.0.80m and c.3.20m bgl, however, several of the boreholes remained dry. Given the ground condition, it is likely that the water has resulted from surface ingress which has been trapped/perched within the boreholes rather than a continuous groundwater table.

During the investigation, GEO did not identify any visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) or any landfill type waste, with no potentially biodegradable, decomposable or putrescible materials.

Ground permeability tests indicate that the ground conditions (firm to stiff and stiff clays) are not suitable for a soak-away drainage system.

10.2 Coal Mining Risk Assessment

The Solid strata is recorded as Pennine Middle Coal Measures and Whitehaven Sandstone Formation. GEO are aware of a number of developments in the vicinity of the site which have been affected by shallow unrecorded coal mine workings that have required grouting to facilitate development.

The e3p report indicates that the site is not located within a development high-risk area but is potentially underlain by coal mine workings in No.8 and No.3 coal seams at depths exceeding c.44m bgl. The seams are recorded as having an extraction thickness of c.0.65m.

The 1:10,000 scale geological map (see Figure 1) indicates that the Windermere Road site is bisected by a fault with a significant downthrow to the north. To the south of the fault, the 'Black Metal Coal Seam' (BMT) is conjectured to sub-crop c.160m east of the site and is likely to pass beneath the site at a depth of at least c.16m bgl (assuming level ground and an average dip angle of 6 degrees). However, taking into account the topography, the seam is likely to be significantly deeper beneath the site. The Brassy Seam has a recorded thickness of c.0.30m.

As indicated on the GVS in Figure 2, The BMT is overlain by the 'Unnamed C (UNM C) Coal Seam' and the 'Brassy Coal (BRSY) Seam'. These vary in thickness between c.0.40m and c.0.85m respectively.

To the north of the fault, the 'Unnamed C (UNM C) Coal Seam' sub-crops c.250m to the east of the development area and is likely to be present beneath the site at a significant depth of at least c.26m bgl (assuming level ground and an average dip angle of 6 degrees). This is overlain by the Brassy (BRSY) and Unnamed E (UNM E) Seams which vary between c.0.85m and c.0.20m respectively.

The intrusive coal mining investigation identified two seams of coal beneath the development areas which vary between c.0.30m and c.0.70m in thickness. It is likely that the seams encountered are the Unnamed C and Brassy in RBH01 and Brassy and Unnamed E in boreholes RBH02 and 03.

It is generally accepted that there is a risk to the proposed development if the rock cover over a worked coal seam is less than ten times the seam thickness (a ratio of 1:10). There is some debate as to the exact thickness of rock cover required to mitigate the risk of collapse or disturbance at the surface and the Coal Authority recommends caution on the use of this 'rule of thumb'. Therefore, a ratio of 1:15

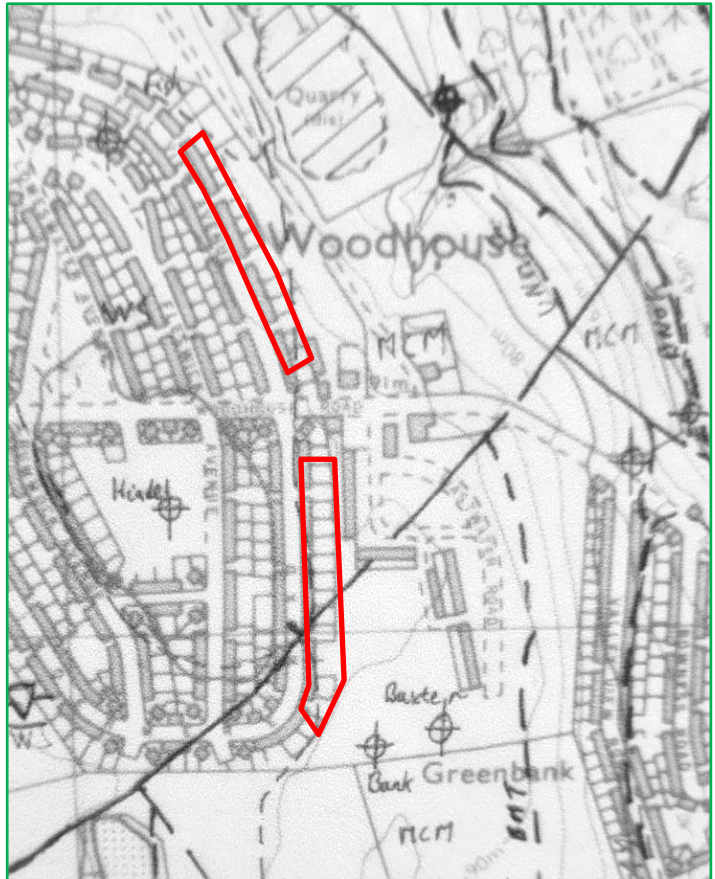


Figure 1 – 1:10,000 scale Geological Map Extract

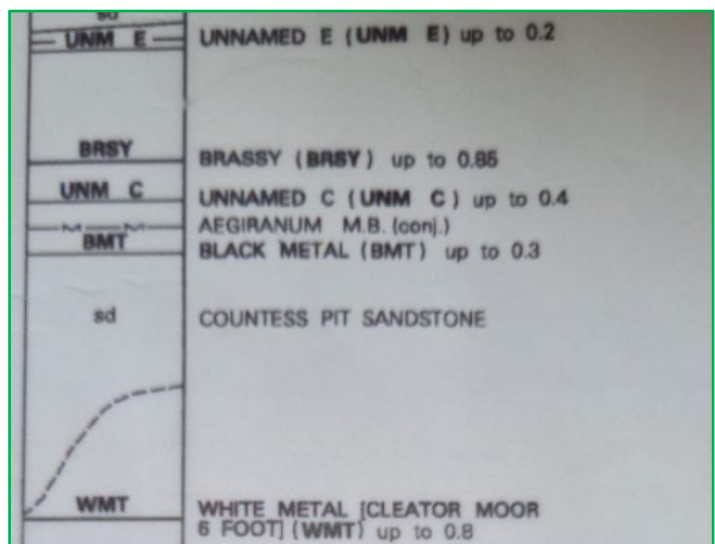


Figure 1 – Generalised Vertical Section (GVS)

(15 times seam thickness to rock cover) or greater is generally considered acceptable.

For this site, the ratio between the coal seam thickness and the rock cover varies between 1:16 and 1:36. As such, the risk to the proposed development from ground movements associated with unrecorded workings within these seams is considered negligible.

As indicated in the e3p report, recorded coal mine workings are present at depths exceeding c.44m bgl. The seams are recorded as having an extraction thickness of c.0.65m. Therefore, the ratio between the seam thickness (c.0.65m) and the rock cover (c0.39m) is 1:60 and the risk to the proposed development from ground movements associated with collapse of the recorded workings is considered negligible.

A shallow band of coal and/or carbonaceous siltstone was encountered sporadically within the trial pits and mini-percussive boreholes across both development areas. No evidence of the shallow coal was encountered in the rotary boreholes. As such, it is likely that the seam(s) have been locally eroded at the surface.

Although no evidence of workings has been encountered, the potential for very shallow workings (i.e. bell pits) cannot be completely ruled out at this stage. As such, it is recommended to employ a “watching brief” during the redevelopment works to ensure that if evidence of shallow workings is encountered within any foundation and other excavations on site, then they be investigated and dealt with appropriately, so that the feature does not pose a risk to the development. It will therefore be prudent to allow for a contingency sum should potential unrecorded mining geohazards be encountered, as this abnormal could have a time and cost impact on the development.

10.2 Future Foundations, Pavements and Buried Structures

It is understood that the proposed development will incorporate conventional housing. Based on the results of the ground investigation, conventional strip foundations could be considered, subject to confirmation by the Structural Engineer. The foundations should maintain a depth of at least c.0.90m below finished ground levels and extend through the topsoil/made ground and into the firm to stiff and/or stiff sandy gravelly clay (glacial till). Foundations should not be placed in or within c.1m of the coal deposits identified below the site.

Further deepening may be required where existing, former or proposed trees are located in the vicinity of the proposed development in accordance with NHBC Standards (Chapter 4.2, “Building Near Trees”).

A safe bearing resistance in the region of 100kN/m² is considered suitable for the firm to stiff and stiff sandy gravelly clays.

With respect to buried structures (concrete), high concentrations of water soluble sulphate were encountered across both sites within the made ground. In accordance with BRE Special Digest 1: 2005 the results recorded equate to a Design Sulphate classification of DS-2 and an ACEC classification of AC-3z.

Based on the ground conditions and the results of the DCP tests, conventional road and pavement construction techniques should be suitable. However, it is always recommended that the appropriate CBR value is confirmed by way of plate load testing at formation level prior to construction.

The above foundation assessment is assuming that no unrecorded or as yet undiscovered shallow coal mining geohazards exist. If during redevelopment, evidence of potential shallow mining geohazards are encountered, then a re-assessment will be required and remedial measures (i.e. grouting) may be

required. It may, therefore be prudent for the Structural Engineer to consider alternative foundation solutions that would mitigate any risks of potential unrecorded and undiscovered mining geohazards.

Foundations should be designed by a Structural Engineer and the design should be agreed by all parties, including Regulators, Building Control and Warranty providers prior to commencing construction on site.

10.3 Ground Contamination

10.3.1 Ground Contamination – Human Health

Based on the Human Health risk assessment, marginally elevated concentrations of Arsenic and PAH have been identified in the topsoil from trial pits TP11 and TP16, both of which were located within the proposed Fell View Avenue Development. As the concentrations only marginally exceeded the GAC, the risk to the end user is considered very low and widespread remediation is not considered necessary. However, it would be prudent to excavate the topsoil in the vicinity of both trial pits to mitigate the risks entirely. Any topsoil removed should be replaced with “clean” topsoil.

Given the results of the chemical screening, standard water supply pipes are likely to be suitable. However, it is recommended that the relevant utility suppliers are contacted in this respect, as a site-specific risk assessment may be required.

Where topsoil is brought on to site (i.e. for gardens and soft landscaping), the materials should be as specified in BS 3882:2015 as ‘suitable for the intended purpose’. BS3882:2015 relates to nutrient content of topsoil and phytotoxic contamination and does not consider contaminants that pose a risk specifically to human health. Soils should be tested for contaminants that are considered to pose a risk to human health in addition to BS3882:2015 to ensure that they are suitable for their intended use. All materials brought on to site that are to be used as part of soft landscaped areas should be assessed with regards to human health criteria.

10.4 Potential Combustibility

The results of the calorific value test on the sample of shallow coal present in trial pit TP01 indicate a potential for combustion wherever coal seams are present at or near to the surface where there is a heat source such as utility trenches (i.e. electrical cables), buildings, bonfires, etc.... There is also a potential for spontaneous combustion where sufficient oxygen is present. Therefore, it would be prudent to remove any significant deposits of coal present at shallow depth (<1.00m bgl), in the corridor of the proposed utility trenches or beneath proposed buildings unless suitable protection measures are installed. Where coal is removed, a Coal Authority license/permit will be required.

As such, it would be prudent to carefully inspect all foundation excavations to ensure no coal deposits are present at formation. Any coal present should be excavated and replaced with suitably compacted gravel or concrete.

10.5 Ground Gas

The results of the ground gas monitoring indicate low concentrations of methane and elevated concentrations of carbon dioxide. The flow rates were negligible throughout. Based on the results of the gas monitoring and the presence of shallow coal, basic gas protection measures are considered necessary. Further details regarding gas protection measures are included in Section 8.3.

Radon protection measures are not considered necessary at this time.

GEO recommend a Ground Gas Remediation Strategy and Verification Plan for approval by the Planning Authority prior to installation in the proposed properties. This will provide details of the necessary protection measures that are required, the appropriate method of installation and details regarding the inspections and checks (verification) that will be required.

During and upon completion, the protection measures will require third party independent verification to confirm that appropriate protection measures have been installed as per the Ground Gas Remediation Strategy and Verification Plan.

10.6 Post Investigation Works

Redundant boreholes should be made safe and secure and should not cause a preferential pathway for contaminants and ground gasses.

The wells that were installed as part of this investigation are not considered to pose a significant risk to the proposed development and are very unlikely to provide a preferential pathway for contaminants based on current or proposed land uses.

Borehole that are located within the footprint of proposed houses should be removed. Where decommissioning is required, the works should be completed in accordance Environment Agency Guidelines: "Guidance on the design and installation of groundwater Monitoring points", Section 5.5 Decommissioning (Page 59), and "Decommissioning abandoned boreholes and wells".

