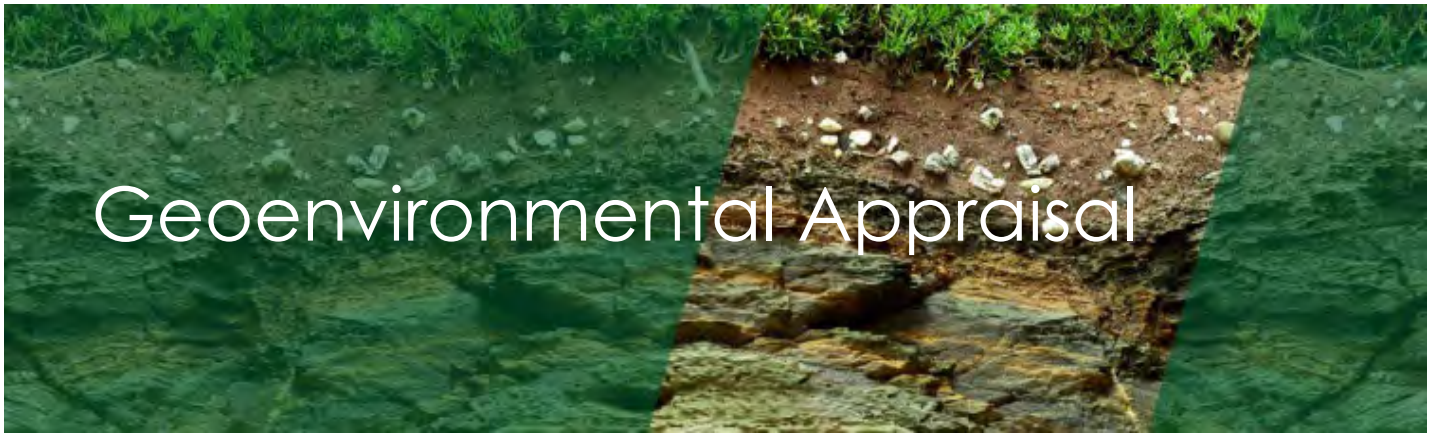
LITHOS



Geoenvironmental Appraisal

Land at Barugh Green

For Countryside Properties

Report no: 3407/2

Date: March 2022

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SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	3407	**Site area/ha**	4.9
Client:	Countryside Properties	**NGR:**	SE 318 078
Site:	Barugh Green	**Nearest postcode:**	S75 1JY

The site is located off Barugh Green Road, approximately 3km northwest of Barnsley town centre, and currently comprises grassed fields used as grazing pasture. The north and west of the site have been subject to extensive opencast workings (Craven I) with further opencast workings (Craven II) in the far southeast. The remaining site area has remained undeveloped throughout history.

Lithos were commissioned by Countryside Properties to provide a geoenvironmental appraisal of the site, which it is understood is to be redeveloped with two & three storey domestic dwellings, associated gardens, POS, adoptable roads and sewers; a proposed layout showing 140 units has been prepared.

Lithos' investigation included a review of the site's history and environmental setting, and a ground investigation comprising 20 trial pits, 12 trial trenches, 25 rotary openhole probeholes (with a further 7 shallow probeholes for well installation), 3 rotary cored boreholes, 7 cable percussion boreholes and 7 lines of stitch drilling.

A summary of salient geoenvironmental issues is provided in the table below.

Issue	Remarks
Made ground	Encountered in the majority of exploratory holes to depths between 0.6m (beyond opencast) and 11.9m (within opencast) where fully penetrated. Within the former opencast made ground typically comprises Made Ground Topsoil (c. 0.2m thick) underlain by Reworked Natural Ground to an average depth of 0.6m and Opencast Backfill to the base of the opencast. Locally, thin beds of Burnt Shale are present at shallow depth. Beyond the former opencast a veneer of made ground is present up to 1.2m thick (average 0.9m) comprising Made Ground Topsoil over Reworked Natural Ground (locally Burnt Shale).
Natural ground	Land beyond areas of backfilled opencasts (east and south) is underlain by Cohesive Residual Soil (firm/stiff gravelly clay) and Granular Residual Soil (clayey gravel) to an average depth of 2.4m and 2.9m respectively. Bedrock was encountered in all trial pits advanced beyond the backfilled opencasts at between 1.5m and 4.2m (average 2.9m) as weak Mudstone and Siltstone (locally Sandstone in the east). Bedrock at the base of the opencast comprises interbedded very weak Mudstone, moderately weak to medium strong Siltstone, and medium strong to strong Sandstone.
Underground mining	The site is located within a Coal Mining Development High Risk Area. The site is underlain by the Thin, Swallow Wood, Top Haigh Moor and Low Haigh Moor coals. Given the number of probeholes drilled, and the absence of any evidence of voids, broken ground, soft push or loss of flush it is considered highly unlikely that the site is underlain by shallow mineworkings in the any of the shallow coal seams present beneath the site.
Opencasts	Approximately 40% of the site (north and west) is underlain by the former Craven I opencast which extracted the Thin Coal and Swallow Wood Coal. The majority of this area has been found to be between 5.8m and 11.9m deep, deepening from southwest to northeast. A shallow 'shelf' is present in the northeast, where only the Thin Coal has been extracted, and is between c. 3m and c. 6m deep. A small area (<1% of total site area) in the far southeast is also underlain by deep made ground associated with the former Craven II opencast. Depths of made ground in this area are highly variable likely associated with obstructions encountered. External highwalls have been located in close proximity to the recorded positions on Coal Authority abandonment plans, dipping at between 11° and 63°. An internal highwall between the shallow 'shelf' and deeper opencast has been identified dipping at c. 48°.
Hazardous gas	The site is in an area where between 1% and 3% of homes are estimated to be above the radon action level. Radon protection is not required, but the Developer might consider providing new dwellings with basic measures in light of Public Health England advice. Gas monitoring is currently underway to determine the need for special precautions against hazardous gas.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	3407	**Site area/ha**	4.9
Client:	Countryside Properties	**NGR:**	SE 318 078
Site:	Barugh Green	**Nearest postcode:**	S75 1JY

