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Geo-environmental Ground Investigation Report

ON

PROPOSED RESIDENTIAL DEVELOPMENT

AT

KERESFORTH HILL ROAD, BARNSELY

FOR

EARLEDGE DEVELOPMENTS Ltd

AUG 2021

E21/7845/R001

INDEX

0.0	Executive Summary	Page 4
1.0	Introduction	Page 7
2.0	The Site	Page 9
3.0	Site History	Page 10
4.0	Site Geology and Mining	Page 11
5.0	Environmental Considerations	Page 12
5.1	Radon	Page 12
5.2	Landfill Sites	Page 12
5.3	Flood Risk	Page 12
5.4	Groundwater	Page 12
6.0	Preliminary Site Conceptual Model	Page 13
7.0	Fieldwork	Page 16
8.0	Results of the Investigation	Page 18
8.1	Geotechnical Investigation	Page 18
8.2	Groundwater	Page 20
8.3	Gas Monitoring	Page 20
9.0	Contamination	Page 22
9.1	Human Health Risk Assessment	Page 22
9.2	Contamination Results	Page 22
9.3	Qualitative Risk Assessment	Page 25
10.0	Conclusions and Recommendations	Page 27
10.1	Geotechnical Assessment	Page 27
10.2	Mining	Page 28
10.3	Ground Floor Slab – Gas Measures	Page 29
10.4	Contamination Assessment	Page 29
10.5	Surface Water Drainage	Page 30

11.0 Suggested Further Work

Page 31

12.0 Approvals

Page 32

Appendix A Site Location Plan
Trial Pit Location Plan
Typical Site Conceptual Model

Appendix B Trial Hole Logs
Borehole Logs

Appendix C Chemical Analysis of Samples

Appendix D Coal Authority Report

Appendix E Historical Plans

0.0 **EXECUTIVE SUMMARY**

SITE	The site is approximately rectangular in shape and located to the north of the junction of Gilroyd Lane and Keresforth Hill Road. There is residential development to the west, and wooded areas to the north west, north, east and south of the site. The site consists of an open field that was overgrown with long grass at the time of the investigation works. Access is from the southern boundary with Keresforth Hill Road. A metal storage container is located adjacent the access. The site generally falls from a high point of 109.9mm AOD in the north east to a low point of 101.5m AOD in the south west at an average grade of 1 in 9. The site is retained above the residential properties to the south and west.
HISTORY	The site is shown as undeveloped from 1855 to the present day. Needlewood colliery was located 75 south east of the site from 1938-1956. From 1965 onwards there is residential development immediately west and 80m south of the site.
GEOLOGY	No superficial deposits or artificial ground are recorded on the site. The site is underlain by the Pennine Middle Coal Measures Formation, consisting of Mudstone, Siltstone and Sandstone. There are no faults recorded within 250m of the site. The site investigation works generally proved 0.2-0.6m of soil overlying 1.4-2.4m of clays. In the west of the site, two trial pits proved 0.9 to 1.05m of weathered sandstone beneath the topsoil. Beneath the clay and weathered sandstone were alternating bands of mudstone and sandstone to a depth of 30m beneath existing ground levels. Two of the boreholes proved a 2m thick layer of weaker strata at depths of 18.4-20.4m and 6.6-8.6m below existing ground levels. Hard strata with no flush was encountered within four of the boreholes undertaken on site.
MINING/QUARRYING	The Coal Authority report states that the states that the property is an area where four seams have been worked at 90m to 210m depth. In addition to this, they believe there is coal at or close to the surface. The boreholes undertaken on site proved an intact 0.7-0.8m coal thick coal seam at 23.0-27.3m depth in two of the boreholes. No evidence of the coal being worked was found in any of the five boreholes undertaken to 30m. Due to the relatively thin nature of the coal seam encountered, and there being in excess of twenty times seam thickness of competent rock cover

above the seam, we would conclude that the proposed development is at negligible risk from shallow mine workings beneath the site based on the information available.

HYDROLOGY	The nearest recorded open surface water feature is Dodworth Dike located 60m south of the site. The site is not located within any Environment Agency defined flood zones or shown to be at risk of flooding from rivers or the sea.
HYDROGEOLOGY	The groundwater vulnerability map for the area indicates that the site overlies rocks designated as a Secondary (A) aquifer. No groundwater was recorded during the trial pit excavations or rotary borehole investigation. Groundwater was recorded at a depth of 2.7m below existing ground levels in a single borehole on a single occasion during the gas monitoring.
HAZARDOUS GAS	The property is in an area requiring basic radon protection measures. Gas monitoring has been undertaken on five occasions to date and recorded no methane and a maximum carbon dioxide concentration of 3.0%. We would currently recommend the gas regime on this site be currently classified as Green by the NHBC traffic light system, or CS1 by BS 8485:2015 Table 2. The gas monitoring is ongoing and a final report confirming any gas protection measures required will be prepared when the monitoring is completed.
CONTAMINATION	The samples of topsoils and subsoils taken from site have proven clean from contamination.
REMEDIATION	The topsoil on site has proved clean from contamination. We would recommend that the topsoil is scraped and screened to remove unsuitable material and then stockpiled behind protective fencing for eventual re-use on site to soft landscaped areas. Due to the steep nature of the site, cut and fill will be required to develop the land, including split level units which are likely to cut into the existing grounds.
FOUNDATIONS	We would suggest that the proposed two storey residential constructions should be constructed on strip/trench fill footings founded entirely onto the clay strata. Where mudstone/sandstone is encountered within the excavations, the foundations should be deepened to lie entirely onto the

mudstone/sandstone strata to avoid differential settlement. The foundation widths will vary dependent upon the line loadings calculated.

SURFACE WATER DRAINAGE

Preliminary investigation work ruled out the use of shallow soakaways on the site due to the underlying impermeable clays and mudstones.

Further investigation works have proved that deep borehole soakaways may be a suitable method of surface water disposal, however, for both Barnsley MBC and the Environment Agency the use of borehole soak-a-ways as a method of surface water disposal is non-preferred, especially as a means of disposing of treated foul drainage.

An agreement will need to be reached with the Yorkshire Water, Barnsley MBC and the Environment Agency regarding the discharge of foul and surface water for the development.

1.0 INTRODUCTION

- 1.1 As requested by Ground Support Services on behalf of Earledge Developments, this practice carried out ground and contamination investigation works for a proposed development on land at the junction of Nab Lane/Bank Street, Mirfield.
- 1.2 The purpose of the report was to:-
- 1.2.1 Identify the nature of the near surface strata, in order to enable recommendations to be made as to the most economic foundation solution for the proposed residential development.
 - 1.2.2 To identify any areas of contaminated ground.
 - 1.2.3 Propose a suitable outline remediation strategy, which will enable the site to be developed safely, to the satisfaction of the overseeing regulators and in compliance with the current environmental standards.
 - 1.2.4 Determine if shallow mine workings would adversely affect the site.
 - 1.2.5 Determine if infiltration methods would be a suitable form of surface water disposal.
- 1.3 Soil sampling was undertaken via trial pits to determine the near surface strata. Distributed samples were taken for testing to ascertain the nature of the soils and fills present.
- 1.4 The conclusions and recommendations made in this report are limited to the findings of the preliminary Geotechnical Survey. The report is made on condition that Haigh Huddleston Associates will not in any circumstances be liable for loss, arising directly or indirectly from ground conditions encountered between trial pits and boreholes, which have not been revealed by the investigation.
- 1.5 Any opinion given on the possible configuration of strata between trial pit and borehole locations and below maximum depth of the investigation is for guidance only. Any remarks on groundwater conditions made are based solely on observations made at the time of investigation. Kindly note that levels may differ from those reported due to seasonal variations or other influences.
- 1.6 Furthermore, there is the possibility that any trial pits or boreholes undertaken as part of the investigatory works may be within the influence of existing or proposed foundations or excavations. Haigh Huddleston Associates cannot be held responsible

for any failure of any excavations, foundations, or structures within the influence of the trial pits or boreholes.

2.0 THE SITE

- 2.1 The site is located on land to the north of the junction of Gilroyd Lane and Keresforth Hill Road and west of the M1 in Barnsley. It lies around OS Grid Reference 432645, 404834. A site location plan is attached in Appendix A at the rear of the report.
- 2.2 The site is approximately rectangular in shape, with the shorter southern boundary fronting onto Keresforth Hill Road. To the eastern boundary is a narrow wooded area with the M1 beyond. To the north and north west is a wooded area and to the west are residential properties. There are further wooded areas to the south beyond Keresforth Hill Road.
- 2.3 The site consists of an open field that was overgrown with long wild grass at the time of the site investigation works. Access is in the southern boundary from Keresforth Hill Road. At the time of the investigation there was some fly tipping in the north west of the site and a metal storage container adjacent the site access.
- 2.4 The site generally falls from a high point of 109.9mm AOD in the north east to a low point of 101.5m AOD in the south west at an average grade of 1 in 9. The site is retained above the residential properties to the south and west.

3.0 SITE HISTORY

- 3.1 The historical plans show no historical development overlying the site itself and very little development in the vicinity of the site.
- 3.2 In 1855 the site is shown as open field with woodland to the north and a sandstone quarry approximately 75m west of the site. Dodworth Dike is shown approximately 60m south of the site.
- 3.3 By 1894 the quarry is no longer shown and a church is shown in approximately the same location.
- 3.4 In 1938, Needlewood Colliery is shown approximately 75m south east of the site. Both the colliery and the church are shown as disused by 1956.
- 3.5 From 1965 onwards there is residential development immediately west of the site and 80m to the south.
- 3.6 In 1978-1993 the M1 is constructed immediately east of the development and Keresforth Hill Road is constructed on the southern boundary.

4.0 SITE GEOLOGY & MINING

- 4.1 The digital 1:10000 BGS geology map of the site has been consulted and we would report as follows:-
- 4.2 No artificial or superficial deposits are shown directly overlying the site
- 4.3 The site is underlain by the Pennine Middle Coal Measures Formation, consisting of Mudstone, Siltstone and Sandstone.
- 4.4 There are no records of faults within 250m of the site.
- 4.5 Preliminary site investigation works for the FRA proved 0.45-0.5m of topsoil overlying over 2.5m of clays.
- 4.6 The Coal Authority Report for the development has been obtained and is included within Appendix D. This states that the property is in a surface area that could be affected by underground mining in 4 seams of coal at 90m to 210m depth, and last worked in 1961. Any movement in the ground due to coal mining activity should have stopped.
- 4.7 In addition to this, the report states that the site is in an area where they believe there is coal at or close to the surface. The Coal Authority Online Resources indicate a coal outcrop immediately north east of the proposed development. Probable shallow working associated with this outcrop extends to the northeast.
- 4.8 There are no mine entries recorded within, or within 20m of, the site boundary. There may, however, be mine entries/additional mine entries in the local area which the Coal Authority has no knowledge of.
- 4.9 No opencast coal mining is recorded within 200m of the site.
- 4.10 There have been no claims for subsidence damage within 50m of the site boundary.
- 4.11 From the above, there is potentially shallow coal beneath the site. Historically, shallow coal seams may have been worked by private individuals since such workings are not recorded by the Coal Authority.

5.0 ENVIRONMENTAL CONSIDERATIONS

5.1 Radon

The property is in a Radon Affected Area, as between 3 and 5% of properties are above the action level.

Basic Radon Protective Measures are necessary.

5.2 Landfill Sites

There are no recorded historical landfill sites within 500m of the site.

5.3 Flood Risk

The site is not located in a currently defined Environment Agency flood zone or at risk of flooding from rivers and the sea.

5.4 Groundwater

The groundwater vulnerability map for the area indicates that the site overlies bedrock designated as a Secondary (A) aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The site is not within a currently defined (Groundwater) Source Protection Zone (SPZ).

The nearest recorded open surface water feature is Dodworth Dike located 60m south of the site.