10.7 General Comments

Consideration must be made for variations to occur in the ground conditions between the exploratory hole locations for which GEO holds no responsibility and areas where limited access was available. It is therefore recommended that a "watching brief" and "observational technique" be applied to this site to ensure that if ground conditions appear to vary from those identified within this investigation report then advice should be sought from a suitably qualified and experienced Engineering Geologist, Geotechnical or Geo-Environmental Engineer.

The recommendations and opinions expressed in this report are based on the strata observed within the exploratory holes in addition to the results of the site and laboratory tests commissioned by GEO. Consequently, GEO takes no responsibility for conditions that have not been revealed or which occur between them. GEO takes no responsibility for the accuracy of third party information provided by sub-contract drillers or laboratories.

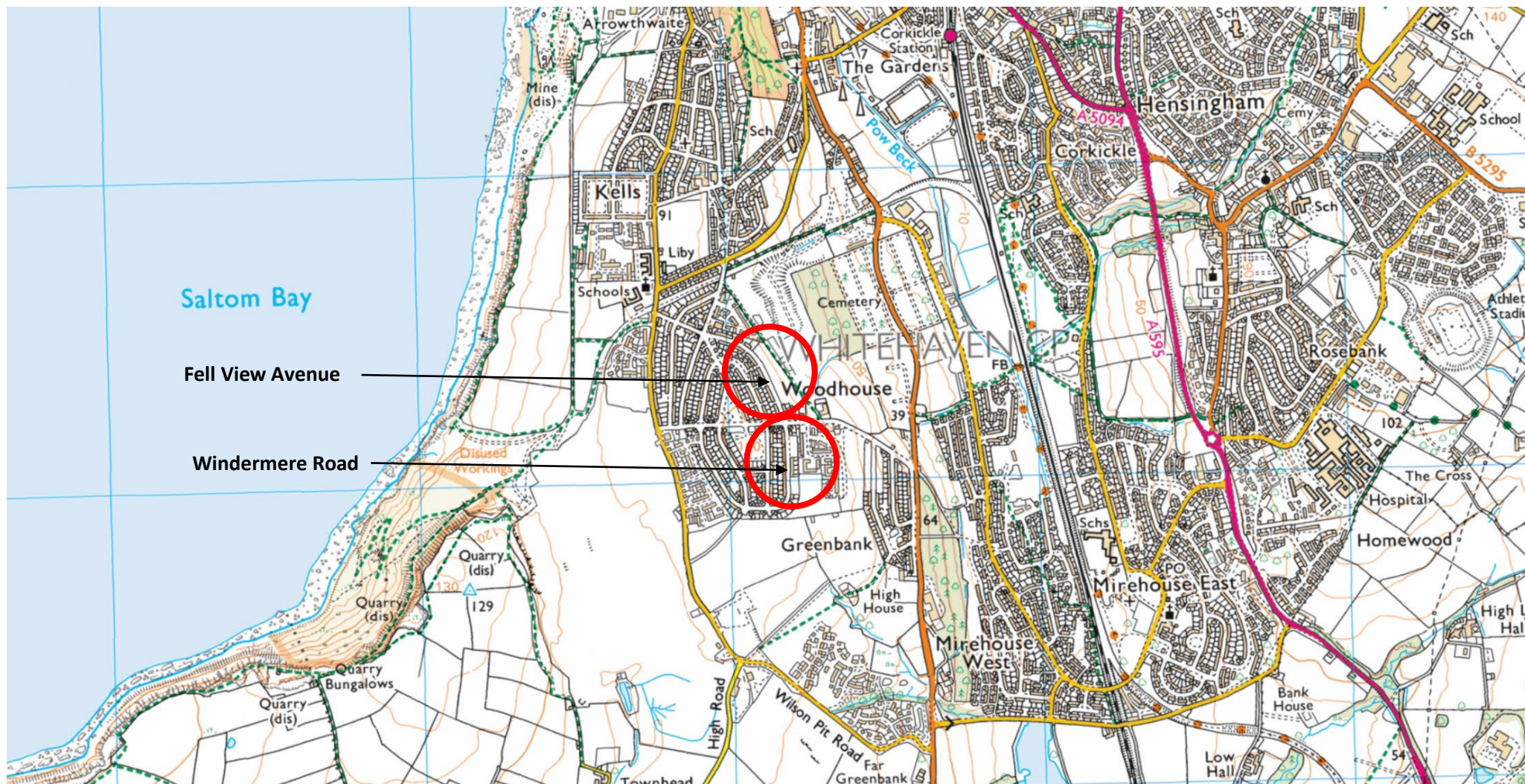
The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/ or other key stakeholders, including warranty providers in order to seek their approval of the findings prior to undertaking any works on site.

End of Report

Appendix I

- Site Location Plan
- Exploratory Hole Location Plan
- Proposed Site Layout Plan

GEO2022-5335: Windermere Rd & Fell View Avenue, Whitehaven – Site Location



GEO2022-5335: Windermere Rd, Whitehaven – Exploratory Hole Location Plans (Page 1 of 2)



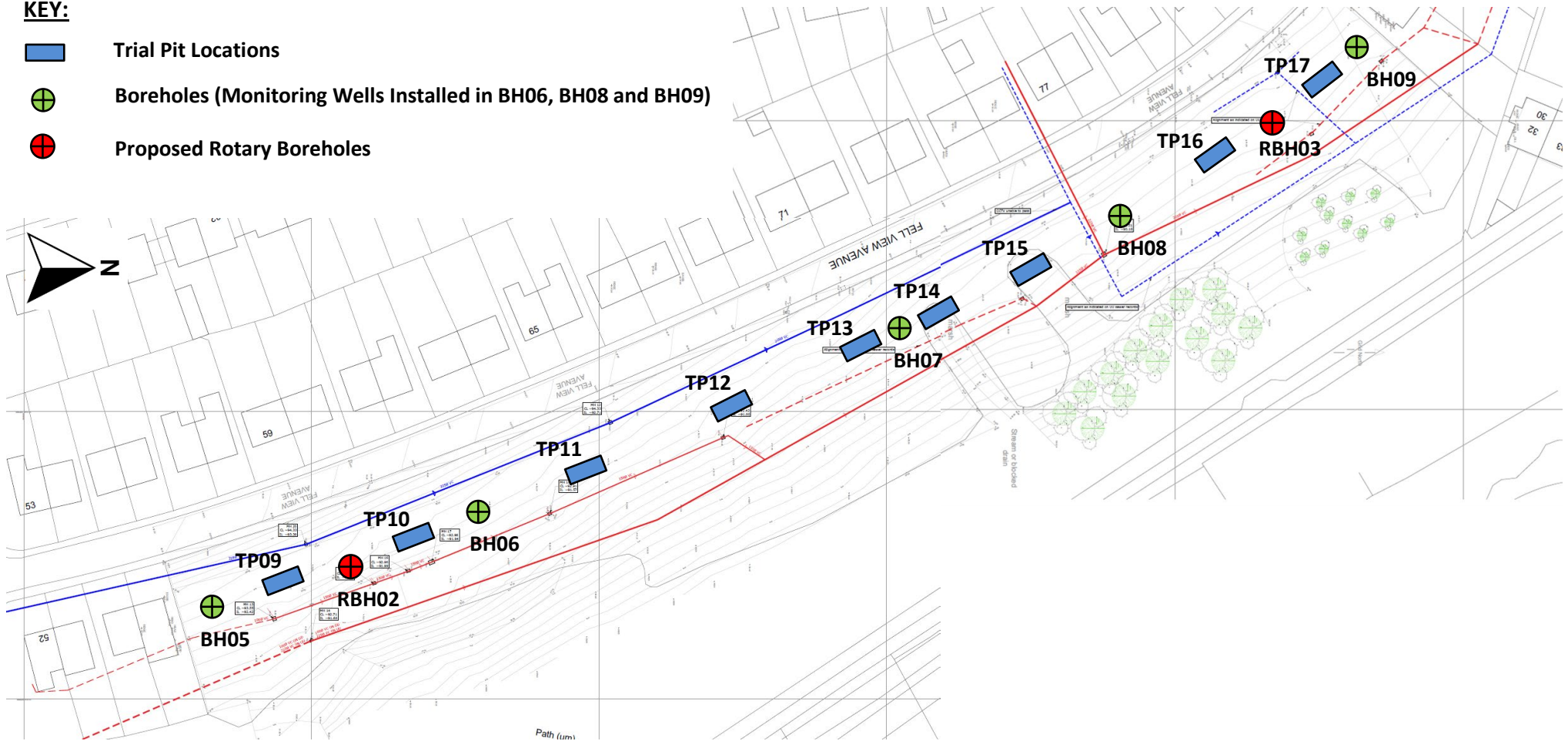
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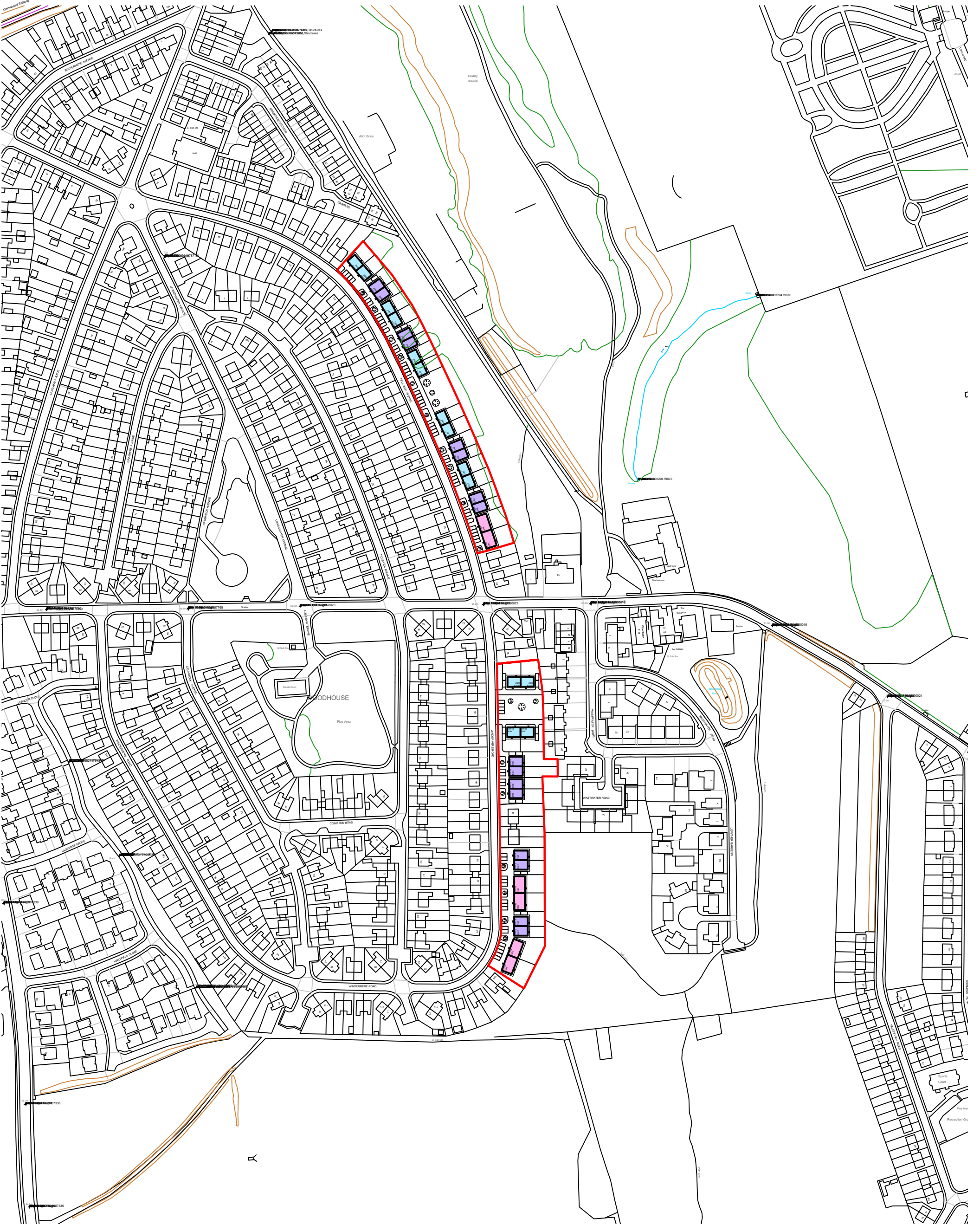
- Trial Pit Locations
- + Boreholes (Monitoring Wells Installed in BH01, BH02, BH03 and BH04)
- X Shallow Hand Dug Pits
- + Rotary Boreholes