Issue	Remarks
Contamination & remediation	Testing suggests Topsoil and Made Ground Topsoil is chemically suitable for re-use. However, the clay content is it typically too high and may therefore need to be blended with sand to generate a more suitable material. Made ground present in the north and west of the site (predominantly Opencast Backfill) has been found to be essentially "clean" although it contains materials (e.g. coal, brick, glass, concrete, etc.), which would generally be considered undesirable as a near-surface material in garden areas. Consequently, a minimum 450mm thickness of clean topsoil will be required in all garden and landscaped areas. Following re-engineering and removal of oversized materials from within the opencast backfill, the thickness of clean cover could be reduced to 300mm.
Preparatory works	Significant preparatory works will be required to render the site suitable for redevelopment, mainly associated with the backfilled opencast in the north and west. Assuming a piled foundation solution, turnover of the uppermost 2m of made ground is required to remove relict obstructions and boulders and prepare the ground for highway construction. It should be assumed that excavations will encounter shallow groundwater and therefore dewatering will be required. If a ground bearing foundation solution is to be used, an increased thickness of turnover of c. 3m across the former opencast will be required with an End Product Earthworks Specification required.
Foundations	Three main foundation solutions are considered likely to be most appropriate for two or three storey residential properties constructed on this site: • Strip/trench-fill for plots located beyond the backfilled opencast. • Piles or rafts/reinforced strips for plots located within the former opencast and beyond the zone of influence of buried highwalls. • Piles for plots located within the former opencast and within the zone of influence of buried highwalls. Where plots are beyond the highwall, but within the zone of influence of the buried highwall, the use of stiff rafts may be possible. Pre-boring of piles will likely be required for plots located over buried highwalls to ensure piles do not deflect off any steep under-ground gradients within the rock. Driven piles within the opencast may encounter problems with terminating on boulders in the Opencast Backfill.
Settlement	Preliminary settlement assessment indicates that the potential range of total settlement (consolidation & creep) for the deepest area of backfill post development over the 60-year design life of the properties is between c. 30mm and c. 60mm. In areas of typical backfill depths, the potential range of total settlement is between c. 25mm and c. 50mm. Differential settlement will be of greatest concern in the highwall zone of influence, however, this will be mitigated via the use of a more robust foundation type. Away from the highwall zone of influence, differential settlement beneath individual plots is not expected to be more than c. 15mm (c. 25% of total maximum settlement).
Groundwater & excavations	Dip data to date suggests that perched waters within the backfilled opencast are very shallow in the west becoming artesian in the northeast. The resting water level within the backfilled opencast is at c. 81mAOD in the southwest rising to c. 80.5mAOD in the northeast. Beyond the backfilled opencast, groundwater levels roughly reflect the perched waters as detailed above. Groundwater is deepest in the south (PH122) becoming artesian in the far north (PH105). Given the above, significant inflows of water are likely to be encountered in the backfilled opencast. Groundwater control will be required as water encountered in excavations in the northeast may rise above ground level. Excavations beyond the former opencasts should remain stable in the short term but if left open for any significant period of time may require shoring most notably in granular soils. The stability of even shallow excavations within the footprint of former opencasts is likely to be poor, most notably in saturated granular fill, and therefore allowance should be made for shoring.
Flooding & drainage	The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. Due to high groundwater levels and the presence of deep made ground across the majority of the site, soakaways will not provide a suitable drainage solution for surface water run-off at the site. Consequently, it will be necessary to consider alternative sustainable drainage systems (SuDS), and there may be a need for surface water balancing.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	3407	**Site area/ha**	4.9
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Issue	Remarks
Highways	Based on visual inspection of the shallow natural materials beyond the former opencast and published guidance, the Cohesive Residual Soil should provide a CBR value of at least 3%. This value should be verified prior to or during construction. However, made ground is present across the north and west to depths of up to c. 12m, and consultation with the adopting authority, regarding the specification of the highways, is strongly recommended. Where made ground is present the uppermost 2m (minimum) should be excavated and either replaced with suitable aggregate, or screened, to allow selection of suitable material, before being replaced in engineered layers. Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials. Highways spanning buried highwalls should be reinforced with 2 layers of geogrid at the base of the engineered made ground.