6.0 **PRELIMINARY CONCEPTUAL SITE MODEL**

- 6.1 The initial stage in assessing the risks posed from contaminated land during the redevelopment of a site is to prepare a conceptual model. A generalised conceptual model can be developed highlighting the main pollutant linkages through a contaminant ► pathway ► receptor model for a residential development. In order to prepare the conceptual model for a particular site the following parameters need to be reviewed as discussed below.
- 6.2 Contamination of existing land can be caused by a number of factors, including:-
- i) Possible historical/current industrial activities.
 - ii) Disposal of waste materials.
 - iii) Storage of materials.
 - iv) A number of natural processes can also lead to hazardous gases and elevated heavy metals.
- 6.3 Potential pathways can include ground and surface water, permeable strata, existing services providing a conduit and voided ground. Potential receptors can include human health, ecosystems, controlled waters and building structures. There are a number of ways that a receptor can be exposed to the contaminant these include, inhalation, direct contact, ingestion, dermal contact, and uptake.
- 6.4 Sources of potential contamination, that could affect the proposed development, from either on or off site activities would include the following:-
- i) Possible ground gas migration from probable shallow mine workings beneath, and in the vicinity of, the site.
- Based on the above activities the potential for some contamination to exist on site is considered to be low.
- 6.5 Considering the proposed residential end use, there will be two possible human receptor groups exposed to the existing onsite contamination:-
- a) Site operatives during development.
 - b) End users, future site residents (the critical receptor is a 6 year-old girl).

- 6.6 Human receptors may be exposed to site contamination by a number of possible pathways. These pathways are summarised in Table 1 below.

Table 1- Potential Human Exposure Pathways

<u>Human Exposure Pathway</u>	<u>Site Residents</u>	<u>Construction Workers</u>
Soil Ingestion	YES	YES
Consumption of Home Grown Vegetables	YES	NO
Dermal Contact	YES	YES
Dust Inhalation	YES	YES
Gases/Vapours	YES	NO

- 6.7 The construction workers will come into contact with any contaminated soil to a far greater extent than future residents. The exposure pathways are generally through dermal contact and indirect ingestion. However their exposure will be for a limited time and the provision and correct use of personnel protective equipment and adequate welfare facilities during construction should restrict their risks to acceptable levels.
- 6.8 Future site residents can be protected in the long term development of the site via a suitable remediation strategy that ensures any proposed contaminated materials remaining on-site are suitably isolated beneath an effective capping layer.
- 6.9 The risk of pollution to controlled waters by existing contamination is considered low. There have been no historical uses of the site, or in the immediate vicinity of the site, likely to cause contamination.
- 6.10 No specific areas of ecological importance have been identified in the initial desk top study. Therefore the site is considered to be in a low risk environmental setting. The potential for phototoxic materials to exist at shallow depth should be considered, these could pose a potential risk to new planting and soft landscaping areas within the proposed development.
- 6.11 The proposed planning drawings indicate residential properties with private garden areas and hard paved site access and parking areas. The presence of elevated sulphates and hydrocarbons could affect the long term integrity of buried concrete

structures, including foundations and drainage pipes. Plastic water supply pipes can also be damaged by the presence of hydrocarbon contamination.

7.0 FIELDWORK

- 7.1 Initial borehole investigation works were undertaken on 28th May 2021 and consisted of five boreholes undertaken to 12-30m below existing ground levels. In addition to this, three further boreholes were undertaken to a depth of 3m to allow the installation of gas monitoring stations.
- 7.2 Trial pit excavations were undertaken on the 16th June 2021 using an 8 tonne tracked excavator with 600mm bucket. Six trial pits were undertaken in total. In addition to this, five rotary boreholes were undertaken on site to a depth of 30m, to determine the presence of shallow mine workings. Two of the boreholes at the lower southern end of the site were used for borehole infiltration testing.
- 7.3 An The preliminary infiltration testing was undertaken by the instantaneous addition of 3000 litres of water to the borehole from a bowser. This was then dipped to measure the change in the depth of water over time as the water permeated into the natural strata. These were only preliminary tests to determine if infiltration would be a viable method of surface water disposal.
- 7.4 Materials encountered in the trial pits and boreholes were examined and categorised. Trial pit and borehole logs are contained within Appendix B of the report.
- 7.5 The site investigation works were designed to achieve comprehensive site coverage within the proposed development area.
- 7.6 Soil samples were removed from the natural and made ground deposits within the trial pits. The samples were removed by operatives wearing gloves and placed into airtight clean plastic containers and glass bottles for transportation to the laboratory.
- 7.7 A total of four samples from the natural ground deposits were recovered from the trial holes for chemical analysis. The testing was carried out by a UKAS accredited laboratory to nationally or accredited in-house methods. The results of the contamination testing are contained within Appendix C of this report.
- 7.8 A suite of common potential contaminants consisting of heavy metals, phytotoxic metals, sulphates, sulphides and poly-aromatic hydrocarbons as well as asbestos were analysed for.

- 7.9 All samples were stored in airtight containers within cool boxes at approximately 4°C until delivery to the laboratory within 48 hours.

8.0 RESULTS OF THE INVESTIGATION

8.1 GEOTECHNICAL INVESTIGATION

- 8.1.1 A copy of the trial hole and borehole logs providing a complete record of strata encountered beneath the proposed development is presented in Appendix B.
- 8.1.2 The fieldwork generally proved a shallow depth of topsoil overlying clays and weathered sandstone with a banded mudstone and sandstone bedrock.
- 8.1.3 At the surface of all four trial pits was a dark brown topsoil. This varied in thickness from 0.2m to 0.3m across site.
- 8.1.4 Below the topsoil in all but TP05 and TP06 was a soft to firm reddish brown sandy clay. This varied in thickness from 1.7m to 2.1m across site. In TP01 a 0.1m thick layer of weak flaggy sandstone was encountered at the base of the clay, and in TP04 there were flecks of coal and small flags of sandstone at depth.
- 8.1.5 Below the clay in TP01-TP04, a weathered mudstone excavated as small angular gravels in a clay matrix was encountered at 2.0-2.4m below existing ground levels. This mudstone became less weathered and harder to excavate with depth.
- 8.1.6 In the west of the site, beneath the topsoil in TP05 and TP06 was a moderately strong weathered sandstone excavated as flaggy gravels and cobbles in a sandy clay matrix. This varied in thickness from 0.9m to 1.05m between the two trial pits.
- 8.1.7 At the base of TP05 and TP06, a soft to stiff light brown clay with pockets of immature coal at depth was encountered. The trial pits terminated in this strata at 2.7m and 1.2m below existing ground levels respectively.
- 8.1.8 The boreholes undertaken on site generally proved 0.2-0.6m of soil overlying 1.4-2.4m of clays. Beneath the clay were alternating bands of mudstone and sandstone to a depth of 30m beneath existing ground levels.
- 8.1.9 In BH03 in the north of site, the clay was underlain by solid mudstone to a depth of 30m.

- 8.1.10 In BH01 in the south east there was a 2m thick layer of weaker strata at a depth of 18.4-20.4m below ground levels. In BH02 in the south west, this 2m thick layer of weak strata was encountered at 6.60-8.60m below existing ground levels.
- 8.1.11 In BH100 and BH103 in the west of the site, an intact 0.7-0.8m thick seam of coal was encountered at 23.0-23.7m and 26.5-27.3m below existing ground levels respectively. Four of the boreholes undertaken recorded a loss of flush in hard strata encountered at the base of the boreholes.
- 8.1.12 As discussed previously in the report, two of the boreholes were used to carry out soakaway tests in order to determine if infiltration methods would be a suitable form of surface water disposal for the development. This was undertaken in BH100 and BH101 at the lower southern end of the site.
- 8.1.13 Approximately 3000 litres of water was added to boreholes BH100 and BH101 with water levels were measured at approximately 14.5m and 19.2m below existing ground levels immediately after the addition of water in each borehole respectively. This coincides with the depth of the sandstone strata recorded within the boreholes.
- 8.1.14 Based on a borehole diameter of 150mm, and borehole depths of 30m, approximately 2900 litres of water had already infiltrated into the sandstone strata as the water was added. The water level then dropped an additional 0.5m in both boreholes over the following 20 minutes before settling.
- 8.1.15 The drop in water level slowed and a further 3000 litres was added to each borehole after an hour. The water level rose to approximately 14.5m and 19.2m below existing ground levels again in BH100 and BH101 respectively. Once again, a 0.5m drop in level was recorded in the water levels over the following 20 minutes before the water level remained stationary for an hour.
- 8.1.16 The result of the geotechnical analysis undertaken on the samples of clayey soil indicates the clay to be of low-intermediate plasticity (Plasticity Index 14-27%). If the modified results are calculated, taking into account the percentage of material retained on a 425micron sieve, the results correspond to a low-medium shrinkage clay. We would therefore recommend the clay be treated as medium shrinkage with regards to the foundations. The test certificates are contained in Appendix C.

8.2 GROUNDWATER

- 8.2.1 No groundwater was encountered during the trial pit investigation.
- 8.2.2 No groundwater strikes were recorded during the rotary borehole investigation. Groundwater was recorded at a depth of 2.7m below existing ground levels in a single borehole on a single occasion during the gas monitoring.
- 8.2.3 It should be recognised that ground water levels may vary throughout the year. During periods of heavy rainfall, the groundwater levels may be substantially higher than the results revealed in these investigations.

8.3 GAS MONITORING

- 8.3.1 As discussed previously three of the shallow boreholes were installed with gas standpipes and lockable covers. Gas testing is currently being undertaken on site and to-date the wells have been monitored on five occasions following the installation of the standpipes.
- 8.3.2 A standard gas monitoring procedure has been followed in accordance with CIRIA guidance, including measurement of the following:-
 - i) Methane, Oxygen and Carbon Dioxide concentrations.
 - ii) Atmospheric Pressure.
 - iii) Gas Flow Rate.
 - iv) Standing water level.
- 8.3.3 The result of the monitoring undertaken to-date is summarised in Table 2 below. A complete set of results will be reported on completion of the intended testing programme.

Table 2 - Summary of Recorded Gas Levels.

Borehole No.	Date	Oxygen %	Carbon Dioxide %	Methane %	Flow Rate (l/hr)	Depth to Water (m)	Atmospheric Pressure (mb)
GW01	14.06.21	17.2	0.7	ND	ND	2.8(DRY)	1007
	30.06.21	19.2	0.7	ND	ND	2.8(DRY)	1010
	14.07.21	17.7	0.7	ND	ND	2.7	1010
	27.07.21	17.8	0.9	ND	ND	2.8(DRY)	998
	11.08.21	19.3	0.6	ND	ND	2.8(DRY)	1007
GW02	14.06.21	17.4	1.8	ND	ND	3.3(DRY)	1007
	30.06.21	19.6	1.5	ND	ND	3.3(DRY)	1009
	14.07.21	19.6	1.3	ND	ND	3.3(DRY)	1009
	27.07.21	17.5	3.0	ND	ND	3.3(DRY)	998
	11.08.21	19.3	2.0	ND	ND	3.3(DRY)	1006
GW03	14.06.21	18.8	0.7	ND	ND	3.3(DRY)	1007
	30.06.21	20.0	0.9	ND	ND	3.3(DRY)	1007
	14.07.21	19.8	0.9	ND	ND	3.3(DRY)	1009
	27.07.21	19.9	0.9	ND	ND	3.3(DRY)	997
	11.08.21	19.9	0.8	ND	ND	3.3(DRY)	1005

8.3.4 A maximum carbon dioxide concentration of 3.0% was recorded in GW02. No methane has been recorded. No flow rates were detected in the monitoring stations.

8.3.5 Due to the low level of carbon dioxide recorded on site, we would recommend the gas regime on this site be currently classified as **Green** by the NHBC traffic light system, or **CS1** by BS 8485:2015 Table 2.

8.3.6 However, it should be noted that **Basic Radon Protective Measures** are necessary.

8.3.7 The gas monitoring is ongoing and a final report confirming any gas protection measures required will be prepared when the monitoring is completed.

9.0 CONTAMINATION

9.1 HUMAN HEALTH RISK ASSESSMENT

9.1.1 The appraisal of contaminated land within the UK is based on a risk assessment approach. The method involves the principle of defining a source ► pathway ► receptor, linkage to establish a human health risk. For any risk to exist to a potential receptor from an identified contaminant there must be an unbroken source ► pathway ► target relationship.