GEO2022-5335: Fell View Avenue, Whitehaven – Exploratory Hole Location Plans (Page 2 of 2)

KEY:

-  Trial Pit Locations
-  Boreholes (Monitoring Wells Installed in BH06, BH08 and BH09)
-  Proposed Rotary Boreholes





Revision Notes:

Rev:	Date:	Notes:

- Legend:
- 2B3P Bungalow (61qm)
 - 2B3P Bungalow (61sqm)
 - 3B5P Bungalow (86sqm)

Project:
Woodhouse, Whitehaven

Drawn By:
SJ

Drawing Title:
Capacity Study (Parcel A and B)

Checked By:
DM

Scale @A3:
@1:2500

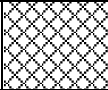
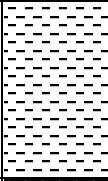
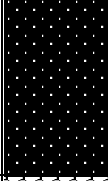
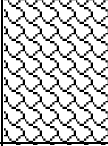
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21/01/2022

Drawing Number:
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Appendix II

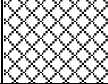
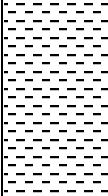
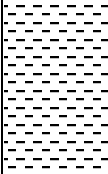
- Exploratory Hole Logs
- DCP Calculation Sheets
- Ground Gas Monitoring Sheets (Preliminary)
- Falling Head Test Results

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.14	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of pottery and brick.		0.10 - J
0.14	0.49	MADE GROUND: Reworked firm to stiff light grey brown slightly sandy CLAY.		
0.49	1.10	Firm to stiff, becoming stiff brown slightly sandy CLAY.		1.00 HSV = 80kPa 1.00 - T
1.10	1.70	Possible highly weathered bedrock: Recovered as black very silty GRAVEL of coal / carbonaceous siltstone.		1.50 - T
1.70	2.20	Possible highly weathered bedrock: Recovered as dark grey brown very silty GRAVEL of very weak siltstone/mudstone.		
		End of trial hole at 2.20m. Trial hole remained open and dry on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	



GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.18	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		0.10 - J
0.18	0.50	MADE GROUND: Firm to stiff reworked light brown slightly sandy CLAY. Occasional pockets of gravel including brick and concrete.		
0.50	1.20	Firm to stiff, becoming stiff light brown slightly sandy CLAY.		0.90 - T 1.10 HSV = 110kPA
1.20	1.80	Stiff light grey mottled orange slightly silty CLAY.		1.50 - T
		End of trial hole at 1.80m bgl. Trial hole remained open and dry on completion. Trial hole backfilled with arisings on completion.		

Engineer: J.Brock

Site Works Date: 08/06/2022

Plant: Tracked 360 Excavator

Log Notes:

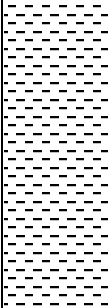
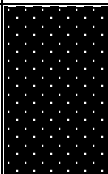
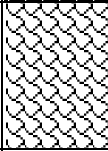
HSV = Hand Shear Vane (kN/m²)

LP = Limited Penetration (HSV/CBR)

B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub



GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.21	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		0.10 - J
0.21	1.30	Firm to stiff light brown slightly gravelly CLAY. Becoming light grey brown with depth.		0.80 - T
1.30	1.90	Possible highly weathered bedrock: Recovered as black very silty GRAVEL of coal / carbonaceous siltstone.		1.50 - T
1.90	2.40	Possible highly weathered bedrock: Recovered as dark grey brown very silty GRAVEL of very weak siltstone/mudstone. Occasional carbonaceous siltstone.		
		End of trial hole at 2.40m bgl. Groundwater ingress (seep) from 1.50m bgl. Trial pit is stable. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	



GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP04

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.10	TOPSOIL: Dark brown sandy gravelly LOAM.		
0.10	1.30	Firm becoming firm to stiff dark brown silty slightly sandy, slightly gravelly CLAY. Becoming light grey brown with depth. Localised relict foundations to c.0.60m bgl (brick on concrete)		0.70 HSV = 60kPa
1.30	1.80	Stiff light grey mottled orange CLAY.		
1.80	2.30	Possible highly weathered bedrock: Recovered as dark grey fine to coarse angular GRAVEL of shaley siltstone. Locally carbonaceous.		
		End of trial hole at 2.30m bgl. Groundwater ingress (moderate) from 1.80m bgl. Trial hole backfilled with arisings on completion.		

Engineer: J.Brock

Site Works Date: 08/06/2022

Plant: Tracked 360 Excavator

Log Notes:

HSV = Hand Shear Vane (kN/m²)

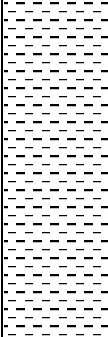
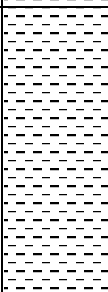
LP = Limited Penetration (HSV/CBR)

B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub



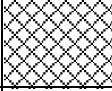
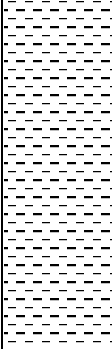
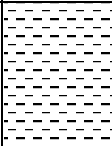
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GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP05

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.10	TOPSOIL: Dark brown sandy gravelly LOAM.		0.10 - J
0.10	1.30	Firm to stiff becoming stiff dark brown silty slightly sandy, slightly gravelly CLAY. Relict foundations to c.0.65m bgl (brick on concrete). Localised reworked clay either side of foundations.		1.00 - T
1.30	2.30	Stiff light grey mottled orange CLAY.		
		End of trial hole at 2.30m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	



GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP06

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.10	TOPSOIL: Dark brown sandy gravelly LOAM with brick and glass.		0.10 - J
0.10	0.40	MADE GROUND: Firm to stiff reworked brown gravelly CLAY. Gravel is fine to coarse angular brick and concrete. Occasional timber and wires.		0.30 - J
0.40	1.60	Firm to stiff becoming stiff brown mottled grey silty slightly sandy, slightly gravelly CLAY.		0.80 HSV = 70kPa 0.90 - T
1.60	2.10	Stiff light grey mottled orange CLAY.		
		End of trial hole at 2.10m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		

Engineer: J.Brock

Site Works Date: 08/06/2022

Plant: Tracked 360 Excavator

Log Notes:

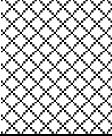
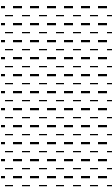
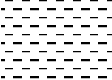
HSV = Hand Shear Vane (kN/m²)

LP = Limited Penetration (HSV/CBR)

B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

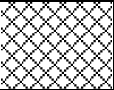
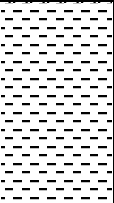
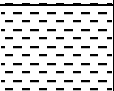


GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP07

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.12	TOPSOIL: Dark brown sandy gravelly LOAM with brick and conc.		
0.12	0.60	MADE GROUND: Firm to stiff reworked brown gravelly CLAY. Gravel is fine to coarse angular brick and concrete. Occasional timber.		
0.60	1.30	Firm to stiff becoming stiff brown mottled grey silty slightly sandy, slightly gravelly CLAY.		0.90 HSV = 65
1.30	1.60	Stiff light grey mottled orange CLAY.		
		End of trial hole at 1.60m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

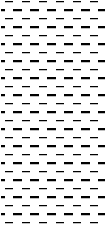
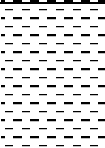


GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP08

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.17	TOPSOIL: Dark brown sandy gravelly LOAM with brick and conc.		
0.17	0.50	MADE GROUND: Firm to stiff reworked brown gravelly CLAY. Gravel is fine to coarse angular brick and concrete.		0.30 - J
0.50	1.20	Firm to stiff becoming stiff brown mottled grey silty slightly sandy, slightly gravelly CLAY.		0.90 HSV = 70
1.20	1.60	Stiff light grey mottled orange CLAY.		
		End of trial hole at 1.60m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

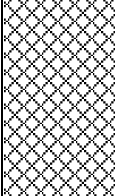
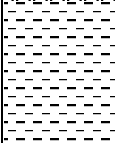
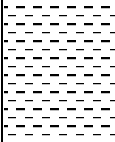


GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP09

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.11	TOPSOIL: Dark brown sandy gravelly LOAM with brick and conc.		0.10 - J
0.11	0.36	MADE GROUND: Firm to stiff reworked brown gravelly CLAY. Gravel is fine to coarse angular brick and concrete.		
0.36	1.10	Firm to stiff brown mottled grey slightly gravelly CLAY.		0.70 - T 1.00 HSV = 75kPa
1.10	1.60	Stiff light grey mottled orange CLAY.		1.30 - T
		End of trial hole at 1.60m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 09/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	



GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP10

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.16	TOPSOIL: Dark brown sandy gravelly LOAM with occasional brick and conc.		
0.16	0.90	MADE GROUND: Firm to stiff reworked brown gravelly CLAY. Gravel is fine to coarse angular brick and concrete.		0.30- J
0.90	1.50	Firm to stiff brown mottled grey slightly gravelly CLAY.		
1.50	2.00	Stiff light grey mottled orange CLAY.		
		End of trial hole at 2.00m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		

Engineer: J.Brock

Site Works Date: 09/06/2022

Plant: Tracked 360 Excavator

Log Notes:

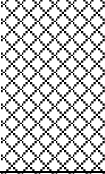
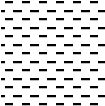
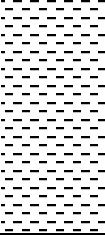
HSV = Hand Shear Vane (kN/m²)

LP = Limited Penetration (HSV/CBR)

B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

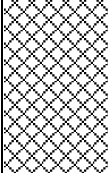
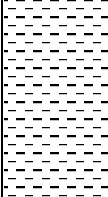
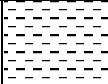
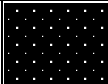


GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP11

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.16	TOPSOIL: Dark brown sandy gravelly LOAM with occasional brick and conc.		0.10 - J
0.16	0.80	MADE GROUND: Reworked firm to stiff brown gravelly CLAY. Gravel is fine to coarse angular brick and concrete. Occasional scaffolding bar and paving slabs.		
0.80	1.20	Firm to stiff becoming stiff brown mottled grey slightly gravelly CLAY.		1.00 HSV = 80kPa
1.20	2.00	Stiff light grey mottled orange CLAY.		1.30 HSV = 110kPa
		End of trial hole at 2.00m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 09/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	



GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP12

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.14	TOPSOIL: Dark brown sandy gravelly LOAM with brick and conc.		0.10 - J
0.14	0.70	MADE GROUND: Reworked firm to stiff brown gravelly CLAY. Gravel is fine to coarse angular brick and concrete. Relict foundations to 0.80m bgl (brick onto concrete).		
0.70	1.40	Firm to stiff becoming stiff brown mottled grey slightly gravelly CLAY. Relict localised foundations to 0.80m bgl (concrete).		
1.40	1.70	Stiff light grey mottled orange CLAY.		1.50 - T
1.70	2.00	Possible highly weathered bedrock: Recovered as black very silty GRAVEL of coal / carbonaceous siltstone.		
2.00	2.30	Possible highly weathered bedrock: Recovered as dark grey brown very silty GRAVEL of very weak siltstone/mudstone. Occasional carbonaceous siltstone.		
		End of trial hole at 2.30m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		

Engineer: J.Brock

Site Works Date: 09/06/2022

Plant: Tracked 360 Excavator

Log Notes:

HSV = Hand Shear Vane (kN/m²)

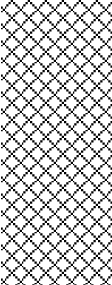
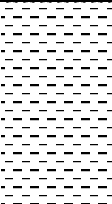
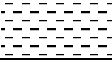
LP = Limited Penetration (HSV/CBR)

B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub



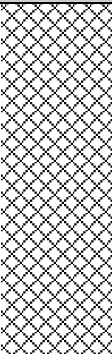
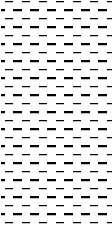
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GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP13

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.10	TOPSOIL: Dark brown sandy gravelly LOAM with brick and conc.		
0.10	1.10 (varies 0.90 to 1.10)	MADE GROUND: Reworked firm to stiff brown very gravelly CLAY. Gravel is fine to coarse angular brick, concrete and pottery. Occasional pockets of sand and gravel. Relict foundations to 0.90m bgl (brick onto concrete).		0.30 - J
1.10	2.00	Firm to stiff becoming stiff brown mottled grey slightly gravelly CLAY.		1.20 – T (bag)
2.00	2.20	Stiff dark brown very gravelly CLAY. Gravel is fine to coarse angular very weak shale.		
		End of trial hole at 2.20m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 09/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