Significant developer abnormals relating to geoenvironmental issues at the site are:

- Ground improvement – turnover of the uppermost 2m (assuming piled foundations) of made ground in order to remove buried obstructions. Should a ground bearing foundation be proposed, then turnover of the uppermost 3m of made ground and re-engineering will be required.
- Perched water in the backfilled opencast is artesian in the northeast. Therefore, all excavations deeper than c. 1m will require dewatering.
- Alternative foundation solution (likely pre-bored piles) for all plots located within the backfilled opencasts and spanning buried highwalls.

Some further work is required, most notably:

- Completion of monitoring & issue of a Hazardous Gas Risk Assessment.
- A simple trial pit investigation beneath existing overhead utilities once diversionary works are complete.
- Preparation of a Remediation Statement.
- Preparation of an Earthworks Specification.
- Preparation of a Materials Management Plan (MMP) if import of materials is required.
- Further settlement assessment once proposed final ground levels are known, taking into account any areas of cut (net stress reduction) and fill (net stress increase).

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

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APPENDICES

Appendix A - General notes

01	Environmental setting
02	Ground investigation fieldwork
03	Geotechnical testing
04	Contamination laboratory analysis & interpretation
05	Hazardous gas

Appendix B - Drawings

Drawing	Revision	Title
3407/1	-	Site location plan
3407/2	B	Proposed site layout
3407/3	A	Site features
3407/4	-	Site photographs
3407/5	-	Preliminary conceptual site model
3407/6	B	Exploratory hole locations
3407/7	-	Published geology & coal outcrops
3407/8	-	Craven I & II opencast abandonment plan
3407/9	-	Flockton Thick Coal abandonment plan
3407/10	-	Revised conceptual site model
3407/11A	-	Line of opencast highwalls
3407/11B	-	Line of opencast highwalls
3407/12	-	Approximate thickness of made ground within opencast
3407/13A	-	Geological cross section – Line A
3407/13B	-	Geological cross section – Line B
3407/14	-	Indicative foundation zoning plan

Appendix C - Commission

Appendix D - Historical OS plans#

Appendix E - Search responses#

From	Date	Content
Landmark	2nd April 2019	Envirocheck report
Coal Authority	2nd April 2019	Mining report
	9th April 2019	Abandonment plans

Appendix F to K – Exploratory records

Appendix F	TP01 to TP07 & TP201 to TP213
Appendix G	TT01 to TT03 & TT201 to TT209
Appendix H	PH101 to PH125
Appendix I	BH201 to BH207
Appendix J	RC201 to RC203
Appendix K	ST201 to ST207

Appendix L – Chemical test results

Appendix M – Geotechnical test results

Appendix N – Gas monitoring results

Some of this data is not included within the paper or PDF copies of this report; by request, it can be provided on a CD.

FOREWORD (geoenvironmental appraisal report)

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Lithos Consulting Limited (Lithos); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

This report has been reviewed by a Competent Person, as defined in the National Planning Policy Framework. We ensure that all projects are managed by individuals with necessary experience, relevant qualifications, and current membership of a relevant professional organisation. Records of engineers, project managers and reviewers involved in this project are maintained by us. Lithos QA/QC procedures for all our work forms an integral part of our ISO9001 accreditation and as such is regularly audited.

The report presents observations and factual data obtained during our site investigation and provides an assessment of geoenvironmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from Lithos prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. Lithos cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context. However, it should be noted that in order to keep the number of sheets of paper in the hard copy to a minimum, some information (e.g. full copy of the Landmark/Groundsure Report) is not included in the pdf, by request, it can be provided on a CD.

The findings and opinions conveyed in this report (including review of any third-party reports) are based on information obtained from a variety of sources as detailed within this report, and which Lithos believes are reliable. Reasonable care and skill has been applied in examining the information obtained. Nevertheless, Lithos cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

The report represents the findings and opinions of experienced geoenvironmental consultants. Lithos does not provide legal advice and the advice of lawyers may also be required.

Intrusive investigation can only investigate shallow ground beneath a small proportion of the total site area. It is possible therefore that the intrusive investigation undertaken by Lithos, whilst fully appropriate, may not have encountered all significant subsurface conditions. Consequently, no liability can be accepted for conditions not revealed by the exploratory holes. Any opinion expressed as to the possible configuration of strata between or below exploratory holes is for guidance only and no responsibility is accepted as to its accuracy

It 9houldd be borne in mind that the timescale over which the investigation was undertaken may not allow the establishment of equilibrium groundwater levels. Particularly relevant in this context is that groundwater levels are susceptible to seasonal and other variations and may be higher during wetter periods than those encountered during this commission.

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

Lithos cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remediation options.

Lithos reserve the right to amend their conclusions and recommendations in the light of further information that may become available.

GEOENVIRONMENTAL APPRAISAL
of land at
BARUGH GREEN

1 INTRODUCTION

1.1 The commission and brief

1.1.1 Lithos Consulting Limited were commissioned by Countryside Properties to carry out a geoenvironmental appraisal of land at Barugh Green.

1.1.2 Lithos have previously issued a Preliminary Investigation Report (Ref 3407/1B, dated August 2020) and a Mining Investigation letter report (Ref 016/3407/GLM, dated 21st August 2020). The information contained in Report 3407/1B and letter 016/3407/GLM have been incorporated within this Report, which now supersedes Report 3407/1B.