9.1.2 In the first instance site data for the contaminant levels are compared against guidance such as the CLEA values published by DEFRA. Should the site values exceed the guidance criteria, the contamination levels are recognised to have the potential to pose a risk to human health. Two scenarios are then available: -

- a) To break or remove one of the source ► pathway ► receptor linkages, by specifying an appropriate level of remedial work. Examples of remedial action may include the removal of the contaminated material or alternatively specifying a sufficient capping layer.
- b) The alternative approach is to provide a more detailed human health site specific risk assessment. This will involve examining factors such as soil properties, exposure assumptions, groundwater flows and contamination composition.

9.2 CONTAMINATION RESULTS

9.2.1 As stated above, in order to put the analytical results into context, the data has in the first instance been assessed in relation to several sets of guidelines: -

9.2.2 The analytical results have been assessed via an initial screening assessment with regard to the current Contaminated Land Exposure Assessment model (CLEA UK) for human health, which has been produced for the Environment Agency and the Department of Environment, Food and Rural Affairs (DEFRA). The CLEA model provides Soil Guideline Values (SGVs) for a limited range of contaminants only, and these are based on risk to human health. As such they do not take into account potential risks to other receptors e.g. groundwater and third party land.

- 9.2.3 It is proposed to redevelop the site for residential properties with private garden areas. Soil results have therefore been assessed against the CLEA SGV's for residential use with plant uptake, as these are considered to be the most suitable guidelines to protect the most critical targets from contaminants via all possible exposure routes.
- 9.2.4 Where no CLEA SGV has been published, Generic Assessment Criteria (GAC) based on guidelines from the Chartered Institute of Environmental Health (CIEH) and Land Quality Management Ltd (LQM) S4UL document residential land use with plant uptake has been used. Where there is no GAC, guidance limits have been adopted from sources referenced in the table below.
- 9.2.5 A new approach has now been adopted for the calculation of SGV based on an acceptably low level of risk. These Category 4 Screening Levels (C4SL) have been calculated for six substances to date by modifying the toxicological/exposure parameters within CLEA. C4SLs have been used as tier 1 trigger levels within this assessment, superseding the previous CIEH and LQM SGVs.
- 9.2.6 Assessment of risk is considered as a tiered approach. Assessment based on non intrusive means is considered Tier 1 assessment, comparison against SGVs and GACs is a Tier 2 assessment, and the generation of and comparison with Site Specific Assessment Criteria (SSAC) is a Tier 3 assessment and is conducted where deemed appropriate following the Tier 2 assessment.
- 9.2.7 The sulphate and acid concentrations have been compared against the BRE digest "Concrete in Aggressive Ground" parts 1-4. This will enable the concrete class to be specified in relation to possible contact with aggressive soils.
- 9.2.8 The results of the chemical analysis are presented on the laboratory analysis sheets with Appendix C. A summary of the significance of the results is presented in Table 3.

Table 3**Comparison of contaminant against accepted guidance values for residential use with plant uptake**

<u>CONTAMINANT</u>	<u>SGV</u> <u>MG/KG</u>	<u>CONCENTRATION IN</u> <u>ALL SOILS.</u> <u>MG/KG</u>	<u>No. OF</u> <u>SAMPLES</u> <u>EXCEEDING</u> <u>GUIDANCE</u> <u>VALUES</u>	<u>PERCENTAGE</u> <u>OF SAMPLES</u> <u>EXCEEDING</u> <u>GUIDELINE</u> <u>VALUE</u>
Arsenic	37 (4)	9.5-19	0/4	
Cadmium	22 (4)	0.1-0.3	0/4	
Chromium (Total)	130 (2)	15-21	0/4	
Lead	200 (4)	30-55	0/4	
Mercury (Total)	1.2 (1)	<0.05-0.21	0/4	
Selenium	250 (1)	<0.5-0.8	0/4	
Copper	2400 (1)	22-45	0/4	
Nickel	180 (1)	17-24	0/4	
Zinc	3700 (1)	72-85	0/4	
Sulphate	0.24 (3)	0.03-0.07	0/4	
Thiocyanate	50	<0.6-0.8	0/4	
Sulphide	250	<10-44	0/4	
Naphthalene	2.3 (1)	<0.1	0/4	
Benzo(a)pyrene	5 (4)	<0.1-0.4	0/4	
Dibenzo(a,h)anthracene	0.24	<0.1-0.2	0/4	
PAH (Total)	40	<1.6-5.2	0/4	
Phenols	760 (1)	<0.3	0/4	
Asbestos	No fibres	None	0/4	
pH	6-8	6.5-8.2	0/4	

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(2) DEFRA CLR SGV's withdrawn used for initial comparison

(3) BS 8110 1985 Table 6.1

(4) Category 4 Screening Levels

9.2.9 No elevated levels of heavy or phytotoxic metals were recorded in the samples from site.

9.2.10 There were no elevated levels of PAH (Total) or individual PAH compounds.

9.2.11 No asbestos was detected in the samples taken from site.

9.2.12 No elevated sulphate levels were recorded in the samples taken from site. This corresponds to a design sulphate class DS-1, ACEC class AC-1, when compared against the BRE Special Digest 1 "Concrete in aggressive ground".

9.3 **QUALITATIVE RISK ASSESSMENT**

9.3.1 The Qualitative Risk Assessment is based upon the previously discussed source ► pathway ► receptor principle. In relation to the proposed site these may be described as follows:-

9.3.2 **SOURCE**

- i) No contaminants identified in the samples taken from site.
- ii) No elevated levels of ground gas.

9.3.3 **PATHWAYS**

- i) Ingestion of contamination material.
- ii) Inhalation of contaminated particles.
- iii) Dermal contact with the known contamination.
- iv) Leaching to controlled waters.

9.3.4 **RECEPTORS**

- i) Residential site users.
- ii) Construction and maintenance workers.
- iii) Controlled waters.
- iv) The building structure.

9.3.5 Each of the receptors will now be appraised and attribute the likely risks involved.

i) Residential site users.

Based on the chemical results obtained it is considered that there is currently a **negligible** risk to end users from localised ground contamination on-site.

No elevated levels of heavy or phytotoxic metals were detected in the samples taken from site.

No elevated PAH compounds were detected in the samples taken from site.

No asbestos was detected in the samples taken from site.

The chemical analysis undertaken on the samples of topsoil have proved it suitable for re-use on site. Prior to construction work commencing on site, it is recommended that the existing topsoil is scraped and stockpiled behind protective fencing to prevent cross contamination during the construction work.

Due to the low level of carbon dioxide recorded on site, we would recommend the gas regime on this site be currently classified as **Green** by the NHBC traffic light system, or **CS1** by BS 8485:2015 Table 2.

The gas monitoring is ongoing and a final report confirming any gas protection measures required will be prepared when the monitoring is completed.

ii) Construction and Maintenance Workers.

It is considered that there is a **low** risk to construction and maintenance workers from the redevelopment of the site.

Construction workers should always wear PPE including overalls, boots and gloves when handling the contaminated materials onsite. In addition eating, drinking and smoking should be restricted to designated areas where the above hygiene facilities are available.

iii) Controlled Waters

The samples taken from site proved clean from contamination. It is therefore considered unlikely that there is a risk to groundwater and controlled waters from existing contamination on site.

iv) Building Structures.

Service providers should be forwarded the final validated chemical levels in order for them to provide an accurate specification for the apparatus to be provided. New services should be surrounded and backfilled with clean material to afford some protection to the apparatus and allow any future maintenance work to be undertaken in clean material.

No elevated sulphate levels were recorded in the samples of soil at the surface. This corresponds to a design sulphate class DS-1, ACEC class AC-1, when compared against the BRE Special Digest 1 "Concrete in aggressive ground".

10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 GEOTECHNICAL ASSESSMENT

- 10.1.1 The fieldwork generally proved clays or weathered sandstone overlying a mudstone bedrock. For initial design purposes we would envisage a safe bearing capacity of 100kN/m² where foundations are cited onto the firm clay strata and 150kN/m² where foundations are extended onto the underlying mudstone strata.
- 10.1.2 We would therefore recommend the proposed low rise residential constructions should be constructed on strip/trench fill footings founded entirely onto the clay strata. Where mudstone is encountered within the excavations, the foundations should be deepened to lie entirely onto the mudstone strata to avoid differential settlement. The foundation widths will vary dependent upon the line loadings calculated.
- 10.1.3 Due to the steep nature of the site, cut and fill will be required to develop the land, including split level units which are likely to cut into the existing grounds.
- 10.1.4 All foundations should be placed below a line of 45degrees drawn up from the base of any services or other structures.
- 10.1.5 Where existing foundations or structures are encountered during construction, these should be totally removed from the excavations to enable the new foundations to be constructed without obstructions.
- 10.1.6 At present it is not anticipated that excessive ground water control measures will be required. Please note that ground water flows can vary throughout the year and a further assessment should be undertaken if construction work is proposed following a prolonged rainfall event.
- 10.1.7 Wherever any foundations are located near existing or proposed new trees, their foundations must be sited below the root growth zone. Reference should be made to the NHBC standards Chapter 4.2 "Building Near Trees" which provides guidance on foundation criteria, depths and construction. All services should be similarly protected. Plasticity testing of the clays on site has shown them to be of medium volume change potential.

10.1.7 No elevated sulphate levels were recorded in the samples of soil at the surface. This corresponds to a design sulphate class DS-1, ACEC class AC-1, when compared against the BRE Special Digest 1 "Concrete in aggressive ground".

10.2 MINING

10.2.1 The Coal Authority states that the property is in a surface area that could be affected by underground mining in 4 seams of coal at 90m to 210m depth, and last worked in 1961. In addition to this, the report states that the site is in an area where they believe there is coal at or close to the surface.

10.2.2 The boreholes undertaken on site generally proved 0.2-0.6m of soil overlying 1.4-2.4m of clays. Beneath the clay were alternating bands of mudstone and sandstone to a depth of 30m beneath existing ground levels. In BH03 in the north of site, the clay was underlain by solid mudstone to a depth of 30m.

10.2.3 In BH01 in the south east there was a 2m thick layer of weaker strata at a depth of 18.4-20.4m below ground levels. In BH02 in the south west, this 2m thick layer of weak strata was encountered at 6.60-8.60m below existing ground levels. In BH100 and BH103 in the west of the site, an intact 0.7-0.8m thick seam of coal was encountered at 23.0-23.7m and 26.5-27.3m below existing ground levels respectively. Four of the boreholes undertaken recorded a loss of flush in hard strata encountered at the base of the boreholes.

10.2.4 No evidence of the coal being worked was found in any of the five boreholes undertaken to 30m.

10.2.5 Due to the relatively thin nature of the coal seam encountered, and there being in excess of twenty times seam thickness of competent rock cover above the seam, we would conclude that the proposed development is at negligible risk from shallow mine workings beneath the site based on the information available.

10.3 GROUND FLOOR SLAB – GAS MEASURES

- 10.3.1 As discussed previously, gas monitoring stations were installed in three of the borehole locations on site due to the possibility of ground gas migration from probable shallow mine workings in the vicinity of the site.
- 10.3.2 A maximum carbon dioxide concentration of 3.0% was recorded in GW02. No methane has been recorded. No flow rates have been detected on site.
- 10.3.3 The proposed development consists of low rise residential housing and therefore the gas regime has been characterised in accordance with the traffic light methodology as outlined in CIRIA Report C665. Due to the low carbon dioxide levels on site, we would recommend the gas regime on this site be currently classified as **Green** by the NHBC traffic light system, or **CS1** by BS 8485:2015 Table 2.
- 10.3.4 **Basic Radon Protection Measures** are required for the site.
- 10.3.5 A detailed analysis of the results and any gas protection measures required will be confirmed on completion of the on-site gas testing in a separate report.