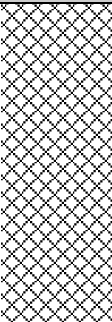
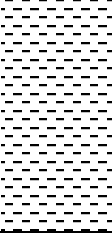


GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP14 (Boggy Area)

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	1.20	MADE GROUND: Soft, locally very soft saturated dark grey to black gravelly SILT with much organic material. Much brick (whole and part), concrete, timber and tile. Relict foundations to 1.20m bgl (brink onto concrete).		0.40 - J
1.20	2.00	Firm to stiff becoming stiff brown mottled grey slightly gravelly CLAY.		
		End of trial hole at 2.00m bgl. Groundwater ingress from surface and from made ground. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 09/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

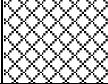
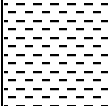
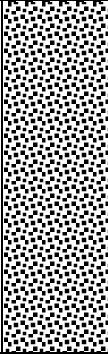


GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP15 (Boggy Area)

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	1.10	MADE GROUND: Soft, locally very soft saturated dark grey to black gravelly SILT with much organic material. Much brick (whole and part), sandstone, concrete and timber.		
1.10	1.90	Firm to stiff becoming stiff brown mottled grey slightly gravelly CLAY.		
		End of trial hole at 1.90m bgl. Groundwater ingress from surface and from made ground. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 09/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

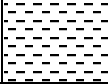
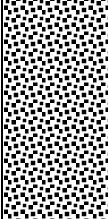


GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP16

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TOPSOIL: Dark brown sandy gravelly LOAM.		0.10 - J
0.20	0.40	MADE GROUND: Reworked firm to stiff brown very gravelly CLAY with occasional sandstone cobbles, brick and concrete. Relict foundations to 0.50m bgl (brick onto concrete).		
0.40	0.80	Firm to stiff red brown silty sandy gravelly CLAY. Relict foundations to 0.50m bgl (brick onto concrete).		
0.80	2.00	Dark red brown very silty/clayey angular to sub-rounded GRAVEL and COBBLES of sandstone (appears dense – slow digging).		
		End of trial hole at 2.00m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 09/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

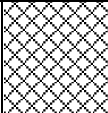


GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – TP17

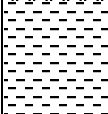
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.16	TOPSOIL: Dark brown sandy gravelly LOAM.		0.10 - J
0.16	0.50	MADE GROUND: Reworked firm to stiff brown very gravelly CLAY with occasional sandstone cobbles, brick and concrete. Relict foundations to 0.60m bgl (brick onto concrete).		
0.50	0.80	Firm red brown silty sandy gravelly CLAY.		
0.80	1.60	Dark red brown very silty/clayey angular to sub-rounded GRAVEL and COBBLES of sandstone (appears dense – slow digging).		Old water pipe and drain (infilled) at 0.80m and 1.20m bgl respectively. Localised reworked ground surrounding.
1.60	1.90	Possible highly weathered bedrock: Recovered as dark grey angular GRAVEL and COBBLES of sandstone.		
		End of trial hole at 1.90m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 09/06/2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	



GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – HP01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.26	TOPSOIL: Dark brown sandy gravelly LOAM.		0.20 - J
0.26	0.70	MADE GROUND: Reworked firm to stiff brown very gravelly CLAY with occasional brick and concrete.		0.40 - J
0.70	0.80	Firm to stiff brown slightly sandy gravelly CLAY.		
		End of trial hole at 0.80m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		Hand dug to 0.80m bgl
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Hand Digging Tools			Log Notes: HSV = Hand Shear Vane (kN/m ²) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

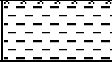
GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – HP02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TOPSOIL: Dark brown sandy gravelly LOAM.		0.10 - J
0.20	0.60	Firm to stiff brown slightly sandy gravelly CLAY.		
		End of trial hole at 0.60m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		Hand dug to 0.60m bgl
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Hand Digging Tools			Log Notes: HSV = Hand Shear Vane (kN/m ²) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

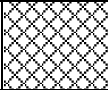
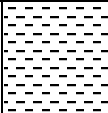
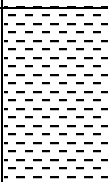
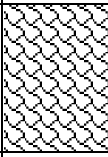
GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – HP03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.28	TOPSOIL: Dark brown sandy gravelly LOAM.		0.20 - J
0.20	0.50	Firm to stiff brown slightly sandy gravelly CLAY.		
		End of trial hole at 0.60m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		Hand dug to 0.60m bgl
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Hand Digging Tools			Log Notes: HSV = Hand Shear Vane (kN/m ²) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

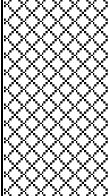
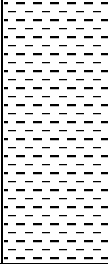
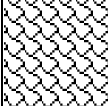
GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – HP04

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TOPSOIL: Dark brown sandy gravelly LOAM.		0.10 - J
0.20	0.47	MADE GROUND: Reworked firm to stiff brown very gravelly CLAY with occasional brick and concrete.		
0.47	0.60	Firm to stiff brown slightly sandy gravelly CLAY.		
		End of trial hole at 0.60m bgl. Trial pit dry and stable on completion. Trial hole backfilled with arisings on completion.		Hand dug to 0.60m bgl
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Hand Digging Tools			Log Notes: HSV = Hand Shear Vane (kN/m ²) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – BH01

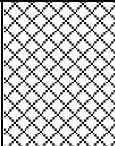
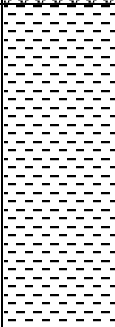
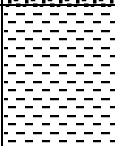
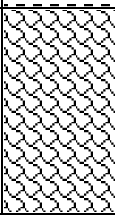
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.17	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		0.10 - J
0.17	0.52	MADE GROUND: Dark grey brown silty sandy GRAVEL of concrete, brick and aggregate.		0.30 - J
0.52	0.90	Firm becoming firm to stiff brown slightly sandy slight gravelly CLAY.		
0.90	1.50	Stiff brown slightly silty, slightly sandy gravelly CLAY.		1.00 SPT = N6 1.10 - T
1.50	2.00	Possible highly weathered bedrock: Recovered as dark grey brown very silty GRAVEL of very weak siltstone/mudstone.		2.00 SPT = N>50(LP)
		End of borehole at 2.00m due to sample tube and SPT refusal. Groundwater ingress from 1.10m bgl. Standing water at 0.95m bgl on completion. Borehole installed: GL to 1.0m plain pipe and bentonite seal 1.0 to 2.0m slotted pipe and gravel filter		Hand dug to 1.00m
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Archway Competitor C130 Superheavy			Log Notes: SPT = Standard Penetration test (N value) HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – BH02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.17	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		0.10 - J
0.17	0.90	MADE GROUND: Reworked firm to stiff light grey brown slightly sandy CLAY with occasional brick.		
0.90	1.80	Firm to stiff becoming stiff grey brown mottled orangey brown slightly silty, slightly sandy gravelly CLAY.		1.00 SPT = N6
1.80	2.20	Possible highly weathered bedrock: Recovered as dark grey brown very silty GRAVEL of very weak siltstone/mudstone. Occasional thin bands of coal.		2.00 SPT = N>50 (LP)
		End of borehole at 2.20m due to sample tube and SPT refusal. Groundwater ingress from 2.10m bgl. Standing water at 2.10m bgl on completion. Falling Head test completed – see results below. Borehole installed: GL to 1.0m plain pipe and bentonite seal 1.0 to 2.0m slotted pipe and gravel filter		Hand dug to 1.00m
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Archway Competitor C130 Superheavy			Log Notes: SPT = Standard Penetration test (N value) HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

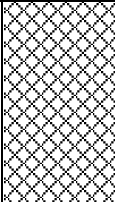
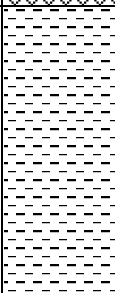
BH02 - Falling Head Test - Results	
Duration (mins)	Water Level (m bgl)
0	0.25
18	0.40
44	0.50
68	0.56
120	0.64
180	0.75
300	0.93

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – BH03

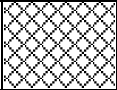
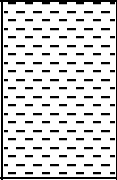
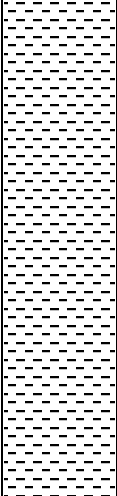
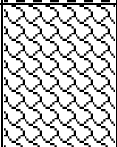
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		
0.30	0.80	MADE GROUND: Reworked firm to stiff light grey brown slightly sandy CLAY with occasional brick and plastic.		
0.80	1.90	Firm to stiff becoming stiff grey brown mottled orangey brown slightly silty, slightly sandy gravelly CLAY.		1.00 SPT = N7
1.90	2.00	Black to dark grey very silty GRAVEL of carbonaceous siltstone.		
2.00	2.50	Stiff light grey brown gravelly CLAY.		2.00 SPT = N12
2.50	3.20	Possible highly weathered bedrock: Recovered as dark grey brown very silty GRAVEL of very weak siltstone/mudstone. Occasional thin bands of coal.		3.00 SPT = N>50 (LP)
		End of borehole at 3.20m due to sample tube and SPT refusal. Borehole remained dry. Falling Head Test Completed – See results below. Borehole installed: GL to 1.0m plain pipe and bentonite seal 1.0 to 2.0m slotted pipe and gravel filter		Hand dug to 1.00m
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Archway Competitor C130 Superheavy		Log Notes: SPT = Standard Penetration test (N value) HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

BH03 - Falling Head Test - Results	
Duration (mins)	Water Level (m bgl)
0	0.23
54	0.27
110	0.29
147	0.30
180	0.31
300	0.35

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – BH04

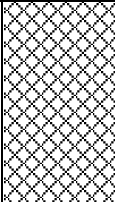
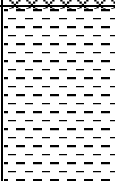
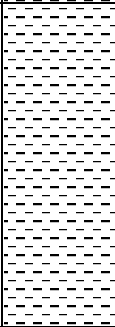
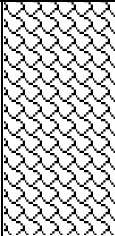
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.14	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		
0.14	0.80	MADE GROUND: Reworked firm light grey brown slightly sandy CLAY with occasional brick and concrete.		0.50 - J
0.80	1.80	Firm to stiff becoming stiff grey brown mottled orangey brown slightly silty, slightly sandy gravelly CLAY.		1.00 SPT = N8 1.20 - T
1.80	2.10	Possible highly weathered bedrock: Black to dark grey very silty GRAVEL of carbonaceous siltstone.		2.00 SPT = N>50 (LP)
		End of borehole at 2.10m due to sample tube and SPT refusal. Borehole remained dry. Borehole installed: GL to 1.0m plain pipe and bentonite seal 1.0 to 2.0m slotted pipe and gravel filter		Hand dug to 1.00m
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Archway Competitor C130 Superheavy			Log Notes: SPT = Standard Penetration test (N value) HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – BH05

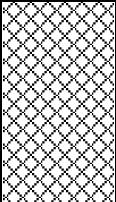
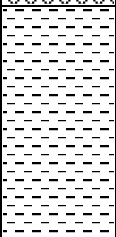
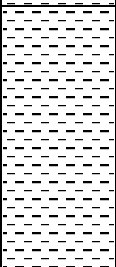
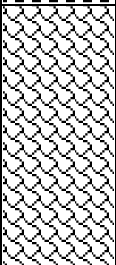
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.12	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		
0.12	0.40	MADE GROUND: Reworked firm light grey brown slightly sandy CLAY with occasional brick and concrete.		
0.40	1.00	Firm to stiff, becoming stiff brown slightly sandy CLAY.		1.00 SPT = N7
1.00	2.70	Stiff grey brown mottled orangey brown slightly silty, slightly sandy gravelly CLAY.		2.00 SPT = N13
2.70	3.20	Possible highly weathered bedrock: Recovered as dark grey brown very silty GRAVEL of very weak siltstone/mudstone. Occasional thin bands of coal.		3.00 SPT = N>50(LP)
		End of borehole at 3.20m due to sample tube and SPT refusal. Borehole remained dry. Falling Head test completed – see results below Borehole backfilled with arisings.		Hand dug to 1.00m
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Archway Competitor C130 Superheavy			Log Notes: SPT = Standard Penetration test (N value) HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