1.1.3 Correspondence regarding Lithos' appointment, including the brief for this investigation, is included in Appendix C. The agreed scope of works included:

- A site walkover and inspection
- An assessment of the land use history
- Determination of the site's environmental setting
- A mining risk assessment in accordance with Coal Authority guidance.
- An intrusive ground investigation comprising 20 trial pits, 12 trial trenches, 25 rotary openhole probeholes (with a further 7 shallow probeholes for well installation), 3 rotary cored boreholes, 7 cable percussion boreholes and 7 lines of stitch drilling
- Assessment of the geotechnical properties of the near surface deposits, including a preliminary settlement assessment, to enable provision of foundation and highway recommendations
- A qualitative assessment of contamination risks
- Recommendations for the necessary site preparatory and remediation works

1.1.4 Primary aims of this investigation were to identify salient geoenvironmental issues affecting the site to support the submission of a planning application, and also to enable Countryside Properties to obtain budget costs for: foundations; gas protection measures; and site preparatory and remediation works.

1.2 The proposed development

1.2.1 It is understood that consideration is being given to redevelopment of the site with two & three storey domestic dwellings, associated gardens, POS, adoptable roads and sewers.

1.2.2 A site layout showing 140 units has been provided by Countryside Properties (Drawing reference SKPY-004-A-PL-01 Rev. N, dated 12th January 2022) which is reproduced as Drawing 3407/2 in Appendix B to this report.

1.3 Report format and limitations

1.3.1 All standard definitions, procedures and guidance are contained within Appendix A, which includes background, generic information on:

- Assessment of the site's environmental setting
- Ground investigation fieldwork
- Geotechnical testing

- Contamination testing
- Hazardous gas

1.3.2 General notes and limitations relevant to all Lithos geoenvironmental investigations are described in the Foreword and should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

1.3.3 In accordance with the agreed scope of works, the ground investigation reported here is not fully compliant with Eurocode 7 (EC7) and this report does not purport to be a Ground Investigation Report, nor a Geotechnical Design Report as defined by EC7. The ground appraisal, parametric assessment and preliminary design guidance presented are intended to assist others as they prepare the design of the proposed works.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site's location is shown on Drawing 3407/1 presented in Appendix B to this report. Site details are summarised in the table below.

Detail	Remarks
Location	3 km northwest of Barnsley town centre
NGR	SE 318 078
Approximate area	4.9ha (12.1 acres)
Known services	Two sets of overhead electric cables (11kV cross the southeast trending northeast-southwest)

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on 29th November 2021.

2.2.2 The site is access through a locked gate off Barugh Green Road in the northwest corner and currently comprises a northern grassed field and the northern extent of an adjoining field to the south, used as grazing pasture.

2.2.3 A drainage ditch runs along the northern boundary adjacent to Barugh Green Road. An area of waterlogged, boggy ground was noted in the centre north with further waterlogged areas in the southwest.

2.2.4 Hedgerows and (semi)mature trees form the northern, western and southern boundaries of the northern field, with gaps in the southern hedgerow allowing access to the southern field.

2.2.5 Existing salient features, at the time of the walkover are presented on Drawing 3407/3 in Appendix B to this report and summarised in the table below.

Feature	Remarks
Current Access	Off Barugh Green Road
Topography	Gently falls towards the northeast corner
Approximate areas	49,000m^2 grass
Nature of boundaries	North & west – hedgerow and trees East – post & wire fence South – electrified post & wire fence

Feature	Remarks
Surrounding land uses	North – Barugh Green Road with industrial units beyond East – Claycliffe Avenue with housing beyond. South & west – open fields

2.2.6 A selection of site photographs is included on Drawing 3407/4.

3 SITE HISTORY

3.1 Site centred extracts from Ordnance Survey (OS) plans dating back to 1855 have been examined. Some of these plans are presented in Appendix D to this report.

3.2 The table below provides a summary of the salient points relating to the history of the site. It is not the intention of this report to describe in detail all the changes that have occurred on or adjacent to the site. Significant former uses/operations are highlighted in **bold** text for ease of reference.

Date	Site	Surrounding land
1855	**Open fields** with stream crossing northwest corner southwest-northeast	Unnamed road immediately beyond northern boundary Open fields in all directions
1894	No significant changes	Houses immediately northwest and northeast Red Brook Bleach Works 150m east
1906		Bleach works relabelled Linen Works
1933		Chemical works and Barugh Coke & By-product Works 250m northeast
1938		Barugh Green Road beyond northern boundary Residential development immediately beyond eastern boundary off Claycliffe Avenue and Mawfield Road
1956	Overhead electric cable cross southeast corner trending northeast-southwest	Continued expansion of residential area to the east
1966	Stream no longer shown crossing northwest Drain shown running northeast-southwest across centre of site	Large area to the west and south labelled **Opencast Workings** Linen works, chemical works and Barugh Coke & By-product Works no longer shown Area 150m northeast shown as refuse tip
1970	No significant changes	Engineering works and garage shown immediately beyond Barugh Green Road to the north
1973	Drain and electric cables no longer shown crossing site	Areas to the south and west no longer shown as opencast workings Tip to the northeast shown to de disused
1993	No significant changes	Expansion of works to the north with Industrial Estate shown beyond Area of former tip 150m northeast labelled as Disused Workings
2006		No significant changes
2019	Drain labelled on northern boundary	Significant expansion of industrial estate to the north

3.3 Although none of the OS maps indicate opencast mining has taken place on site, it falls within the wider area of the Craven I and II opencasts (see Section 4.5)

4 ENVIRONMENTAL SETTING

4.1 General

4.1.1 Notes describing how the site's environmental setting has been assessed are included in Appendix A to this report. Reference has been made to publicly available Government held digital data via QGIS (an Open Source Geographic Information System). Extracts from the response received from Landmark and the Coal Authority are presented in Appendix E. These responses are summarised below, together with the findings of our own "desk study" investigation.