10.4 CONTAMINATION ASSESSMENT

- 10.4.1 No elevated levels of heavy or phytotoxic metals were detected in the samples taken from site.
- 10.4.2 No elevated PAH compounds were detected in the samples taken from site.
- 10.4.3 No asbestos was detected in the samples taken from site.
- 10.4.4 The chemical analysis undertaken on the samples of topsoil have proved it suitable for re-use on site. Prior to construction works commencing on site, it is recommended that the existing topsoil is scraped and stockpiled behind protective fencing to prevent cross contamination during the construction work.
- 10.4.5 Should any suspected areas of contamination be exposed during site strip/construction, an engineer should be contacted to determine if additional

chemical testing should be undertaken. The on-site staff should maintain a photographic record and dates of any exposed contaminated material.

10.5 SURFACE WATER DRAINAGE

- 10.5.1 The trial pits undertaken on site have proved clays and weathered sandstone overlying a mudstone bedrock.
- 10.5.2 Due to the strata encountered on site, the FRA for the development ruled out the use of shallow soak-a-ways as a form of surface water disposal.
- 10.5.3 Preliminary deep borehole soakaway testing has been undertaken on site with two separate boreholes extending into the sandstone strata. 3000 litres of water was added to each borehole. Water levels were measured at approximately 14.5m and 19.2m below existing ground levels immediately after the addition of water. The levels then dropped approximately 0.5m within 20 minutes. After an hour a further 3000 litres were added to each borehole with similar results.
- 10.5.4 However, for both Barnsley MBC and the Environment Agency the use of borehole soak-a-ways as a method of surface water disposal is non-preferred, especially as a means of disposing of treated foul drainage.
- 10.5.5 An agreement will need to be reached with the Yorkshire Water, Barnsley MBC and the Environment Agency regarding the discharge of foul and surface water for the development.

11.0 SUGGESTED FURTHER WORK

- 11.1 Gas monitoring to be completed and final assessment on gas protection measures to be made.

12.0 APPROVALS

12.1 Proposals for the remediation of contaminated land may require the approval of numerous bodies.

These include:

- a) Barsley MBC Environmental Health Department as required by the building and planning regulations.
- b) The NHBC or similar as they will provide the insurance costs to cover the property.
- c) The Environment Agency if there are risks of contamination to ground or surface water systems. They will also require notification if material is removed from site and taken to an appropriate tip.
- d) Relevant highways and drainage authorities and other service companies may also wish to know about the level of contaminants.

Prepared by



M. Dean. BSc., HND

Checked by



M. Huddleston. MEng

August 2021

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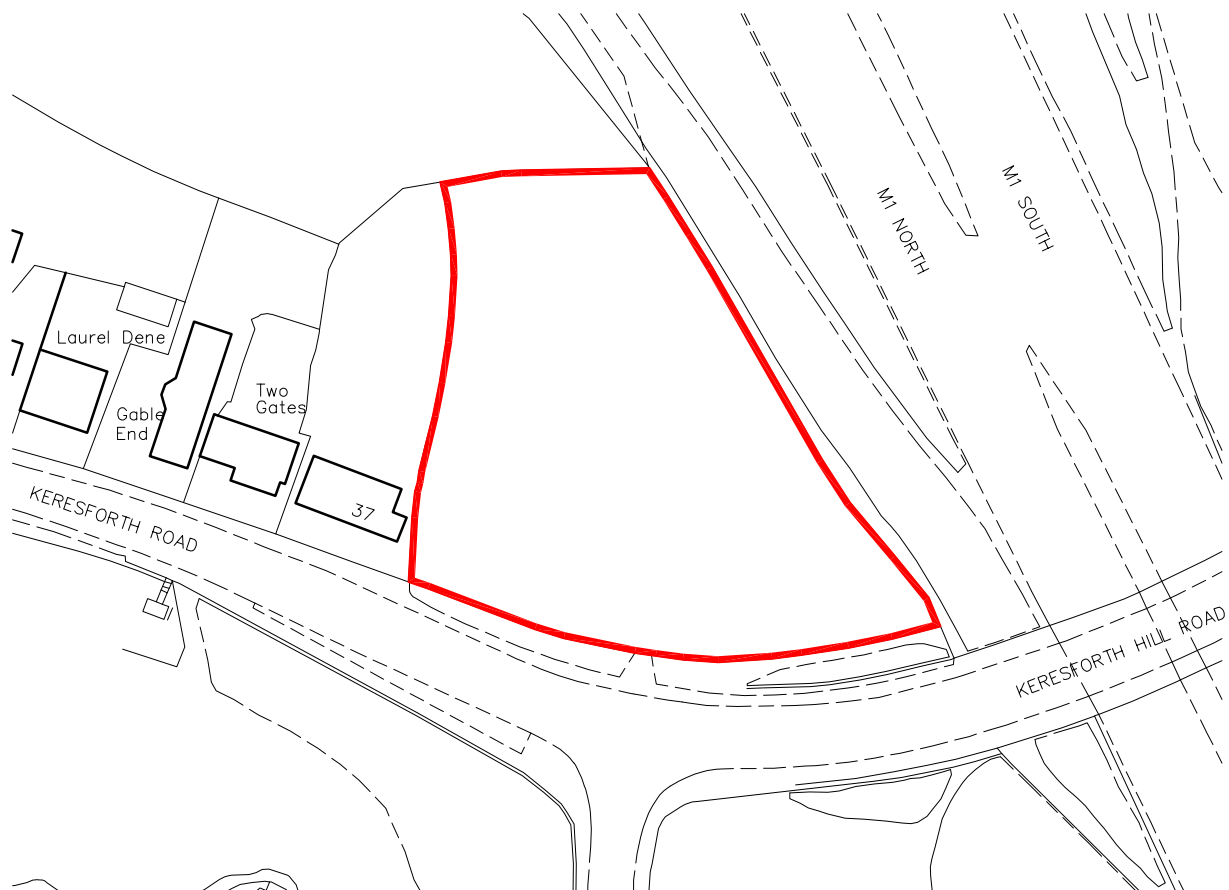
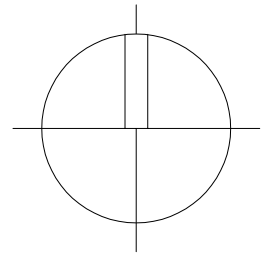
APPENDIX A

Site Location Plan

Dwg No. E21/7845/03 – Site Investigation Plan

Dwg No. E21/7845/32 - Typical Site Conceptual Model

North



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**LAND AT KERESFORTH HILL ROAD
DODWORTH
BARNSELY**

LOCATION PLAN

Scale 1:1250

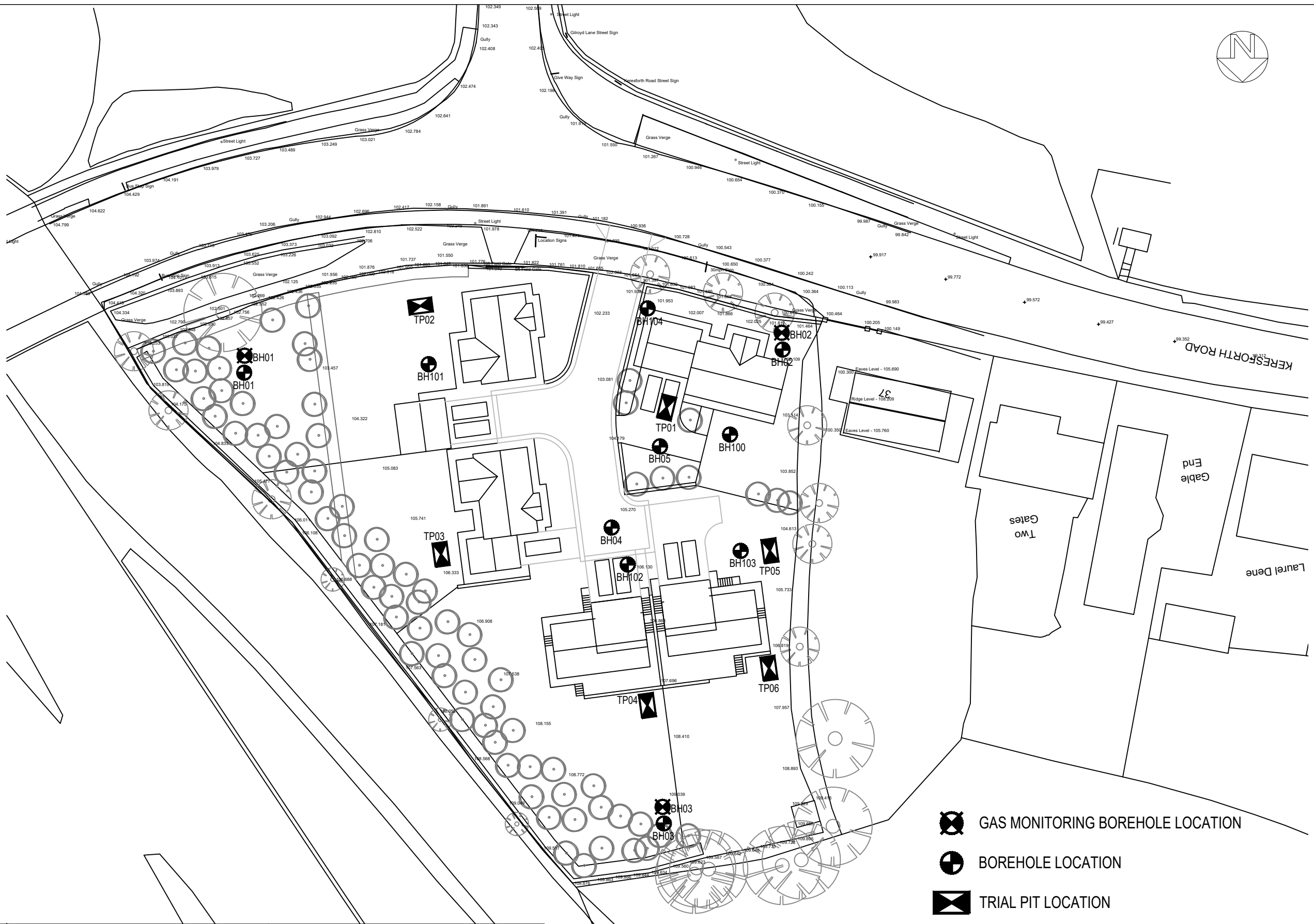
Date April 2018

Ref 17.36

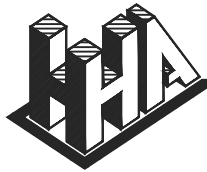
Drwg No OS1

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-  GAS MONITORING BOREHOLE LOCATION
-  BOREHOLE LOCATION
-  TRIAL PIT LOCATION