BH05 - Falling Head Test - Results	
Duration (mins)	Water Level (m bgl)
0	0.20
20	0.24
45	0.28
218	0.32
300	0.36

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – BH06

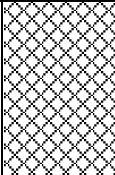
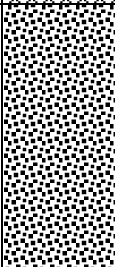
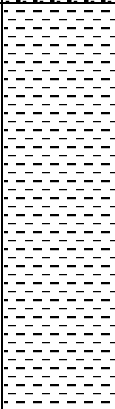
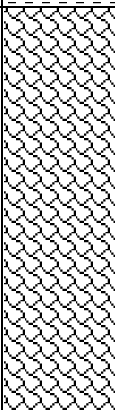
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		
0.20	0.90	MADE GROUND: Reworked firm light grey brown slightly sandy CLAY with occasional brick and concrete.		
0.90	1.50	Firm to stiff, becoming stiff brown slightly sandy CLAY.		1.00 SPT = N11
1.50	2.60	Stiff grey brown mottled orangey brown slightly silty, slightly sandy gravelly CLAY.		2.00 SPT = N19
2.60	3.40	Possible highly weathered bedrock: Recovered as light grey very silty GRAVEL of very weak siltstone/mudstone. Occasional thin bands of coal.		3.00 SPT = N55
		End of borehole at 3.40m due to sample tube and SPT refusal. Borehole remained dry. Borehole installed: GL to 1.0m plain pipe and bentonite seal 1.0 to 3.0m slotted pipe and gravel filter		Hand dug to 1.00m
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Archway Competitor C130 Superheavy			Log Notes: SPT = Standard Penetration test (N value) HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – BH07

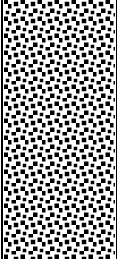
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.11	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		
0.11	0.80	MADE GROUND: Reworked firm to stiff light grey brown slightly sandy CLAY with occasional brick and concrete.		
0.80	1.60	Firm to stiff brown slightly sandy CLAY.		1.00 SPT = N6
1.60	2.50	Stiff grey brown mottled orangey brown slightly silty, slightly sandy gravelly CLAY. Gravel if fine to coarse angular very weak shale.		2.00 SPT = N16
2.50	3.40	Possible highly weathered bedrock: Recovered as light grey very silty GRAVEL of very weak siltstone/mudstone. Occasional thin bands of coal.		3.00 SPT = N>50 (LP)
		End of borehole at 3.40m due to sample tube and SPT refusal. Borehole remained dry. Falling Head test completed – see results below Borehole backfilled with arisings.		Hand dug to 1.00m
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Archway Competitor C130 Superheavy			Log Notes: SPT = Standard Penetration test (N value) HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

BH07- Falling Head Test - Results	
Duration (mins)	Water Level (m bgl)
0	0.25
24	0.26
158	0.30
300	0.34

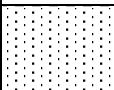
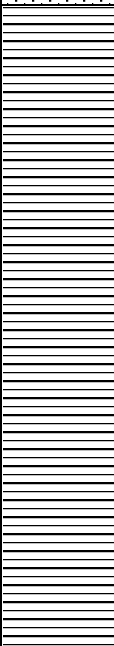
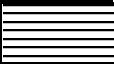
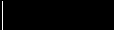
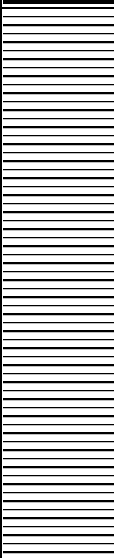
GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – BH08

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.10	TOPSOIL: Dark brown sandy gravelly LOAM with rare fragments of brick.		
0.10	0.70	MADE GROUND: Reworked firm light grey brown slightly sandy CLAY with occasional brick and concrete.		
0.70	1.60	Medium dense to dense dark red brown very silty/clayey angular to sub-rounded GRAVEL and COBBLES of sandstone.		1.00 SPT = N26
1.60	3.00	Stiff grey brown mottled orangey brown slightly silty, slightly sandy gravelly CLAY.		2.00 SPT = N27
3.00	4.40	Possible highly weathered bedrock: Recovered as light grey brown very silty GRAVEL of very weak siltstone/mudstone. Occasional thin bands of coal.		3.00 SPT = N36 4.00 SPT = N56
		End of borehole at 4.40m due to sample tube and SPT refusal. Borehole remained dry. Borehole installed: GL to 1.0m plain pipe and bentonite seal 1.0 to 4.0m slotted pipe and gravel filter		Hand dug to 1.00m
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Archway Competitor C130 Superheavy			Log Notes: SPT = Standard Penetration test (N value) HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven – BH09

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.12	TOPSOIL: Dark brown sandy gravelly LOAM.		
0.12	0.40	MADE GROUND: Reworked firm light grey brown slightly sandy CLAY with occasional brick and concrete.		
0.40	1.50	Medium dense to dense dark red brown very silty/clayey angular to sub-rounded GRAVEL and COBBLES of sandstone.		1.00 SPT = N>50 (LP)
		End of borehole at 1.50m due to sample tube and SPT refusal. Borehole remained dry. Borehole installed: GL to 0.50m plain pipe and bentonite seal 0.50 to 1.0m slotted pipe and gravel filter		Hand dug to 1.00m
Engineer: J.Brock Site Works Date: 08/06/2022 Plant: Archway Competitor C130 Superheavy			Log Notes: SPT = Standard Penetration test (N value) HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven - RBH01

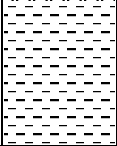
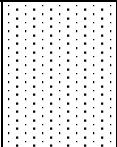
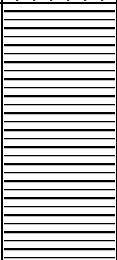
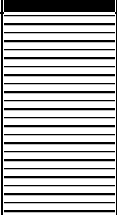
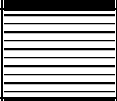
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.65	MADE GROUND: Loamy soil and reworked gravelly CLAY.		
0.65	2.20	Reddish brown and grey sandy, gravelly CLAY.		
2.20	3.50	Light brown SANDSTONE.		3.00-4.50: 4 mins
3.50	14.70	Grey brown MUDSTONE.		4.50-6.00: 7 mins 6.00-7.50: 6 mins 7.50-9.00: 6 mins 9.00-10.50: 14 mins 10.50-12.00: 17 mins 12.00-13.50: 14 mins 13.50-15.00: 14mins
14.70	15.40	Black COAL (0.70m).		15.00-16.50: 6 mins
15.40	16.40	Grey MUDSTONE.		
16.40	16.80	Black COAL (0.40m).		16.50-18.00: 10 mins
16.80	28.50	Grey brown MUDSTONE.		18.00-19.50: 18 mins 19.50-21.00: 14 mins 21.00-22.50: 17 mins 22.50-24.00: 15 mins 24.00-25.50: 24 mins 25.50-27.00: 20 mins

Continued Overleaf

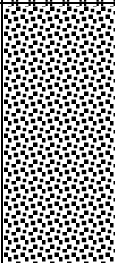
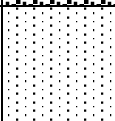
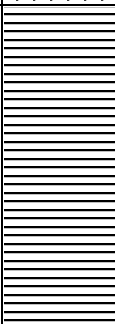
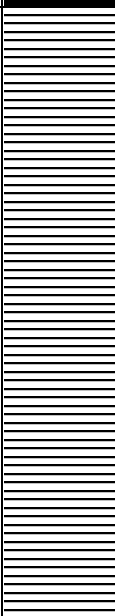
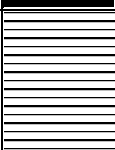
GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven - RBH01 (Cont/d...)

				27.00-28.50: 16 mins
		Borehole backfilled with bentonite and arisings. No adverse gas detected during or after drilling. 100% flush throughout. No evidence of workings or broken ground.		Hand dug before drilling. Cased to 4.00m.
Engineer: GE Site Works Date: 18/07/2022 Plant: Beretta T21 Tracked rotary rig with water flush			Log Notes: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (blows per 300mm n300) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven - RBH02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.40	MADE GROUND: Loamy soil and reworked gravelly CLAY.		
0.40	2.90	Reddish brown and grey sandy, gravelly CLAY.		
2.90	5.50	Light brown SANDSTONE.		3.00-4.50: 6 mins 4.50-6.00: 10 mins
5.50	10.20	Grey brown MUDSTONE.		6.00-7.50: 10 mins 7.50-9.00: 12 mins 9.00-10.50: 8 mins
10.20	10.60	Black COAL (0.40m).		10.50-12.00: 9 mins
10.60	13.80	Grey MUDSTONE.		12.00-13.50: 16 mins 13.50-15.00: 6 mins
13.80	14.50	Black COAL (0.70m).		
14.50	16.10	Grey brown MUDSTONE.		15.00-16.50: 47 mins
16.10	16.60	Very hard red brown IRONSTONE.		16.50-16.60: 90 mins
		End of borehole due to refusal on ironstone. Borehole backfilled with bentonite and arisings. No adverse gas detected during or after drilling. 100% flush throughout. No evidence of workings or broken ground.		Hand dug before drilling. Cased to 5.00m.
Engineer: GE Site Works Date: 19/07/2022 Plant: Beretta T21 Tracked rotary rig with water flush			Log Notes: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (blows per 300mm n300) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

GEO2021-5335: Windermere Rd & Fell View Avenue, Whitehaven - RBH03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.15	MADE GROUND: Loamy soil and reworked gravelly CLAY.		
0.40	5.00	Reddish brown very sandy GRAVEL and COBBLES of sandstone.		3.00-4.50: 15 mins 4.50-6.00: 11 mins
5.00	7.00	Light brown SANDSTONE.		6.00-7.50: 10 mins
7.00	12.50	Grey brown MUDSTONE.		7.50-9.00: 14 mins 9.00-10.50: 11 mins 10.50-12.00: 10 mins 12.00-13.50: 15 mins
12.50	12.80	Black COAL (0.30m).		
12.80	22.80	Grey MUDSTONE.		13.50-15.00: 15 mins 15.00-16.50: 15 mins 16.50-18.00: 23 mins 18.00-19.50: 25 mins 19.50-21.00: 15 mins 21.00-22.50: 11 mins 22.50-24.00: 12 mins
22.80	23.40	Black COAL (0.60m).		
23.40	25.50	Grey brown MUDSTONE.		24.00-25.50: 13 mins

Continued Overleaf.

		End of borehole due to no progress through ironstone. Borehole backfilled with bentonite and arisings. No adverse gas detected during or after drilling.		Hand dug before drilling. Cased to 6.00m.
Engineer: GE Site Works Date: 20/07/2022 Plant: Beretta T21 Tracked rotary rig with water flush			Log Notes: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (blows per 300mm n300) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	



Dynamic Cone Penetrometer Calculation Sheet

Site:	Windermere Rd & Fell View Avenue, Whitehaven
Test Location:	TP02
Test Depth (mm):	0
Zero Blow Reading:	60

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value ¹ CBR=10 ^{(2.48-1.057.Log(DCP))}
2	190	130	130	2	65.0	3.7
5	330	270	140	7	28.0	8.9
5	600	540	270	12	54.0	4.5
5	895	835	295	17	59.0	4.1
2	945	885	50	19	25.0	10.1

Site:	Matterdale Community Centre
Test Location:	TP04
Test Depth (mm):	0
Zero Blow Reading:	60

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value ¹ CBR=10 ^{(2.48-1.057.Log(DCP))}
2	400	340	340	2	170.0	1.3
5	920	860	520	7	104.0	2.2
1	950	890	30	8	30.0	8.3

Site:	Matterdale Community Centre
Test Location:	TP05
Test Depth (mm):	0
Zero Blow Reading:	50

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value ¹ CBR=10 ^{(2.48-1.057.Log(DCP))}
3	230	180	180	3	60.0	4.0
2	395	345	165	5	82.5	2.8
5	680	630	285	10	57.0	4.2
4	945	895	265	14	66.3	3.6

1 - TRRL Equation, Log₁₀(CBR) = 2.48 - 1.057Log₁₀ (mm/blow)



Dynamic Cone Penetrometer Calculation Sheet

Site:	Windermere Rd & Fell View Avenue, Whitehaven
Test Location:	TP07
Test Depth (mm):	0
Zero Blow Reading:	70

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value ¹ CBR=10 ^{(2.48-1.057.Log(DCP))}
3	265	195	195	3	65.0	3.7
5	490	420	225	8	45.0	5.4
5	580	510	90	13	18.0	14.2
						REFUSAL - COBBLE?