Issue	Data reviewed	Summary
Geology	1:50,000 BGS map (Sheet 87) 1:10,000 BGS map (Sheet SE30NW)	Drift – None mapped although 'worked-out opencast coal-seam area (backfilled)' shown in centre and west. Solid – Pennine Middle Coal Measures (mudstone, siltstone & sandstone). Shallowest coal seam – Gawber Coal outcrops in the far east dipping towards the east, with the Swallow Wood Coal at about 15m depth. Further details in Section 4.5 below. Strata Dip – Gentle (5°) to the northeast. Faults – none mapped beneath site.
Mining & Quarrying	Coal Authority BGS maps Historical OS plans	Further details in Section 4.5 below.
Radon	Public Health England	The site lies in an area where between 1% and 3% of homes are estimated to be above the action level. Further details in Section 12.
Hydrogeology	Environment Agency Envirocheck Report Environment Agency electronic open data via QGIS	Source Protection Zone? No. Aquifer Secondary A (Solid). Groundwater abstractions? None within 1km. Soil leaching potential – Medium. Pollution incidents? None at or significant to site.
Hydrology		Drainage ditch on the northern boundary which flows east. Water quality – Site located within Dearne catchment area from Cawthorne Dyke to Lundwood STW currently rated as ecologically moderate and chemically failing. Pollution incidents? None at or significant to site. Abstractions? None within 1km. Discharge consents? Nearest 190m east for storm sewage effluent.
Flood risk		The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency).

4.2 Landfills

4.2.1 Known or suspected areas of landfill in the vicinity of the proposed development site are summarised below:

Location	NGR (proximity to site)	Remarks	Source of data
Cannon Way	SE 317 080 (100m northwest)	Accepted inert waste although dates of input are not known. Currently developed with retail units.	Environment Agency EA electronic open data via QGIS* Envirocheck Report
South Yorkshire Industrial Estate	SE 321 079 (120m east)	Accepted inert and commercial waste between 1983 and 1990. Currently developed with retail units.	
Wilthorpe Road	SE 322 078 (240m east)	Accepted inert waste between 1983 and1999 Currently developed with residential properties.	

* QGIS is an Open Source Geographic Information System.

4.3 Mineral safeguarded areas

4.3.1 The site is underlain by coal and might therefore be considered by the Local Authority to lie within a Mineral Safeguarding Area (MSA).

4.3.2 MSAs are areas of known mineral resources that are of sufficient economic or conservation value to warrant protection for generations to come. The purpose of MSAs is not to preclude automatically other forms of development, but to make sure that mineral resources are adequately and effectively considered in land-use planning decisions.

4.3.3 Specialist guidance on Mineral Safeguarding "A Guide to Mineral Safeguarding in England" has been produced by The Coal Authority and the British Geological Survey.

4.3.4 Paragraph 204 of the National Planning Policy Framework (NPPF) requires Local Authorities, when preparing Local Plans to:

- Define Minerals Safeguarding Areas and adopt appropriate policies in order that known locations of specific minerals resources of local and national importance are not needlessly sterilised by non-mineral development, whilst not creating a presumption that resources defined will be worked; and define Minerals Consultation Areas based on these Minerals Safeguarding Areas.
- Set out policies to encourage the prior extraction of minerals, where practicable and environmentally feasible, if it is necessary for non-mineral development to take place.

4.3.5 NPPF Paragraph 144 notes that when determining planning applications, local planning authorities should give weight to the benefits of the mineral extraction.

4.3.6 As a consequence of the NPPF, and the presence of coal beneath the site, the Local Authority may require Countryside Properties to consider the opportunity to recover (extract) the coal. Applicants submitting planning applications may need to demonstrate to the Local Authority that they will extract the coal, unless:

- It can be shown it is not economically viable to do so, or
- It is not environmentally acceptable to do so, or
- The need for the development outweighs the need to extract the coal, or
- The coal will not be sterilised by the development

4.3.7 The viability of coal extraction at this site is considered later in this Report (Section 15.7) in light of the findings of Lithos' intrusive mining investigation, which comprised the drilling of 25 rotary probeholes to depths of between 10.5m and 39.0m (see Section 9.8).

4.4 Agriculture

4.4.1 Historical plans show that the site has been occupied by arable farmland. Generally farming is not considered likely to have caused significant ground contamination. However, activities such as slurry spreading, the discharge of chemicals to ground, and unregulated burial are known to have occurred on farmland. Potential contaminants associated with farming activity could include any of the following.