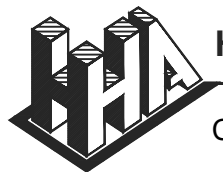
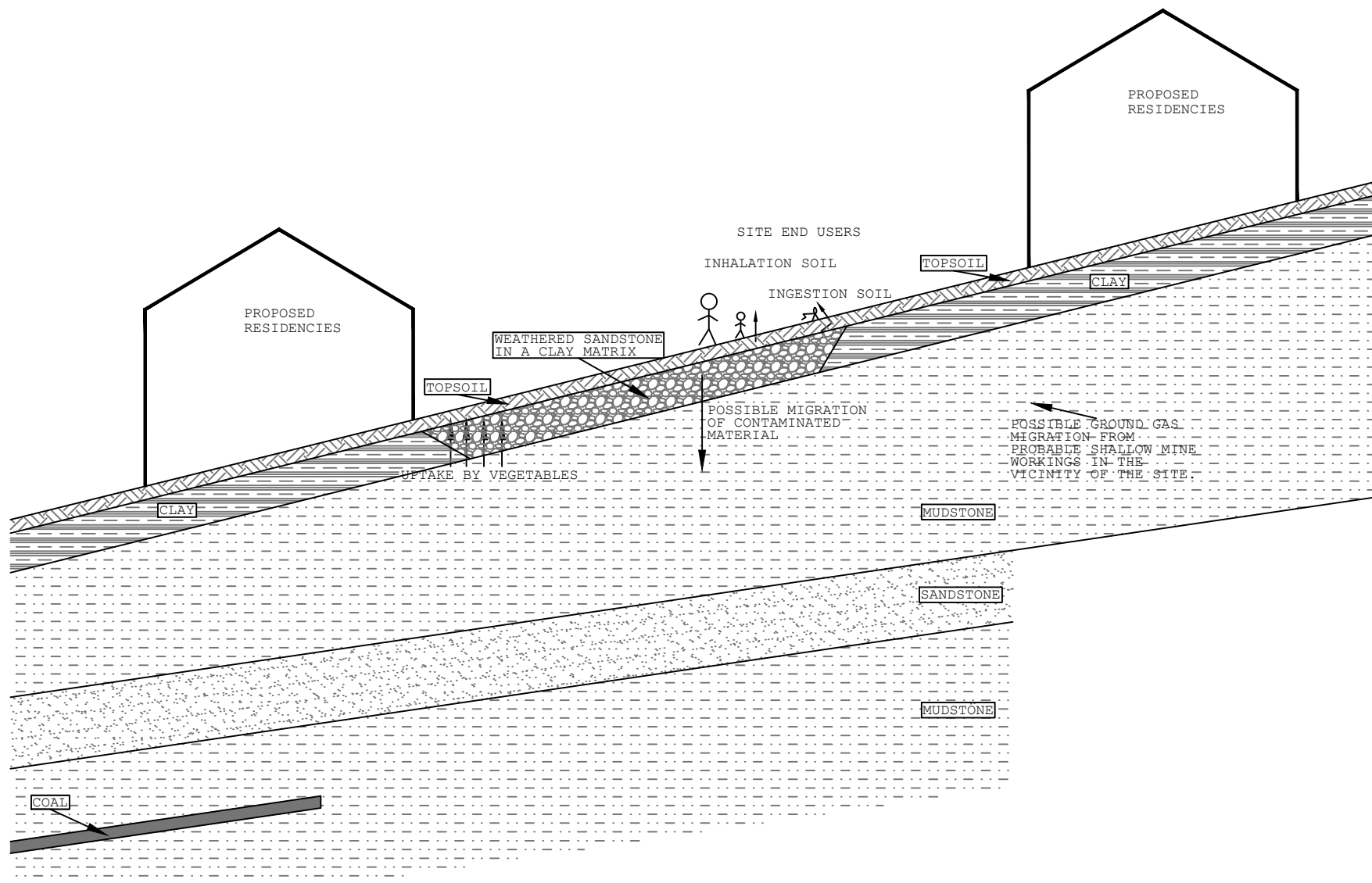


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Client				
EARLEDGE DEVELOPMENTS Ltd				
Project				
KERESFORTH HILL ROAD				
Detail				
SITE INVESTIGATION PLAN				
Scale	Dwn	Chkd	Date	Dwg No.
1:500@A1	CM	MD	June'21	E21/7845/003



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Client

EARLEDGE DEVELOPMENTS Ltd

Project

KERESFORTH HILL ROAD

Detail

Typical Site Conceptual Model

Scale
NTS

Dwn
MD

Chkd
MD

Date
Aug'21

Dwg No.
E21/7845/32

APPENDIX B

Trial Hole Logs

Borehole Logs

TRIAL HOLE NO. 1



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Client :	Earledge Developments Ltd	Job No :	7845
Site :	Keresforth Hill Road	Date :	16 June 2021

0.0		
	0.2	Rough grass over dark brown topsoil.
0.5		Soft/firm dark slightly reddish brown sandy clay.
1.0		
1.5		
2.0		
	2.3	
	2.4	Very weak brown sandstone excavated as flaggy gravels.
2.5		Very weak highly weathered grey/brown mudstone excavated within a clay matrix.
	2.8	
3.0		
3.5		
4.0		

REMARKS:

Ground water encountered during excavation NO

Sample taken NO

Sides of excavation remained stable YES

Level

NOTES:

.....

.....

Civil & Structural Engineering Consultants

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0.0REMARKS:

NO

YES at 0.1m & 0.8m

YES

.....

.....

.....

TRIAL HOLE NO. 3



Haigh Huddleston & Associates

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Client :	Earledge Developments Ltd	Job No :	7845
Site :	Keresforth Hill Road	Date :	16 June 2021

0.0		
	0.3	Rough grass over dark brown topsoil.
0.5		Firm light brown mottled grey sandy clay.
1.0		
1.5		
2.0	2.0	
2.5	2.6	Very weak light brown/grey highly weathered mudstone excavated as angular gravels within a clayey matrix.
	2.8	Moderately weak light brown mudstone becoming difficult to excavate.
3.0		
3.5		
4.0		

REMARKS:

Ground water encountered during excavation

NO

Sample taken

YES at 0.1m.

Sides of excavation remained stable

YES

Level

.....

NOTES:

.....

TRIAL HOLE NO. 4



Haigh Huddleston & Associates

Civil & Structural Engineering Consultants

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Client :	Earledge Developments Ltd	Job No :	7845
Site :	Keresforth Hill Road	Date :	16 June 2021

0.0		
	0.3	Long grass over dark brown topsoil.
0.5		Firm light brown mottled grey slightly sandy clay.
1.0		Small flags of sandstone at 2.1m. in clay. Flecks of coal.
1.5		Very weak light brown highly weathered slightly damp mudstone excavated as small angular gravels in a clay matrix.
2.0		
2.2		
2.5		
2.7		
3.0		
3.5		
4.0		

REMARKS:

Ground water encountered during excavation

NO

Sample taken

YES at 0.1m. & 1.0m.

Sides of excavation remained stable

YES

Level

.....

NOTES:

.....

TRIAL HOLE NO. 5



Haigh Huddleston & Associates

Civil & Structural Engineering Consultants

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Client :	Earledge Developments Ltd	Job No :	7845
Site :	Keresforth Hill Road	Date :	16 June 2021

0.0		
	0.25	Long grass over dark brown topsoil.
	0.5	Medium dense brown clayey sand and angular flaggy sandstone gravels and cobbles.
	1.0	
	1.3	
	1.5	Soft to firm light brown clay.
	2.0	
	2.5	Firm to stiff light brown clay with pockets of immature coal.
	2.7	
	3.0	
	3.5	
	4.0	

REMARKS:

Ground water encountered during excavation NO
Sample taken NO
Sides of excavation remained stable YES
Level

NOTES:

.....
.....

TRIAL HOLE NO. 6



Haigh Huddleston & Associates

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Client :	Earledge Developments Ltd	Job No :	7845
Site :	Keresforth Hill Road	Date :	16 June 2021

0.0		
	0.3	Long grass over dark brown topsoil.
0.5		Moderately strong weathered light brown sandstone excavated as flaggy gravels and cobbles in a sandy clay matrix.
1.0		Soft to firm light brown clay.
1.2		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		

REMARKS:

Ground water encountered during excavation NO
Sample taken NO
Sides of excavation remained stable YES
Level

NOTES:

.....
.....



DRILLING LOG SHEET

SITE: Kerestorth Hill Rd

CREW INITIALS: DS GP

RIG: C6

LEAD DRILLER INITIALS

LEAD DRILLER SIGNED

SL

DATE: 28/5/21

SHEET: 1 OF 2

EQUIPMENT USED: Rotary percussive

BH	DEPTH	STRATA DESCRIPTION
1	0.00 - 0.50	made ground
	0.50 - 2.10	clay
	2.10 - 18.40	mudstone
		1 sandstone
	18.40 - 20.40	weater strata leasy drilling
	20.40 - 22.00	hard strata no flush
Install	0.00 - 0.60	made ground
1	0.60 - 2.00	clay
	2.00 - 3.00	mudstone
		2m slotted 1m solid gravel to 1m bgl bentonite to surface concrete cap
2	0.00 - 0.60	made ground
	0.60 - 2.00	clay
	2.00 - 6.60	mudstone
		1 sandstone
	6.60 - 8.60	weater strata leasy drilling
	8.60 - 12.00	hard strata no flush

BH	DEPTH	STRATA DESCRIPTION
Install	0.00 - 0.50	made ground
2	0.50 - 2.00	clay
	2.00 - 3.00	mudstone
		2m slotted 1m solid gravel to 1m bgl bentonite to surface concrete cap
3	0.00 - 0.50	made ground
	0.50 - 2.10	clay
	2.10 - 30.00	mudstone
		No coal and no loss of flush
Install	0.00 - 0.50	made ground
3	0.50 - 2.10	clay
	2.10 - 3.00	mudstone
		2m slotted 1m solid gravel to 1m bgl bentonite to surface concrete cap

BH	CASING DIA	CASING DEPTH

GAS READING

TOTALS	BH's	DRILL	CASE	CORE
TODAY				
PREVIOUS				
TO DATE				



EQUIPMENT USED: Rotary percussive

LEAD DRILLER SIGNED

54

BH	DEPTH	STRATA DESCRIPTION
4	0.00- 0.60	made ground
	0.60- 2.10	clay
	2.10- 18.00	mudstone
	18.00- 21.00	1 sandstone
		hard strata
		no flush
5	0.00- 0.50	made ground
	0.50- 2.10	clay
	2.10- 19.50	mudstone
		1 sandstone
	19.50- 24.00	hard strata
		no flush

[illegible]

	BH	CASING DIA	CASING DEPTH
Failure of casing head			
Failure of casing body			
Failure of casing shoe			

GAS READING

TOTALS	BH's	DRILL	CASE	CORE
TODAY	8	118	—	
PREVIOUS	—	—	—	
TO DATE	8	118	—	



DRILLING LOG SHEET

SITE: Keresforth Road

CREW INITIALS: DS RIG: SM 400

DATE: 16-6-21 SHEET: 1 OF 1

EQUIPMENT USED:

LEAD DRILLER INITIALS SP	LEAD DRILLER SIGNED
-----------------------------	-------------------------

BH	DEPTH	STRATA DESCRIPTION
100	000 - 0.20	Soil
	0.20 - 2.40	Clay and Sandstone
	2.40 - 3.30	mudstone brown
	3.30 - 6.50	mudstone grey
	6.50 - 7.90	Sandstone grey
	7.90 - 13.20	mudstone grey
	13.20 - 18.20	Sandstone grey
	18.20 - 22.20	mudstone grey
	22.20 - 23.00	mudstone black
	23.00 - 23.70	Coal
	23.70 - 30.00	mudstone grey
101	000 - 0.20	Soil
	0.20 - 2.30	Clay and Sandstone
	2.30 - 8.20	mudstone brown
	8.20 - 11.00	mudstone grey
	11.00 - 11.60	mudstone black
	11.60 - 18.10	mudstone grey
	18.10 - 23.60	Sandstone grey
	23.60 - 30.00	mudstone grey
102	000 - 0.20	Soil
	0.20 - 2.60	Clay and Sandstone
	2.60 - 7.90	mudstone brown
	7.90 - 17.20	mudstone grey
	17.20 - 22.80	Sandstone grey

BH	DEPTH	STRATA DESCRIPTION
	22.80 - 30.00	mudstone grey
103	000 - 0.20	Soil
	0.20 - 2.30	Clay and sandstone
	2.30 - 4.80	mudstone brown
	4.80 - 23.80	mudstone grey
	23.80 - 26.50	mudstone black
	26.50 - 27.30	Coal
	27.30 - 30.00	mudstone grey
104	000 - 0.20	Soil
	0.20 - 2.50	Clay and Sandstone
	2.50 - 5.80	mudstone brown
	5.80 - 13.10	mudstone grey
	13.10 - 18.60	Sandstone grey
	18.60 - 30.00	mudstone grey

BH	CASING DIA	CASING DEPTH

GAS READING

TOTALS	BH's	DRILL	CASE	CORE
TODAY	5	150		
PREVIOUS	-	-		
TO DATE	5	150		

APPENDIX C

Chemical Analysis of Samples

Geotechnical Analysis of Samples



Certificate of Analysis

Certificate Number 21-12997

Issued: 25-Jun-21

Client Haigh Huddleston & Associates Ltd
Firth Buildings
99-101 Leeds Road
Dewsbury
WF12 7BU

Our Reference 21-12997

Client Reference 7845

Order No (not supplied)

Contract Title Keresforth Hill Road

Description 4 Soil samples.