Site:	Matterdale Community Centre
Test Location:	TP09
Test Depth (mm):	0
Zero Blow Reading:	90

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value ¹ CBR=10 ^{(2.48-1.057.Log(DCP))}
2	260	170	170	2	85.0	2.8
2	440	350	180	4	90.0	2.6
4	730	640	290	8	72.5	3.3
5	920	830	190	13	38.0	6.5

Site:	Matterdale Community Centre
Test Location:	TP11
Test Depth (mm):	0
Zero Blow Reading:	60

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value ¹ CBR=10 ^{(2.48-1.057.Log(DCP))}
2	230	170	170	2	85.0	2.8
5	390	330	160	7	32.0	7.7
5	500	440	110	12	22.0	11.5
5	630	570	130	17	26.0	9.6
5	875	815	375	17	75.0	3.1

1 - TRRL Equation, $\text{Log}_{10}(\text{CBR}) = 2.48 - 1.057\text{Log}_{10}(\text{mm/blow})$



Dynamic Cone Penetrometer Calculation Sheet

Site:	Windermere Rd & Fell View Avenue, Whitehaven
Test Location:	TP16
Test Depth (mm):	0
Zero Blow Reading:	70

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value ¹ CBR=10 ^{(2.48-1.057.Log(DCP))}
5	230	160	160	5	32.0	7.7
5	295	225	65	10	13.0	20.1
5	340	270	45	15	9.0	29.6
5	390	320	50	20	10.0	26.5
5	500	430	110	25	22.0	11.5
5	600	530	210	25	42.0	5.8
5	720	650	120	30	24.0	10.5
5	850	780	130	35	26.0	9.6

1 - TRRL Equation, $\text{Log}_{10}(\text{CBR}) = 2.48 - 1.057\text{Log}_{10}(\text{mm/blow})$

RESULTS OF INSITU PERMEABILITY TESTS

SITE: Windermere Rd & Fell View Avenue, Whitehaven
JOB No: 2022-5335
BOREHOLE No: BH02, Test 1
DATE: 08/06/2022

casing ht above gl= 0 m
 casing depth= 0 m
 borehole depth= 2.2 m
 L= 2.2 m

WL= 4 m assumed
 casing dia= 0.101 m
 Response zone diameter 0.101 m
 $k=A/FT$ $k=A/(F(t_2-t_1)\ln H_1/H_2)$

Time (mins)	Time (secs)	Water level below top of casing (m)	Water level below GL (m)	Water head above borehole base (m)	Water head over existing water level (m)	H/Ho	Intake factor F	Borehole area m ²	t2-t1 secs	lnh1/h2	Permeability k m/s
0	0	0.25	0.250	1.950	3.750	1	3.6619511	0.0080118			
18	1080	0.40	0.400	1.800	3.600	0.96	3.6619511	0.0080118	1080	0.040822	8.26972E-08
44	2640	0.50	0.500	1.700	3.500	0.933333	3.6619511	0.0080118	1560	0.0281709	3.9509E-08
68	4080	0.56	0.560	1.640	3.440	0.917333	3.6619511	0.0080118	1440	0.0172915	2.62718E-08
120	7200	0.64	0.640	1.560	3.360	0.896	3.6619511	0.0080118	3120	0.0235305	1.65005E-08
180	10800	0.75	0.750	1.450	3.250	0.866667	3.6619511	0.0080118	3600	0.033286	2.02292E-08
300	18000	0.93	0.930	1.270	3.070	0.818667	3.6619511	0.0080118	7200	0.0569774	1.73137E-08

Tests analysed in accordance with Hvorslev (BS5930: Section 25.4)

3.37536E-08

Average permeability = 3.38 x 10⁻⁸ m/s

Ground Gas & Groundwater Monitoring Record Sheet 01

Site: Windermere Rd & Fell View Avenue, Whitehaven

Project No: 2022-5335

Date: 11/06/2022

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	1018 R	0.0	0.0	0.8	0.8	19.1	19.3	<0.1	DRY	2.00	-
BH02	1018 R	0.0	0.0	1.2	1.0	19.8	19.5	<0.1	1.85	2.00	-
BH03	1018 R	0.0	0.0	0.9	0.9	19.1	19.1	<0.1	1.80	2.00	-
BH04	1018 R	0.0	0.0	7.3	7.0	13.4	13.4	<0.1	DRY	2.00	-
BH06	1018 R	0.0	0.0	1.3	1.2	19.3	19.3	<0.1	DRY	3.00	-
BH08	1018 R	0.0	0.0	1.3	0.8	19.7	19.7	<0.1	3.15	3.50	-
BH09	1018 R	0.0	0.0	0.5	0.5	20.8	20.8	<0.1	DRY	1.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.

Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

F = Falling Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure

Nm – Not Monitored

Monitoring Completed By: SG

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Overcast and Dry

Temperature 14.0°C

Notes: N/A

Website: www.geoenvironmentalengineering.com

Email: info@geoenvironmentalengineering.com

Telephone: 08456 768 895 / 07883 440 186

Ground Gas & Groundwater Monitoring Record Sheet 02

Site: Windermere Rd & Fell View Avenue, Whitehave

Project No: 2022-5335

Date: 22/06/2022

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	1006 F	0.0	0.0	0.8	0.8	14.4	14.7	<0.1	DRY	2.00	-
BH02	1006 F	0.0	0.0	1.1	1.1	14.2	14.3	<0.1	1.85	2.00	-
BH03	1006 F	0.0	0.0	0.3	0.5	14.3	14.5	<0.1	1.90	2.00	-
BH04	1006 F	0.0	0.0	3.8	3.4	14.1	14.5	<0.1	DRY	2.00	-
BH06	1006 F	0.0	0.0	1.1	1.1	14.5	14.5	<0.1	DRY	3.00	-
BH08	1006 F	0.0	0.0	0.8	0.8	14.5	14.8	<0.1	3.20	3.50	-
BH09	1006 F	0.0	0.0	0.3	0.3	14.1	14.2	<0.1	DRY	1.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.

Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

F = Falling Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure

Nm – Not Monitored

Monitoring Completed By: SG

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Overcast and Dry

Temperature 16.0°C

Notes: N/A

Website: www.geoenvironmentalengineering.com

Email: info@geoenvironmentalengineering.com

Telephone: 08456 768 895 / 07883 440 186

Ground Gas & Groundwater Monitoring Record Sheet 03

Site: Windermere Rd & Fell View Avenue, Whitehave

Project No: 2022-5335

Date: 28/09/2022

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	982 F	0.0	0.0	1.3	1.3	19.1	19.3	<0.1	0.95	2.00	-
BH02	982 F	0.0	0.0	4.5	4.5	15.7	16.2	<0.1	1.15	2.00	-
BH03	982 F	0.0	0.0	2.2	2.2	17.8	18.1	<0.1	1.30	2.00	-
BH04	982 F	0.0	0.0	4.3	3.7	16.6	17.0	<0.1	1.30	2.00	-
BH06	982 F	0.0	0.0	1.2	1.3	16.8	16.7	<0.1	1.85	3.00	-
BH08	982 F	0.0	0.0	6.3	6.3	11.4	11.3	<0.1	2.50	3.50	-
BH09	982 F	0.0	0.0	1.8	1.4	18.5	18.7	<0.1	DRY	1.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.

Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

F = Falling Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure

Nm – Not Monitored

Monitoring Completed By: SG

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Overcast and Dry

Temperature 15.0°C

Notes: N/A

Website: www.geoenvironmentalengineering.com

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Ground Gas & Groundwater Monitoring Record Sheet 04

Site: Windermere Rd & Fell View Avenue, Whitehaven

Project No: 2022-5335

Date: 25/10/2022

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	989 R	0	0	1.2	1.2	19.5	19.8	<0.1	0.80	2.00	-
BH02	989 R	0	0	4.5	4.5	13.5	15.7	<0.1	1.20	2.00	-
BH03	989 R	0	0	8.5	8.3	14.1	14.7	<0.1	2.30	2.00	-
BH04	989 R	0	0	1.2	1.2	19.8	20.0	<0.1	2.00	2.00	-
BH06	989 R	nm	nm	nm	nm	nm	nm	nm	nm	3.00	-
BH08	989 R	0	0	2.1	2.0	17.1	17.4	<0.1	2.30	3.50	-
BH09	989 R	0	0	1.2	0.7	19.1	19.9	<0.1	1.30	1.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.

Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

F = Falling Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure

Nm – Not Monitored

Monitoring Completed By: SG

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Overcast and Dry

Temperature 14.0°C

Notes: N/A

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Ground Gas & Groundwater Monitoring Record Sheet 05

Site: Windermere Rd & Fell View Avenue, Whitehaven

Project No: 2022-5335

Date: 05/12/2022

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	1020 F	0.3	0.9	0.1	3.4	20.6	16.5	<0.1	1.00	2.00	-
BH02	1020 F	0	0	0.4	4.7	21.8	18.4	<0.1	1.00	2.00	-
BH03	1020 F	0	0	0.2	5.3	22.0	13.3	<0.1	1.30	2.00	-
BH04	1020 F	0	0	0.2	0.5	21.8	21.9	<0.1	1.40	2.00	-
BH06	1020 F	0	0	0.5	3.6	21.4	21.4	<0.1	2.30	3.00	-
BH08	1020 F	0	0	0.1	8.0	8.0	21.6	<0.1	2.30	3.50	-
BH09	1020 F	0	0	0.2	2.5	2.5	21.7	<0.1	DRY	1.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.

Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

F = Falling Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure

Nm – Not Monitored

Monitoring Completed By: TE

Equipment Used: GA2000 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Light Drizzle

Temperature 4.0°C

Notes: N/A

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Ground Gas & Groundwater Monitoring Record Sheet 06

Site: Windermere Rd & Fell View Avenue, Whitehaven

Project No: 2022-5335

Date: 09/12/2022

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	999 F	0	0	0.3	3.0	21.3	18.7	<0.1	1.00	2.00	-
BH02	999 F	0	0	0.2	4.4	21.1	14.4	<0.1	1.25	2.00	-
BH03	999 F	0	0	0.2	7.2	21.2	11.3	<0.1	1.50	2.00	-
BH04	999 F	0	0	0.1	4.9	21.2	16.5	<0.1	1.50	2.00	-
BH06	999 F	0	0	0.4	6.4	21.3	16.8	<0.1	2.40	3.00	-
BH08	999 F	0	0	0.6	8.6	21.0	10.9	<0.1	2.50	3.50	-
BH09	999 F	0	0	0.6	2.8	20.6	20.4	<0.1	DRY	1.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.

Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

F = Falling Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure

Nm – Not Monitored

Monitoring Completed By: TE

Equipment Used: GA2000 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry and sunny

Temperature 3.0°C

Notes: N/A

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Appendix III

■ Laboratory Test Results



ANALYTICAL TEST REPORT

Contract no: 110347

Contract name: Windermere Road, Whitehaven

Client reference: GEO2022-5335

Clients name: Geo Environmental Engineering

Clients address: 4 Culgarth Avenue
Cockermouth
Cumbria
CA13 9PL

Samples received: 15 June 2022

Analysis started: 15 June 2022

Analysis completed: 27 June 2022

Report issued: 27 June 2022

Key

U	UKAS accredited test
M	MCERTS & UKAS accredited test
\$	Test carried out by an approved subcontractor
I/S	Insufficient sample to carry out test
N/S	Sample not suitable for testing
NAD	No Asbestos Detected

Approved by:

Will Fardon
Technical Director

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
110347-1	BH01	1.10	Sandy Loamy Clay with Gravel & Roots	-	-	22.0
110347-2	BH04	1.20	Sandy Clay	-	-	22.0
110347-3	TP01	0.10	Sandy Clayey Loam with Gravel & Roots	-	-	18.6
110347-4	TP01	1.50	Sandy Clayey Loam with Gravel	-	-	22.9
110347-5	TP02	0.90	Sandy Clay	-	-	24.1
110347-6	TP03	0.10	Sandy Clayey Loam with Gravel & Roots	-	-	25.0
110347-7	TP03	1.50	Sandy Loamy Clay	-	-	20.1
110347-8	TP05	0.10	Sandy Clayey Loam with Roots	-	-	22.0
110347-9	TP06	0.30	Sandy Clayey Loam with Gravel & Roots	-	-	18.1
110347-10	TP08	0.30	Sandy Clayey Loam with Gravel & Roots	-	-	20.2
110347-11	TP09	0.10	Sandy Clayey Loam with Gravel & Roots	-	-	25.4
110347-12	TP10	0.30	Sandy Clayey Loam with Gravel & Roots	-	-	16.5
110347-13	TP11	0.10	Sandy Clayey Loam with Gravel & Roots	-	-	19.9
110347-14	TP12	0.10	Sandy Clayey Loam with Gravel & Roots	-	-	18.4
110347-15	TP12	1.50	Sandy Clay	-	-	8.9
110347-16	TP14	0.40	Sandy Loamy Clay with Gravel & Roots	-	-	21.7
110347-17	TP16	0.10	Sandy Clayey Loam with Gravel & Roots	-	-	18.0
110347-18	TP17	0.10	Sandy Clayey Loam with Gravel & Roots	-	-	21.0
110347-19	HP01	0.40	Sandy Loamy Clay with Gravel	-	-	17.3
110347-20	HP04	0.10	Sandy Loamy Clay with Gravel & Roots	-	-	24.3

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SOILS

Lab number Sample id Depth (m) Date sampled			110347-1 BH01 1.10 10/06/2022	110347-2 BH04 1.20 10/06/2022	110347-3 TP01 0.10 10/06/2022	110347-4 TP01 1.50 10/06/2022	110347-5 TP02 0.90 10/06/2022	110347-6 TP03 0.10 10/06/2022
Test	Method	Units						
Arsenic (total)	CE127 ^M	mg/kg As	-	-	18	-	-	25
Cadmium (total)	CE127 ^M	mg/kg Cd	-	-	<0.2	-	-	0.2
Chromium (total)	CE127 ^M	mg/kg Cr	-	-	38	-	-	49
Chromium (III)	CE208	mg/kg CrIII	-	-	38	-	-	49
Chromium (VI)	CE146	mg/kg CrVI	-	-	<1	-	-	<1
Copper (total)	CE127 ^M	mg/kg Cu	-	-	30	-	-	40
Lead (total)	CE127 ^M	mg/kg Pb	-	-	86	-	-	105
Mercury (total)	CE127 ^M	mg/kg Hg	-	-	<0.5	-	-	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni	-	-	22	-	-	32
Selenium (total)	CE127 ^M	mg/kg Se	-	-	1.2	-	-	1.4
Zinc (total)	CE127 ^M	mg/kg Zn	-	-	63	-	-	99
pH	CE004 ^M	units	8.8	7.5	8.7	7.0	7.6	8.0
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	17	106	35	25	<10	21
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	-	-	4.3	-	-	6.4
PAH								
Naphthalene	CE087 ^M	mg/kg	-	-	0.05	-	-	0.08
Acenaphthylene	CE087 ^M	mg/kg	-	-	<0.02	-	-	<0.02
Acenaphthene	CE087 ^M	mg/kg	-	-	<0.02	-	-	0.03
Fluorene	CE087 ^U	mg/kg	-	-	<0.02	-	-	0.08
Phenanthrene	CE087 ^M	mg/kg	-	-	0.31	-	-	0.88
Anthracene	CE087 ^U	mg/kg	-	-	0.09	-	-	0.15
Fluoranthene	CE087 ^M	mg/kg	-	-	0.61	-	-	1.52
Pyrene	CE087 ^M	mg/kg	-	-	0.50	-	-	1.20
Benzo(a)anthracene	CE087 ^U	mg/kg	-	-	0.36	-	-	0.71
Chrysene	CE087 ^M	mg/kg	-	-	0.28	-	-	0.60
Benzo(b)fluoranthene	CE087 ^M	mg/kg	-	-	0.40	-	-	0.83
Benzo(k)fluoranthene	CE087 ^M	mg/kg	-	-	0.18	-	-	0.37
Benzo(a)pyrene	CE087 ^U	mg/kg	-	-	0.30	-	-	0.66
Indeno(123cd)pyrene	CE087 ^M	mg/kg	-	-	0.21	-	-	0.47
Dibenz(ah)anthracene	CE087 ^M	mg/kg	-	-	0.05	-	-	0.11
Benzo(ghi)perylene	CE087 ^M	mg/kg	-	-	0.20	-	-	0.42
PAH (total of USEPA 16)	CE087	mg/kg	-	-	3.54	-	-	8.11
Subcontracted analysis								
Calorific value	\$	MJ/kg	-	-	-	11	-	-
Asbestos (qualitative)	\$	-	-	-	NAD	-	-	NAD

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SOILS

Lab number Sample id Depth (m) Date sampled			110347-7 TP03 1.50 10/06/2022	110347-8 TP05 0.10 10/06/2022	110347-9 TP06 0.30 10/06/2022	110347-10 TP08 0.30 10/06/2022	110347-11 TP09 0.10 10/06/2022	110347-12 TP10 0.30 10/06/2022
Test	Method	Units						
Arsenic (total)	CE127 ^M	mg/kg As	-	17	19	17	30	24
Cadmium (total)	CE127 ^M	mg/kg Cd	-	<0.2	<0.2	0.2	0.3	0.2
Chromium (total)	CE127 ^M	mg/kg Cr	-	53	43	54	58	54
Chromium (III)	CE208	mg/kg CrIII	-	53	43	54	58	54
Chromium (VI)	CE146	mg/kg CrVI	-	<1	<1	<1	<1	<1
Copper (total)	CE127 ^M	mg/kg Cu	-	38	30	34	50	27
Lead (total)	CE127 ^M	mg/kg Pb	-	76	63	63	111	62
Mercury (total)	CE127 ^M	mg/kg Hg	-	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni	-	26	25	30	42	28
Selenium (total)	CE127 ^M	mg/kg Se	-	1.2	1.3	1.4	1.5	1.1
Zinc (total)	CE127 ^M	mg/kg Zn	-	94	92	100	160	97
pH	CE004 ^M	units	6.3	7.9	7.7	8.2	7.3	7.8
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	48	87	579	84	18	480
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	-	6.0	2.9	3.5	7.1	3.0
PAH								
Naphthalene	CE087 ^M	mg/kg	-	0.03	<0.02	0.04	0.08	0.06
Acenaphthylene	CE087 ^M	mg/kg	-	<0.02	<0.02	<0.02	0.04	<0.02
Acenaphthene	CE087 ^M	mg/kg	-	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	CE087 ^U	mg/kg	-	<0.02	<0.02	<0.02	0.03	0.02
Phenanthrene	CE087 ^M	mg/kg	-	0.24	0.10	0.32	0.53	0.37
Anthracene	CE087 ^U	mg/kg	-	0.05	<0.02	0.07	0.14	0.06
Fluoranthene	CE087 ^M	mg/kg	-	0.60	0.18	0.78	1.43	0.70
Pyrene	CE087 ^M	mg/kg	-	0.52	0.14	0.66	1.15	0.58
Benzo(a)anthracene	CE087 ^U	mg/kg	-	0.36	0.07	0.46	0.80	0.37
Chrysene	CE087 ^M	mg/kg	-	0.32	0.06	0.45	0.75	0.34
Benzo(b)fluoranthene	CE087 ^M	mg/kg	-	0.55	0.08	0.70	1.04	0.52
Benzo(k)fluoranthene	CE087 ^M	mg/kg	-	0.20	0.04	0.26	0.44	0.21
Benzo(a)pyrene	CE087 ^U	mg/kg	-	0.42	0.07	0.51	0.79	0.38
Indeno(123cd)pyrene	CE087 ^M	mg/kg	-	0.31	0.04	0.39	0.57	0.28
Dibenz(ah)anthracene	CE087 ^M	mg/kg	-	0.07	<0.02	0.10	0.14	0.07
Benzo(ghi)perylene	CE087 ^M	mg/kg	-	0.30	0.04	0.36	0.52	0.27
PAH (total of USEPA 16)	CE087	mg/kg	-	3.98	0.82	5.08	8.44	4.24
Subcontracted analysis								
Calorific value	\$	MJ/kg	-	-	-	-	-	-
Asbestos (qualitative)	\$	-	-	NAD	NAD	NAD	NAD	NAD

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SOILS

Lab number Sample id Depth (m) Date sampled			110347-13 TP11 0.10 10/06/2022	110347-14 TP12 0.10 10/06/2022	110347-15 TP12 1.50 10/06/2022	110347-16 TP14 0.40 10/06/2022	110347-17 TP16 0.10 10/06/2022	110347-18 TP17 0.10 10/06/2022
Test	Method	Units						
Arsenic (total)	CE127 ^M	mg/kg As	40	22	-	13	35	25
Cadmium (total)	CE127 ^M	mg/kg Cd	0.3	<0.2	-	<0.2	0.3	0.3
Chromium (total)	CE127 ^M	mg/kg Cr	53	65	-	47	54	56
Chromium (III)	CE208	mg/kg CrIII	53	65	-	47	54	56
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	-	<1	<1	<1
Copper (total)	CE127 ^M	mg/kg Cu	47	27	-	19	50	42
Lead (total)	CE127 ^M	mg/kg Pb	116	38	-	55	112	93
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5	<0.5	-	<0.5	<0.5	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni	38	22	-	19	49	34
Selenium (total)	CE127 ^M	mg/kg Se	2.4	1.2	-	0.9	1.7	1.4
Zinc (total)	CE127 ^M	mg/kg Zn	146	56	-	95	141	126
pH	CE004 ^M	units	7.6	7.8	5.7	7.4	7.0	7.3
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	56	13	<10	1744	417	28
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	0.6	3.0	-	2.2	0.6	2.4
PAH								
Naphthalene	CE087 ^M	mg/kg	0.09	0.02	-	0.04	0.13	0.11
Acenaphthylene	CE087 ^M	mg/kg	0.05	<0.02	-	<0.02	0.08	0.05
Acenaphthene	CE087 ^M	mg/kg	0.03	<0.02	-	0.02	0.03	0.02
Fluorene	CE087 ^U	mg/kg	0.04	<0.02	-	0.04	0.06	0.03
Phenanthrene	CE087 ^M	mg/kg	0.71	0.24	-	0.48	1.18	0.73
Anthracene	CE087 ^U	mg/kg	0.13	0.04	-	0.10	0.25	0.16
Fluoranthene	CE087 ^M	mg/kg	1.71	0.61	-	0.83	2.81	1.87
Pyrene	CE087 ^M	mg/kg	1.37	0.50	-	0.66	2.30	1.63
Benzo(a)anthracene	CE087 ^U	mg/kg	0.92	0.32	-	0.40	1.44	1.07
Chrysene	CE087 ^M	mg/kg	0.81	0.29	-	0.37	1.30	1.01
Benzo(b)fluoranthene	CE087 ^M	mg/kg	1.25	0.42	-	0.50	1.98	1.50
Benzo(k)fluoranthene	CE087 ^M	mg/kg	0.50	0.18	-	0.21	0.80	0.59
Benzo(a)pyrene	CE087 ^U	mg/kg	0.92	0.30	-	0.37	1.53	1.13
Indeno(123cd)pyrene	CE087 ^M	mg/kg	0.70	0.23	-	0.28	1.15	0.85
Dibenz(ah)anthracene	CE087 ^M	mg/kg	0.16	0.05	-	0.06	0.31	0.19
Benzo(ghi)perylene	CE087 ^M	mg/kg	0.61	0.21	-	0.26	1.08	0.78
PAH (total of USEPA 16)	CE087	mg/kg	10.0	3.42	-	4.61	16.4	11.7
Subcontracted analysis								
Calorific value	\$	MJ/kg	-	-	-	-	-	-
Asbestos (qualitative)	\$	-	NAD	NAD	-	NAD	NAD	NAD