Agricultural activity	Potential contaminant
Sewage farming, slurry spreading	Methane, metals, nitrates, oxygen depletion
Plant & animal protection	Pesticides & herbicides
Soil conditioners	Metals, sulphates, PAH
Field sports	Lead shot
Waste burial, land levelling, backfilling ponds/quarries	Methane, metals, PAH etc
Naturally occurring contaminants	Arsenic, metals

4.4.2 Whilst it is likely that pesticides have been applied during arable use of the land, these are not likely to include the persistent organochloride pesticides such as Dieldrin, Aldrin, DDT etc. Pesticides routinely used on arable crops the UK (Phenoxy Acetic acid herbicide or PAAH) rapidly degrade in soils or leach via rainwater infiltration to groundwater. It is highly unlikely these would be detected by soil sampling and therefore it is not proposed to undertake analysis of these.

4.5 Coal & mining

4.5.1 In July 2011 the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology relating to coal mining development areas. This Section provides the necessary mining risk assessment required by the proposed planning application.

4.5.2 The majority of the site (north & west) lies within a High Risk Area – an area with specific mining legacy risks to the surface, including mine entries; shallow coal workings etc.

4.5.3 The remainder of the site lies within a Low Risk Area – within the defined coalfield, but no known defined risks have been recorded by the CA; there may still be unrecorded issues.

4.5.4 The 1:10,000 BGS map (SE30NW) suggests that the following coal seams underlie the site at shallow depth. All coal seams are recorded to dip gently (c. 5 degrees) towards the east.

Seam name(s)	Approximate thickness/m	Approximate depth below Gawber/m*	Remarks
Gawber Coal	0.7	-	Outcrops in the far east, and only underlies land in the far east (c. 500m^2).
Thin coal	-	10	Outcrops in the centre, and underlies land in the eastern half (c. 2.3ha).
Swallow Wood Coal	1.2	15	Outcrops to the west, and underlies the entire site
Top Haigh Moor	1.2	45	This deep seam lies about 30m* below the Swallow Wood, with strata between the two seams likely to comprise Haigh Moor Rock (sandstone)

4.5.5 Approximate outcrops are shown on Drawing 3407/7.

4.5.6 It should be noted that seam outcrops plotted on geological maps have been known to be inaccurate by distances in excess of 100m.

4.5.7 A CA mining report states that:

- The site is underlain by underground coal workings in 3 seams, the shallowest seam, the Flockton Thick, was worked from Dodworth Colliery at around 70m to 125m depth below the site with an extraction thickness of 0.7m. Last worked in 1959.
- There are no recorded mine entries within 100 metres of the enquiry boundary.
- No faults, fissures or breaklines recorded.
- No mines gas recorded within 500 metres of the enquiry boundary.
- No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.
- The property is in an area where notices to withdraw support were given in 1956, 1977 and 1987.
- 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.

Unrecorded shallow workings

4.5.8 The mining reports suggests there are no known or probable unrecorded shallow workings (i.e. at less than 30m depth). In addition, abandonment plans obtained from the Coal Authority for former opencasts within the site (see Section 4.5.25) suggest old mineworkings were not encountered during operations.

4.5.9 However, it should be noted that it did not become a statutory requirement to maintain and preserve plans of abandoned mines until the Mine (Coal) Regulations Act of 1872 and consequently there may be mineworkings beneath the site for which the Coal Authority have no records.

4.5.10 Coal has been mined in Yorkshire for centuries; the first mining probably took place in the fifteenth century. Early mining methods included drifts or adits from outcrop. Where mining extended further from the crop, bell pits were often sunk, and as the coal got deeper still, shafts were used to access gallery workings (pillar & stall).

4.5.11 The shafts associated with bell pits are typically only about 1.2m in diameter, and the bell pit itself was typically 5m to 10m in diameter (bell pit size would have been constrained by roof stability). Consequently, bell pits are often closely spaced; the most intensive concentration of shafts recorded to date (66 per acre) was at the Middleton Broom Opencast site.

4.5.12 As coal was removed during bell pitting, the unsupported strata above assumed an inverted slope of stability, generating a bee-hive shape around the base of the shaft which forms the characteristic vertical section. The depth limit of bell pit mining is almost certainly 15m, and this is considered a deep bell pit; the vast majority were probably less than half this depth.

4.5.13 At greater depths, pillar and stall workings appear to have been the preferred method, and such workings were often accessed via a single shaft. Consequently, shafts associated with such workings are more widely spaced; but rarely exceeded one quarter of a mile (400m) shaft to shaft, due to problems with ventilation and underground haulage. It was customary to view the life expectancy of an individual pit as about three to five years and at any one time several new pits would be sinking to replace those currently operating.

4.5.14 Up until the last decades of the eighteenth century, coal mining almost always represented a short-term interruption to ongoing use of land for agricultural. The right to sink shafts and extract coal was usually conditional upon restoration of the surface after coal extraction was complete. This not only involved filling the shaft, but also required that any subsequent settlement of shaft fill material did not result in depressions in the field surface. Consequently, it was usual to fill the shaft and heap excess arisings into a dome over the shaft eye. Over subsequent years, the dome supplied material to compensate for settlement of the shaft fill. In the normal course of events, at the conclusion of the recovery period, any remaining spoil accumulations above ground level would have been planed off to leave a relatively stable, level surface where the shaft had been.

4.5.15 In general plan, gallery workings consisted of a series of parallel, rectangular working chambers separated by long piers or pillars of coal, colloquially referred to as benks or banks. The major axis of the galleries was generally up the dip although strike working was not uncommon.