Date Received 21-Jun-21

Date Started 21-Jun-21

Date Completed 25-Jun-21

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

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

Approved By

A handwritten signature in black ink, appearing to read "A Fenwick".

Adam Fenwick
Contracts Manager



Summary of Chemical Analysis

Matrix Descriptions

Our Ref 21-12997

Client Ref 7845

Contract Title Keresforth Hill Road

Sample ID	Depth	Lab No	Completed	Matrix Description
TP01	0.1	1864801	25/06/2021	Brown sandy CLAY including some rootlets
TP02	0.1	1864802	25/06/2021	Brown sandy CLAY including some rootlets
TP03	0.2	1864803	25/06/2021	Brown sandy CLAY including some rootlets
TP05	0.3	1864804	25/06/2021	Brown very gravelly SAND

Summary of Chemical Analysis

Soil Samples

Our Ref 21-12997

Client Ref 7845

Contract Title Keresforth Hill Road

Lab No	1864801	1864802	1864803	1864804
Sample ID	TP01	TP02	TP03	TP05
Depth	0.10	0.10	0.20	0.30
Other ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sampling Date	16/06/2021	16/06/2021	16/06/2021	16/06/2021
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units				
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	18	19	9.5	11
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.3	0.1	0.2
Chromium	DETSC 2301#	0.15	mg/kg	19	21	16	15
Copper	DETSC 2301#	0.2	mg/kg	36	45	22	25
Lead	DETSC 2301#	0.3	mg/kg	55	55	30	30
Mercury	DETSC 2325#	0.05	mg/kg	0.21	0.16	< 0.05	0.05
Nickel	DETSC 2301#	1	mg/kg	23	20	17	24
Selenium	DETSC 2301#	0.5	mg/kg	0.6	< 0.5	0.8	< 0.5
Zinc	DETSC 2301#	1	mg/kg	85	84	72	79
Inorganics							
pH	DETSC 2008#		pH	6.8	6.5	7.1	7.0
Thiocyanate	DETSC 2130#	0.6	mg/kg	< 0.6	0.8	0.6	< 0.6
Sulphide	DETSC 2024*	10	mg/kg	44	40	< 10	32
Sulphate as SO ₄ , Total	DETSC 2321#	0.01	%	0.05	0.07	0.04	0.03
PAHs							
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	DETSC 3301	0.1	mg/kg	0.7	0.3	< 0.1	0.2
Anthracene	DETSC 3301	0.1	mg/kg	0.2	< 0.1	< 0.1	< 0.1
Fluoranthene	DETSC 3301	0.1	mg/kg	0.9	0.6	0.1	0.2
Pyrene	DETSC 3301	0.1	mg/kg	0.7	0.5	< 0.1	0.2
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	0.4	0.3	< 0.1	< 0.1
Chrysene	DETSC 3301	0.1	mg/kg	0.4	0.3	< 0.1	< 0.1
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	0.3	0.3	< 0.1	< 0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	0.1	0.2	< 0.1	< 0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	0.4	0.3	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	0.2	0.2	< 0.1	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	0.1	0.2	< 0.1	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	0.4	0.3	< 0.1	< 0.1
PAH Total	DETSC 3301	1.6	mg/kg	5.2	3.5	< 1.6	< 1.6
Phenols							
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3

Summary of Asbestos Analysis Soil Samples

Our Ref 21-12997

Client Ref 7845

Contract Title Keresforth Hill Road

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1864801	TP01 0.10	SOIL	NAD	none	Steven Lambert
1864802	TP02 0.10	SOIL	NAD	none	Steven Lambert
1864803	TP03 0.20	SOIL	NAD	none	Steven Lambert
1864804	TP05 0.30	SOIL	NAD	none	Steven Lambert

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 21-12997
 Client Ref 7845
 Contract Keresforth Hill Road

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1864801	TP01 0.10 SOIL	16/06/21	GJ 250ml, PT 1L		
1864802	TP02 0.10 SOIL	16/06/21	GJ 250ml, PT 1L		
1864803	TP03 0.20 SOIL	16/06/21	GJ 250ml, PT 1L		
1864804	TP05 0.30 SOIL	16/06/21	GJ 250ml, PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub

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

Soil Analysis Notes

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

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

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

Disposal

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

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

Appendix A - Details of Analysis

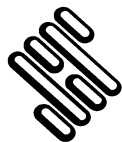
Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETSC 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETSC 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETSC 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETSC 2076	Sulphate Aqueous Extract as SO ₄	mg/l	10	Air Dried	No	Yes	Yes
DETSC 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETSC 2321	Total Sulphate as SO ₄	%	0.01	Air Dried	No	Yes	Yes
DETSC 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETSC 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETSC2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETSC2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETSC2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETSC2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETSC2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETSC2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETSC2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETSC 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

End of Report



STRUCTURAL SOILS LTD
TEST REPORT



Report No. 784965 R1

1774

Date 07-July-2021 Contract Keresworth Hall Road

Client Haigh Huddleston Associates
Address Firth Building
99-101 Leeds Road
Dewsbury
WF12 7BU

For the Attention of Martin Huddleston

Samples submitted by client 17/06/2021
Testing Started 29/06/2021
Testing Completed 07/07/2021

Client Reference
Client Order No.
Instruction Type Written

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests Undertaken

Moisture Content (oven drying method) BS1377:Part 2:1990,clause 3.2 (superseded)**
Liquid Limit (definitive method) BS1377:Part 2:1990,clause 4.3
Plastic Limit BS1377:Part 2:1990,clause 5.3
Plasticity Index Derivation BS1377:Part 2:1990,clause 5.4

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

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of.

Test were undertaken on samples 'as received' unless otherwise stated.

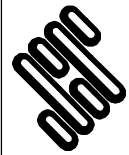
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd, The Potteries, Pottery Street, Castleford, WF10 1NJ Tel.01977 552255. E-mail mark.athorne@soils.co.uk

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Description of Sample
TP01		D	1.00	13	32	18	14	75	Light brown slightly sandy slightly gravelly slightly silty CLAY
TP04		D	1.00	19	48	21	27	97	Light brown slightly sandy slightly gravelly CLAY



STRUCTURAL
SOILS LTD

Contract:

Keresworth Road

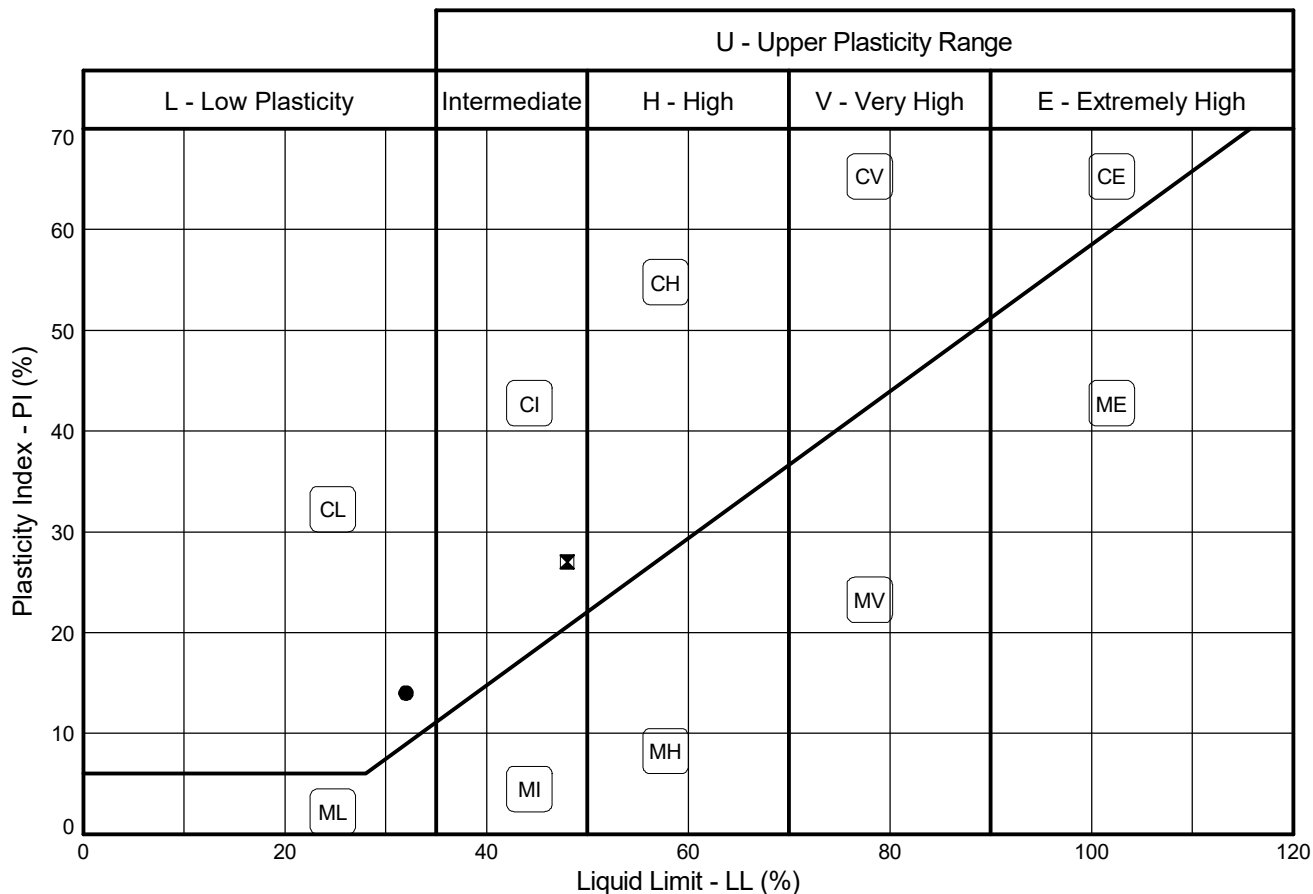
Contract Ref:

784965



PLASTICITY CHART - PI Vs LL

In accordance with BS5930:2015
Testing in accordance with BS1377-2:1990



Sample Identification				BS Test Method #	Preparation Method +	MC %	LL %	PL %	PI %	<425µm %	Lab location	Notes
Exploratory Position ID	Sample	Depth (m)										
●	TP01	D	1.00	3.2/4.3/5.3/5.4	4.2.4	13	32	18	14	75	C	
⊠	TP04	D	1.00	3.2/4.3/5.3/5.4	4.2.3	19	48	21	27	97	C	

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

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

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

- 4.2.3 - Natural State
- 4.2.4 - Wet Sieved

Key: * = Non-standard test, NP = Non plastic.

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)

STRUCTURAL SOILS The Potteries Pottery Street Castleford W. Yorkshire WF10 1NJ	Compiled By		Date
			07/07/21
	Contract		Contract Ref:
	Keresworth Road		784965

TESTING VERIFICATION CERTIFICATE



1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **07/07/2021 14:05:05**.

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

Approved Signatory
Luke Fisher (Laboratory Manager)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU



**STRUCTURAL
SOILS LTD**

Contract:

Keresworth Road

Job No:

784965



APPENDIX D

Coal Authority Report



The Coal
Authority

Resolving the **impacts** of mining

CON29M Non-Residential Mining Report

LAND ADJOINING 37 KERESFORTH
ROAD
DODWORTH
BARNSELY
SOUTH YORKSHIRE

Date of enquiry: 24 May 2018
Date enquiry received: 24 May 2018
Issue date: 24 May 2018

Our reference: 51001842275001
Your reference: 167528017_1 |



CON29M Non-Residential Mining Report

This report is based on, and limited to, the records held by the Coal Authority and the Cheshire Brine Subsidence Compensation Board's records, at the time we answer the search.