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SOILS

Lab number			110347-19	110347-20
Sample id			HP01	HP04
Depth (m)			0.40	0.10
Date sampled			10/06/2022	10/06/2022
Test	Method	Units		
Arsenic (total)	CE127 ^M	mg/kg As	30	27
Cadmium (total)	CE127 ^M	mg/kg Cd	0.2	0.4
Chromium (total)	CE127 ^M	mg/kg Cr	62	58
Chromium (III)	CE208	mg/kg CrIII	62	58
Chromium (VI)	CE146	mg/kg CrVI	<1	<1
Copper (total)	CE127 ^M	mg/kg Cu	145	62
Lead (total)	CE127 ^M	mg/kg Pb	40	115
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni	24	35
Selenium (total)	CE127 ^M	mg/kg Se	1.3	1.4
Zinc (total)	CE127 ^M	mg/kg Zn	86	178
pH	CE004 ^M	units	7.4	7.6
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	14	22
Cyanide (total)	CE077	mg/kg CN	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	0.5	1.5
PAH				
Naphthalene	CE087 ^M	mg/kg	0.02	0.05
Acenaphthylene	CE087 ^M	mg/kg	<0.02	<0.02
Acenaphthene	CE087 ^M	mg/kg	<0.02	<0.02
Fluorene	CE087 ^U	mg/kg	<0.02	<0.02
Phenanthrene	CE087 ^M	mg/kg	0.07	0.28
Anthracene	CE087 ^U	mg/kg	<0.02	0.05
Fluoranthene	CE087 ^M	mg/kg	0.03	0.47
Pyrene	CE087 ^M	mg/kg	0.02	0.37
Benzo(a)anthracene	CE087 ^U	mg/kg	0.02	0.22
Chrysene	CE087 ^M	mg/kg	<0.03	0.24
Benzo(b)fluoranthene	CE087 ^M	mg/kg	0.02	0.34
Benzo(k)fluoranthene	CE087 ^M	mg/kg	<0.03	0.11
Benzo(a)pyrene	CE087 ^U	mg/kg	<0.02	0.22
Indeno(123cd)pyrene	CE087 ^M	mg/kg	<0.02	0.17
Dibenz(ah)anthracene	CE087 ^M	mg/kg	<0.02	0.03
Benzo(ghi)perylene	CE087 ^M	mg/kg	<0.02	0.16
PAH (total of USEPA 16)	CE087	mg/kg	<0.34	2.70
Subcontracted analysis				
Calorific value	\$	MJ/kg	-	-
Asbestos (qualitative)	\$	-	-	-

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
CE208	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	U	10	mg/l SO ₄
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE197	Total Organic Carbon (TOC)	Carbon Analyser	Dry		0.1	% w/w C
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
\$	Calorific value	Combustion, Carbon analyser	Dry		2	MJ/kg
\$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
110347-1	BH01	1.10	N	
110347-2	BH04	1.20	N	
110347-3	TP01	0.10	N	
110347-4	TP01	1.50	N	
110347-5	TP02	0.90	N	
110347-6	TP03	0.10	N	
110347-7	TP03	1.50	N	
110347-8	TP05	0.10	N	
110347-9	TP06	0.30	N	
110347-10	TP08	0.30	N	
110347-11	TP09	0.10	N	
110347-12	TP10	0.30	N	
110347-13	TP11	0.10	N	
110347-14	TP12	0.10	N	
110347-15	TP12	1.50	N	
110347-16	TP14	0.40	N	
110347-17	TP16	0.10	N	
110347-18	TP17	0.10	N	
110347-19	HP01	0.40	N	
110347-20	HP04	0.10	N	

Chemtech Environmental Limited

ADDITIONAL INFORMATION

Notes

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

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

Samples will be disposed of 4 weeks from initial receipt unless otherwise instructed.

For soils and solids, all results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.

Analytical results are inclusive of stones, where applicable.

Appendix IV

- GEO Chemical Assessment Sheet

Geo-Environmental Engineering Ltd

Chemical Assessment Sheets - Soils

Lab number			110347-19	110347-20	110347-1	110347-2	110347-3	110347-4	110347-5	110347-6	110347-7	110347-8	110347-9	110347-10	110347-11	110347-12	110347-13	110347-14	110347-15	110347-16	110347-17	110347-18	Generic Assessment Criteria Residential With Plant Uptake 2.5% SOM				
Sample id			HP01	HP04	BH01	BH04	TP01	TP01	TP02	TP03	TP03	TP05	TP06	TP08	TP09	TP10	TP11	TP12	TP12	TP14	TP16	TP17					
Depth (m)			0.40	0.10	1.10	1.20	0.10	1.50	0.90	0.10	1.50	0.10	0.30	0.30	0.10	0.30	0.10	0.10	1.50	0.40	0.10	0.10	GAC	GAC Exceeded?	GAC Ref:		
Date sampled			10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022						
			Windermere Road Development Area												Fell View Avenue Development Area												
Test	Method	Units	MG	TOPSOIL	DRIFT	DRIFT	TOPSOIL	COAL	DRIFT	TOPSOIL	COAL	TOPSOIL	MG	MG	TOPSOIL	MG	TOPSOIL	TOPSOIL	DRIFT	MG	TOPSOIL	TOPSOIL					
Arsenic (total)	CE127 ^M	mg/kg As	30	27	-	-	18	-	-	25	-	17	19	17	30	24	40	22	-	13	35	25	37	YES	LQM S4UL		
Cadmium (total)	CE127 ^M	mg/kg Cd	0.2	0.4	-	-	<0.2	-	-	0.2	-	<0.2	<0.2	0.2	0.3	0.2	0.3	<0.2	-	<0.2	0.3	0.3	11	No	LQM S4UL		
Chromium (III)	CE208	mg/kg CrIII	62	58	-	-	38	-	-	49	-	53	43	54	58	54	53	65	-	47	54	56	910	No	LQM S4UL		
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	-	-	<1	-	-	<1	-	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	6	No	LQM S4UL		
Copper (total)	CE127 ^M	mg/kg Cu	145	62	-	-	30	-	-	40	-	38	30	34	50	27	47	27	-	19	50	42	2400	No	LQM S4UL		
Lead (total)	CE127 ^M	mg/kg Pb	40	115	-	-	86	-	-	105	-	76	63	63	111	62	116	38	-	55	112	93	200	No	CL:AIRE C4SL		
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5	<0.5	-	-	<0.5	-	-	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	40	No	LQM S4UL		
Nickel (total)	CE127 ^M	mg/kg Ni	24	35	-	-	22	-	-	32	-	26	25	30	42	28	38	22	-	19	49	34	130	No	LQM S4UL		
Selenium (total)	CE127 ^M	mg/kg Se	1.3	1.4	-	-	1.2	-	-	1.4	-	1.2	1.3	1.4	1.5	1.1	2.4	1.2	-	0.9	1.7	1.4	250	No	LQM S4UL		
Zinc (total)	CE127 ^M	mg/kg Zn	86	178	-	-	63	-	-	99	-	94	92	100	160	97	146	56	-	95	141	126	3700	No	LQM S4UL		
pH	CE004 ^M	units	7.4	7.6	8.8	7.5	8.7	7.0	7.6	8.0	6.3	7.9	7.7	8.2	7.3	7.8	7.6	7.8	5.7	7.4	7.0	7.3	<6.5	No	BRE		
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	14	22	17	106	35	25	<10	21	48	87	579	84	18	480	56	13	<10	1744	417	28	N/A	N/A	N/A		
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	N/A	N/A	N/A		
Total Organic Carbon (TOC)	CE197	% w/w C	0.5	1.5	-	-	4.3	-	-	6.4	-	6.0	2.9	3.5	7.1	3.0	0.6	3.0	-	2.2	0.6	2.4	-	-	-		
PAH																											
Naphthalene	CE087 ^M	mg/kg	0.02	0.05	-	-	0.05	-	-	0.08	-	0.03	<0.02	0.04	0.08	0.06	0.09	0.02	-	0.04	0.13	0.11	5.6	No	LQM S4UL		
Acenaphthylene	CE087 ^M	mg/kg	<0.02	<0.02	-	-	<0.02	-	-	<0.02	-	<0.02	<0.02	<0.02	0.04	<0.02	0.05	<0.02	-	<0.02	0.08	0.05	420	No	LQM S4UL		
Acenaphthene	CE087 ^M	mg/kg	<0.02	<0.02	-	-	<0.02	-	-	0.03	-	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	-	0.02	0.03	0.02	510	No	LQM S4UL		
Fluorene	CE087 ^U	mg/kg	<0.02	<0.02	-	-	<0.02	-	-	0.08	-	<0.02	<0.02	<0.02	0.03	0.02	0.04	<0.02	-	0.04	0.06	0.03	400	No	LQM S4UL		
Phenanthrene	CE087 ^M	mg/kg	0.07	0.28	-	-	0.31	-	-	0.88	-	0.24	0.10	0.32	0.53	0.37	0.71	0.24	-	0.48	1.18	0.73	220	No	LQM S4UL		
Anthracene	CE087 ^U	mg/kg	<0.02	0.05	-	-	0.09	-	-	0.15	-	0.05	<0.02	0.07	0.14	0.06	0.13	0.04	-	0.10	0.25	0.16	5400	No	LQM S4UL		
Fluoranthene	CE087 ^M	mg/kg	0.03	0.47	-	-	0.61	-	-	1.52	-	0.60	0.18	0.78	1.43	0.70	1.71	0.61	-	0.83	2.81	1.87	560	No	LQM S4UL		
Pyrene	CE087 ^M	mg/kg	0.02	0.37	-	-	0.50	-	-	1.20	-	0.52	0.14	0.66	1.15	0.58	1.37	0.50	-	0.66	2.30	1.63	1200	No	LQM S4UL		
Benzo(a)anthracene	CE087 ^U	mg/kg	0.02	0.22	-	-	0.36	-	-	0.71	-	0.36	0.07	0.46	0.80	0.37	0.92	0.32	-	0.40	1.44	1.07	11	No	LQM S4UL		
Chrysene	CE087 ^M	mg/kg	<0.03	0.24	-	-	0.28	-	-	0.60	-	0.32	0.06	0.45	0.75	0.34	0.81	0.29	-	0.37	1.30	1.01	22	No	LQM S4UL		
Benzo(b)fluoranthene	CE087 ^M	mg/kg	0.02	0.34	-	-	0.40	-	-	0.83	-	0.55	0.08	0.70	1.04	0.52	1.25	0.42	-	0.50	1.98	1.50	3.3	No	LQM S4UL		
Benzo(k)fluoranthene	CE087 ^M	mg/kg	<0.03	0.11	-	-	0.18	-	-	0.37	-	0.20	0.04	0.26	0.44	0.21	0.50	0.18	-	0.21	0.80	0.59	93	No	LQM S4UL		
Benzo(a)pyrene	CE087 ^U	mg/kg	<0.02	0.22	-	-	0.30	-	-	0.66	-	0.42	0.07	0.51	0.79	0.38	0.92	0.30	-	0.37	1.53	1.13	2.7	No	LQM S4UL		
Indeno(123cd)pyrene	CE087 ^M	mg/kg	<0.02	0.17	-	-	0.21	-	-	0.47	-	0.31	0.04	0.39	0.57	0.28	0.70	0.23	-	0.28	1.15	0.85	36	No	LQM S4UL		
Dibenz(ah)anthracene	CE087 ^M	mg/kg	<0.02	0.03	-	-	0.05	-	-	0.11	-	0.07	<0.02	0.10	0.14	0.07	0.16	0.05	-	0.06	0.31	0.19	0.28	YES	LQM S4UL		
Benzo(ghi)perylene	CE087 ^M	mg/kg	<0.02	0.16	-	-	0.20	-	-	0.42	-	0.30	0.04	0.36	0.52	0.27	0.61	0.21	-	0.26	1.08	0.78	340	No	LQM S4UL		
PAH (total of USEPA 16)			CE087	mg/kg	<0.34	2.70	-	-	3.54	-	-	8.11	-	3.98	0.82	5.08	8.44	4.24	10.0	3.42	-	4.61	16.4	11.7	-	-	-
Subcontracted analysis																											
Calorific value	\$	MJ/kg	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	02-10	YES	Presence		
Asbestos (qualitative)	\$	-	-	-	-	-	NAD	-	-	NAD	-	NAD	NAD	NAD	NAD	NAD	NAD	NAD	-	NAD	NAD	NAD	Present	No	Presence		

Notes:
GAC = Generic Assessment Criteria
YES = GAC Exceeded
CLEA SGV = Clea Soil Guideline Value (Residential with Plant Uptake End Use based on 2.5% SOM)
LQM S4UL = LQM/CIEH 'Suitable 4 Use Levels' S4ULs (Residential with Plant Uptake End Use based on 2.5% SOM)
CL:AIRE C4SL = Category 4 Screening Levels (Residential with Plant Uptake End Use based on 2.5% SOM)
ATRISK SSV = Atkins Soil Screening Values (Residential with Consumption of Home Grown Produce at 1% SOM)



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