4.5.16 Although the broad direction of the stalls was adhered to, there tended to be considerable wandering in the alignment of the pillars, which followed the natural partings provided by the cleat of the coal. There is no sense of the disciplined influence of a surveyed pre-plan, but rather it would appear that the skill of individual miners conditioned the degree to which the workings approached formal regularity. The fact that some pillars drifted into adjacent stalls implies a lack of formal control of progress. It may be that the intermittent cross headings that penetrated laterally through the pillars were intended to provide a check upon the extent to which parallel headings were being preserved.

4.5.17 Usually, the length of the stall extended for up to 10m but some were extremely attenuated, occasionally running uninterruptedly for 15m or more. There was considerable variation in the width of the stalls, ranging between 2m and 6m and an even more noticeable variation in the width of the pillars. The most substantial pillars were about 2.5m in width but many were reduced to less than 0.5m in width. It is possible that this reduction in pillar with was a result of robbing.

4.5.18 Timber props supported the roof where the stall span was greater than about 2m. Prop withdrawal on closure of a mine does not seem to have been prevalent.

4.5.19 From the late 18th century onwards, packing of mineworkings became common practice. Packing of workings (known as 'goaf' packing) was done using unwanted materials associated with mining of the target seam (e.g. dirt partings, dark mudstone, clay, poor quality coal etc). This material was 'packed' by hand into the stalls (voids) from which the coal had been removed, as mining of 'fresh' coal progressed.

4.5.20 As mining continued, the 'roof' of the stall often lost support and would sag/subside, coming to rest on, and compressing, the packed material. This process was done systematically, meaning that the vast majority (if not all) of the stalls were fully packed come the end of mining. However, a small area around the shaft (also known as a 'shaft porch'), tramways and waterways (used to drain workings towards a pumping shaft) would not be packed. Tramways and waterways are linear and of limited width (unlike 'open' stalls), making them very difficult to target during an intrusive investigation.

4.5.21 Compression of the packed materials, and the fact that they comprise re-worked Coal Measures rock, make such former mineworkings very difficult to identify in rotary open probeholes (and possibly even in a cored boreholes).

4.5.22 Bell pits may be present at Barugh Green. If they are, given the likely depth constraints discussed above, it seems likely they will be limited to workings in the Thin and Swallow Wood seams beneath about 2.5 ha (6 acres) of land in the north and east.

4.5.23 Given the absence of loose superficial deposits, it is considered unlikely that mine entries at would have been lined.

Recorded mineworkings

4.5.24 The shallowest recorded mineworkings beneath this site are in the **Flockton Thick** seam (c. 0.7m thick) at a depth of about 125m bgl. An abandonment plan has been obtained for these workings; see Drawing 3407/9.

Opencast workings

4.5.25 Extensive opencast workings (Craven I) of the **Swallow Wood** Coal and the **Thin** Coal, are shown in the north and west of the site on CA plans, extending beyond the western boundary. Further opencast workings (Craven II) to the south of the site are shown to encroach within the southern boundary.

4.5.26 A summary of each opencast site is provided in the table below:

Opencast Site	Seams Worked	Dates of Working	Completion of re-soiling & handing back to agriculture	Total Area Worked/ Coal Removed	Approximate area of site underlain by opencast backfill
Craven I	Swallow Wood Thin Coal (far north-east)	10th July 1950 to 20th Nov 1951	July 1952	11.9 ha (29.3 acres) 80,697 tons	1.9 ha (c. 40%)
Craven II	Low Haigh Moor Top Haigh Moor Swallow Wood Thin Coal Gawber (far east)	29th April 1957 to 7th Feb 1963	Not provided	33.1 ha (81.9 acres) 775,929 tons	340m2 (<1%)

4.5.27 The abandonment plans include base contours for each seam worked (at 10' intervals) and occasional original ground levels; review of these suggest that excavation in:

- Craven I (within the area of current interest) were typically around 6m to 10m deep, and
- Craven II (area underlying the far south-east of the proposed development) are likely less than 5m deep (but deepening quickly to the south, beyond the site's southern boundary).

4.5.28 Abandonment plan NE.498 includes a vertical section (copied on Drawing 3407/8) which is summarised below.

Seam name(s)	Approximate thickness/m	Approximate depth below Gawber/m	Remarks	Coal quality
Gawber Coal	0.91	-	Comprises two beds of coal (each 0.25m thick), separated by a 0.4m dirt parting.	Top leaf: Good Bottom leaf: Moderate (high sulphur content)
Thin coal	0.34	7	Underlain by 0.6m of Fireclay.	Excellent
Swallow Wood Coal	0.91	15	Comprises two beds of coal (0.2m & 0.4m thick), separated by a 0.3m dirt parting.	Top leaf: Excellent Bottom leaf: Good, but numerous pockets of pyrites
Top Haigh Moor	1.12	29	Comprises three beds of coal (0.36m, 0.2m, & 0.25m thick), separated by two thin dirt parting. Underlain by 0.3m of Fireclay.	Top leaf: Moderate Middle leaf: Inferior, with high ash. Bottom leaf: Good
Low Haigh Moor	0.89	37	Comprises two beds of coal (0.25m & 0.4m thick), separated by a 0.25m dirt parting.	Top leaf: Good Bottom leaf: Good

4.5.29 Given the dip of underlying strata, existing topography and information in the table above, the Swallow Wood Coal is anticipated to lie at depths of between c. 6m in the centre-west and c. 15m in the northeast.