Client name

LANDMARK INFORMATION GROUP LIMITED

Enquiry address

LAND ADJOINING 37 KERESFORTH ROAD,
DODWORTH, BARNSELY, SOUTH YORKSHIRE

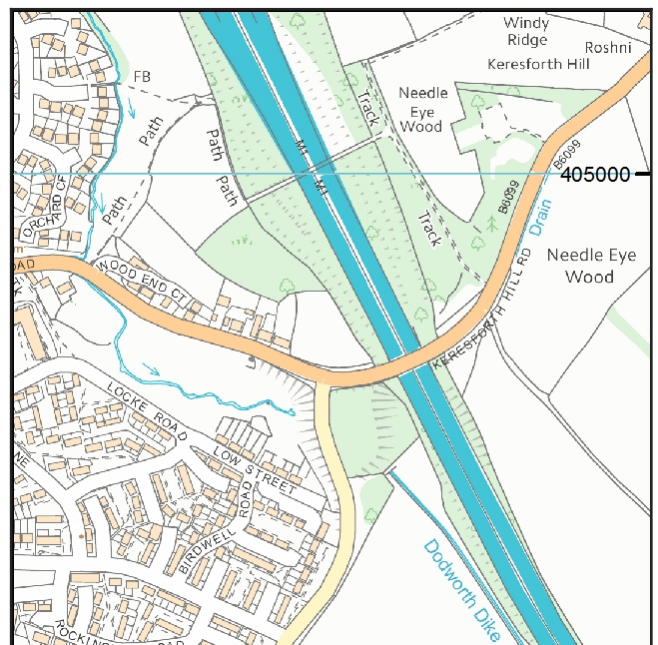
How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

 /company/the-coal-authority
 /thecoalauthority
 /coalauthority



Approximate position of property



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Summary

Has the search report highlighted evidence or potential of		
1	Past underground coal mining	Yes
2	Present underground coal mining	No
3	Future underground coal mining	Yes
4	Mine entries	Yes
5	Coal mining geology	No
6	Past opencast coal mining	No
7	Present opencast coal mining	No
8	Future opencast coal mining	No
9	Coal mining subsidence	No
10	Mine gas	No
11	Hazards related to coal mining	No
12	Withdrawal of support	No
13	Working facilities order	No
14	Payments to owners of former copyhold land	No
15	Information from the Cheshire Brine Subsidence Compensation Board	No

For detailed findings, please go to page 4.

Detailed findings

1. Past underground coal mining

The property is in a surface area that could be affected by underground mining in 4 seams of coal at 90m to 210m depth, and last worked in 1961.

Any movement in the ground due to coal mining activity should have stopped.

In addition the property is in an area where the Coal Authority believe there is coal at or close to the surface. This coal may have been worked at some time in the past. The potential presence of coal workings at or close to the surface should be considered prior to any site works or future development activity. Please refer to the Comments section of this report for further information.

2. Present underground coal mining

The property is not within a surface area that could be affected by present underground mining.

3. Future underground coal mining

The property is not in an area where the Coal Authority has plans to grant a licence to remove coal using underground methods.

The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.

The property is not in an area likely to be affected from any planned future underground coal mining.

However, reserves of coal exist in the local area which could be worked at some time in the future.

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

4. Mine entries

There are no known coal mine entries within, or within 20 metres of, the boundary of the property.

There may however be mine entries/additional mine entries in the local area which the Coal Authority has no knowledge of.

5. Coal mining geology

The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.

6. Past opencast coal mining

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

7. Present opencast coal mining

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

8. Future opencast coal mining

There are no licence requests outstanding to remove coal by opencast methods within 800 metres of the boundary.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

9. Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31st October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

10. Mine gas

The Coal Authority has no record of a mine gas emission requiring action.

11. Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures.

12. Withdrawal of support

The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

13. Working facilities order

The property is not in an area where an order has been made, under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

14. Payments to owners of former copyhold land

The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

15. Information from the Cheshire Brine Subsidence Compensation Board

The property lies outside the Cheshire Brine Compensation District.

Comments on the Coal Authority information

The Coal Authority own the copyright in this report and the information used is protected by our database right.

In view of the mining circumstances a prudent developer would seek appropriate technical advice before any works are undertaken.

Therefore if development proposals are being considered, technical advice relating to both the investigation of coal and former coal mines and their treatment should be obtained before beginning work on site. All proposals should apply good engineering practice developed for mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or mines of coal without the permission of the Coal Authority. Developers should be aware that the investigation of coal seams/former mines of coal may have the potential to generate and/or displace underground gases and these risks both under and adjacent to the development should be fully considered in developing any proposals. The need for effective measures to prevent gases entering into public properties either during investigation or after development also needs to be assessed and properly addressed. This is necessary due to the public safety implications of any development in these circumstances.

Additional remarks

Information provided by the Coal Authority in this report is compiled in response to the Law Society's Con29M Coal Mining and Brine Subsidence Claim enquiries. The said enquiries are protected by copyright owned by the Law Society of 113 Chancery Lane, London WC2A 1PL. Please note that Brine Subsidence Claim enquiries are only relevant for England and Wales. This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority and Cheshire Brine Board's Terms and Conditions applicable at the time the report was produced.

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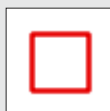
Alternative formats

If you would like this report in an alternative format, please contact our communications team.

Enquiry boundary

Key

Approximate position of enquiry boundary shown



How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

 /company/the-coal-authority

 /thecoalauthority

 /coalauthority



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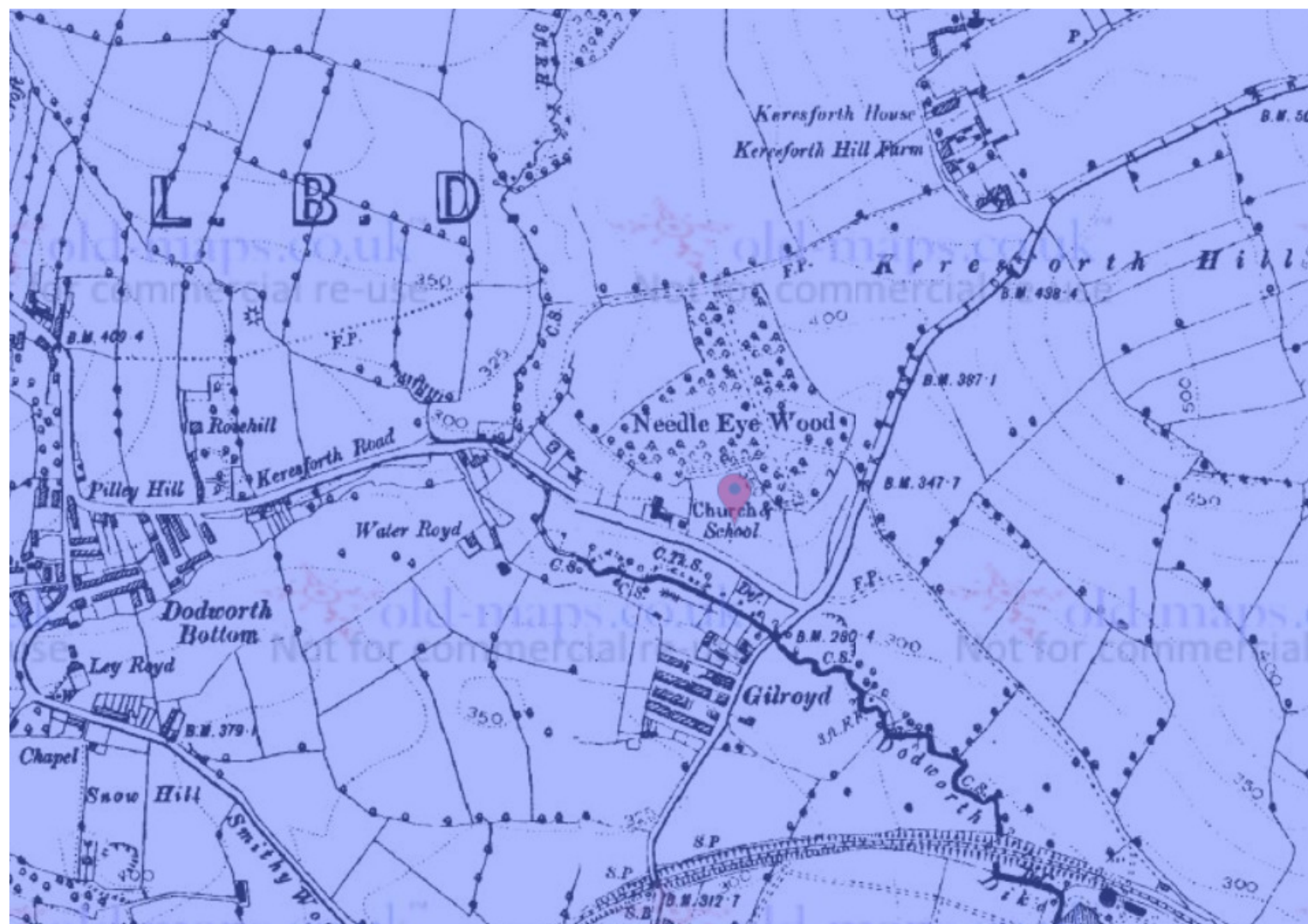
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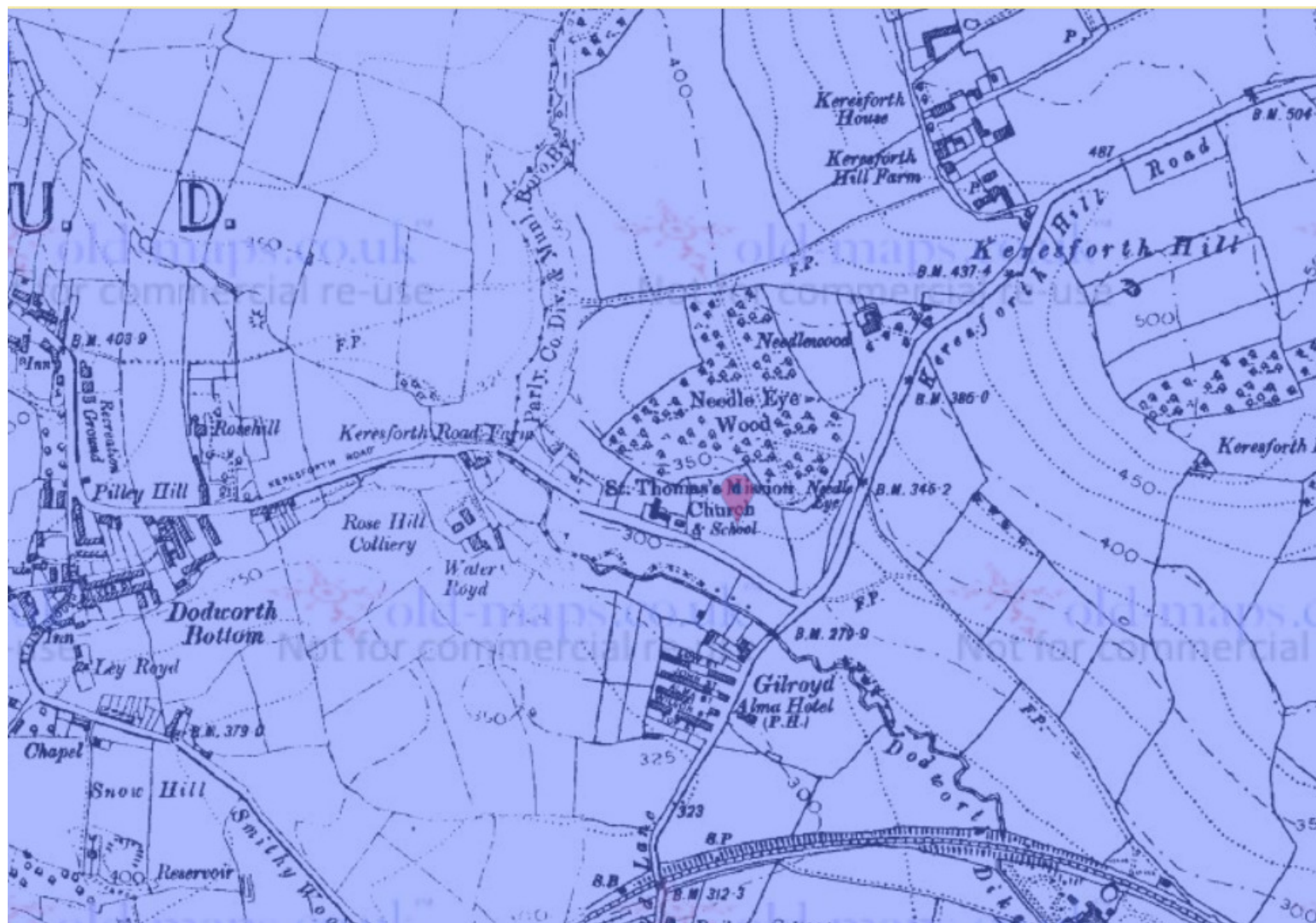
APPENDIX E

Historical Plans

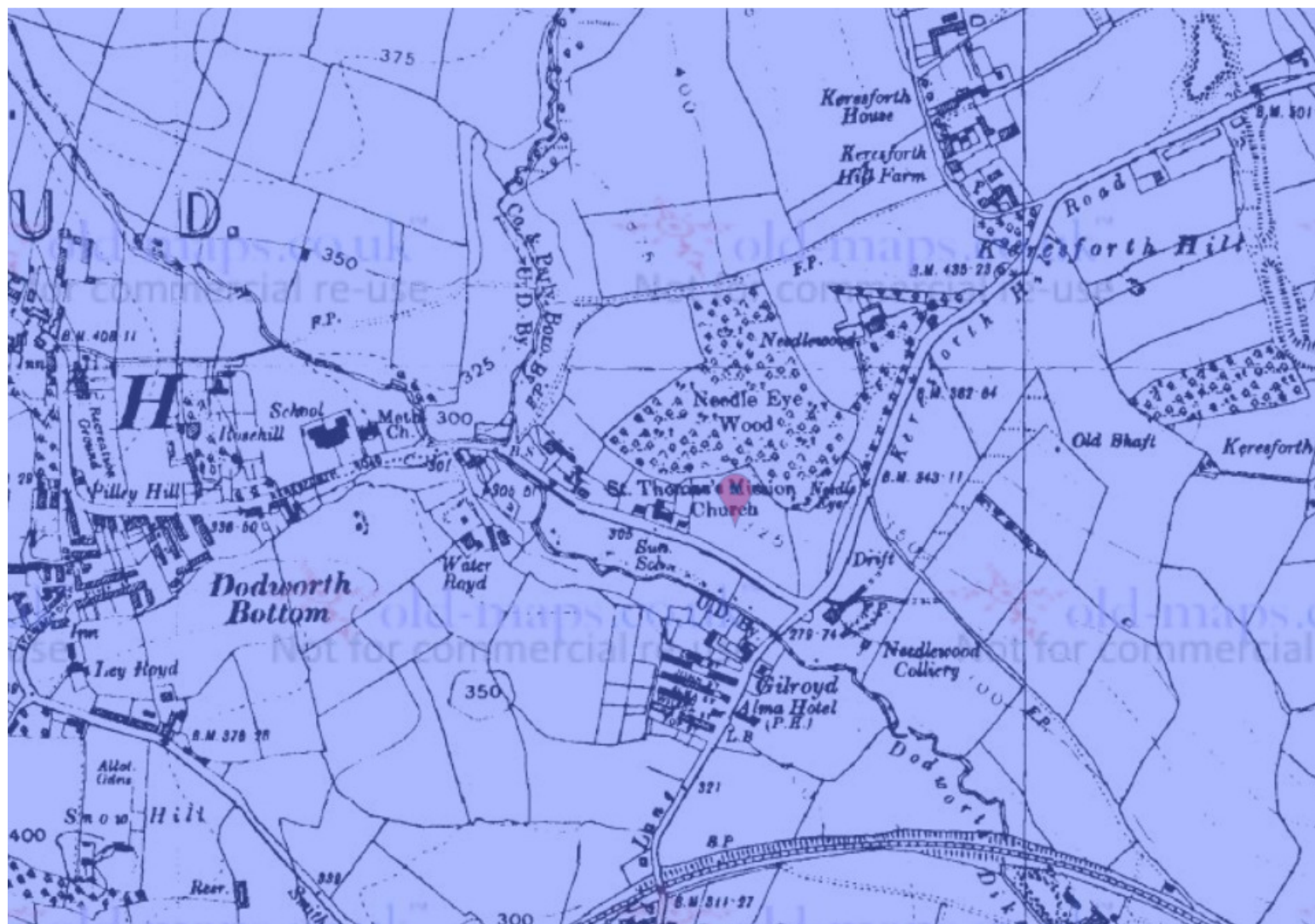


1855

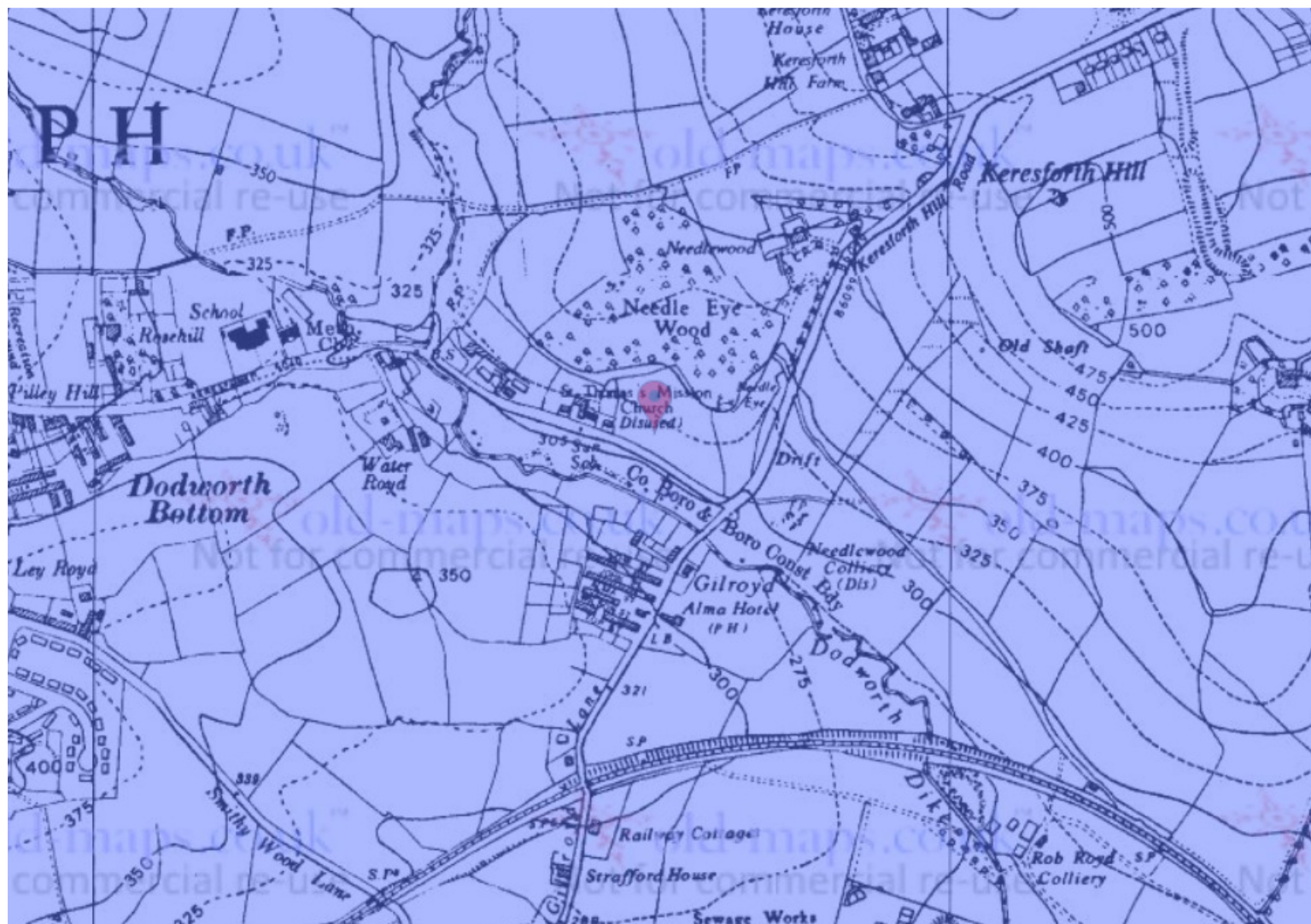




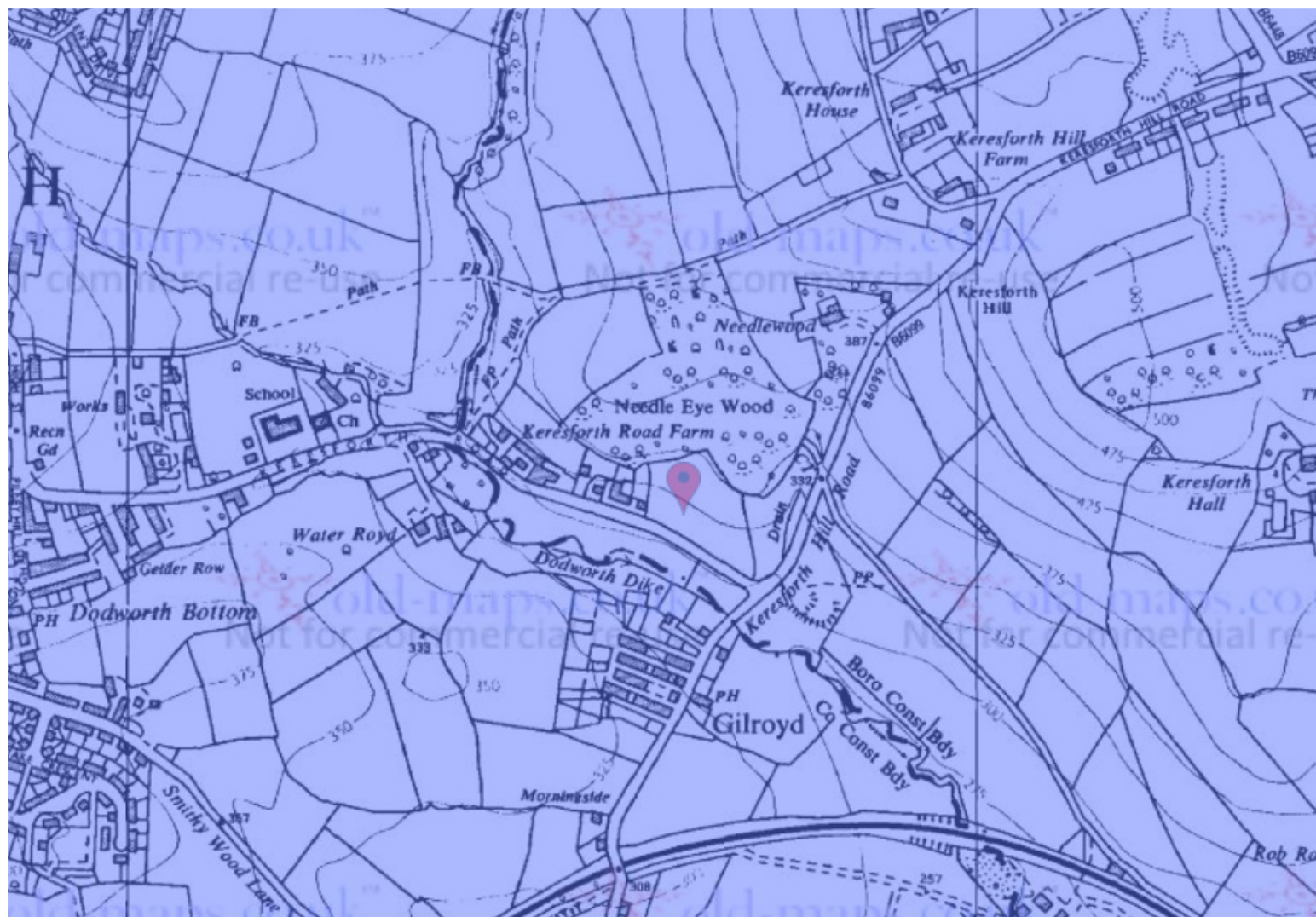
1907



1938



1956



1965-1966



1978-1993