4.5.30 The Craven I opencast did not extend across the entire site to the eastern boundary and therefore the maximum depth of backfill is likely to be less than 15m deep. Indeed, the abandonment plan suggests the excavation was 11.5m deep at its lowest point.

4.5.31 The vertical section summarised above is considered to be more accurate/reliable than the more generic information provided on the 1:10,000 BGS map (SE30NW). The most notable difference between the two is that the Top Haigh Moor is shallower than indicated on the BGS map legend.

4.5.32 Consequently, any unrecorded mineworkings within the Top Haigh Moor seam are likely to be around 15m below the base of the opencast (i.e. c. 25m depth), compared to 30m as indicated on the geological map stratigraphic column.

4.5.33 Depths in the above table are based on ground levels prior to opencast works, ground levels post remediation are not known as no current topographical survey has been provided, but they are likely to be similar to original levels.

4.5.34 High walls associated with the opencast workings are shown in the north and centre of the site, along with a narrow 'spur' located in the west of the site, extending off site to the west (Craven I) High walls associated of Craven II opencast are shown just within the southern site boundary, extending off site to the south. The location, height and slope angle of the high walls will have implications for any proposed layout and foundations of proposed plots.

4.5.35 Abandonment plans showing the extent of opencast obtained from the CA are reproduced as Drawing 3407/8 in Appendix B to this report. These plans provide a record of the mine prior to backfilling and are therefore likely to provide a good approximation of the extent of operations, as well as the location of any high walls present.

4.5.36 Whilst areas beyond the opencast backfill are indicated by the CA to be Low Risk, and there are no known workings, the possibility of unrecorded workings cannot be entirely discounted, and an intrusive mining investigation would be prudent.

4.6 Ironstone

4.6.1 As well as containing valuable coal seams the Coal Measures include bands of ferrous rich ironstone which have historically been extracted by both underground and surface methods as a raw material for the production of iron and steel.

4.6.2 The BGS memoir notes that iron ore extraction and smelting took place in the surrounding area since the roman period, reaching its peak between the 12th and 17th century.

4.6.3 The major ironstone horizons of the general area are associated with coals which are not present beneath this site, however the Swallow Wood Mine (an ironstone band) which lies stratigraphically above the Swallow Wood Coal has been subject to localised extraction.

4.6.4 Consequently, it cannot be discounted that ironstone may have been extracted in underground workings located just above the Swallow Wood Coal.

4.6.5 In Lithos' experience ironstone extraction usually takes place alongside coal extraction (often within the same mine) and therefore it may be the case that underground workings of the Swallow Wood Coal could have also removed ironstone. This often results in ironstone workings being mistakenly identified as coal extraction, and with the total possible thickness of workings being under-estimated.

5 POTENTIAL ISSUES ASSOCIATED WITH DEEP BACKFILL

5.1 Opencast

5.1.1 It is considered likely that the backfill within the Craven I and Craven II opencasts was placed without systematic mechanical compaction in irregular and thick layers, without any screening to remove oversized materials or degradable waste etc. Such material poses a risk to any proposed development due to the potential for differential settlement and long term 'creep' settlement.

5.1.2 It is understood that the backfill has been in place for c. 70 years at Craven I and c. 60 years at Craven II opencasts.

5.1.3 Settlement of deep made ground is initially (first 5 years or so) predominantly associated with immediate settlement and inundation (caused by changes in the water table depth and/or surface water infiltration) as groundwater levels return to equilibrium (i.e. pre opencasting).

5.1.4 Consolidation settlement is associated with a reduction in volume caused by expulsion of water from soil pores and transfer of load from excess porewater pressure to the soil particles.

5.1.5 Creep compression occurs as the particles of fill become more closely packed, under conditions of constant effective stress (arising from self-weight of the fill). Although the movements caused by creep are relatively small, often it is these long-term movements that are of most interest to foundation performance. Many coarse fills show a linear relationship between settlement and the logarithm of the time that has elapsed since the fill was placed (i.e. settlement that occurs during the first 10 years (log cycle 1) is similar to that from years 10 to 100 (log cycle 2).

5.1.6 Where development on deep fill takes place, in addition to any ongoing creep associated with self-weight, settlement is caused by the imposed foundation loads and load as a result of any ground level increases. This leads to some immediate compression and consolidation within stressed zones.

5.1.7 The strength/density of the backfill materials is likely to vary over relatively short distances, especially across the line of buried highwalls.

5.1.8 At this stage, it is considered that the presence of deep backfill will have implications for:

- Foundations – likely piled or heavily reinforced; see further details in Section 14.5 and 14.7 for details of Opencast Backfill settlement.
- Drainage – likely need to be placement at maximum possible gradients using flexible connections to prevent any backfalls should differential settlement of the fill occur. There is potentially the need to pile manholes.
- New utilities – should be constructed of flexible materials. Electricity and communications cabling should also be laid with sufficient 'slack' to accommodate a degree of movement. The use of flexible joints is recommended where possible, particularly where service connections extend across a rigid/flexible structure interface (e.g. from a piled foundation into a garden area).
- Highways - a specification will need to be agreed with the adopting authority, but reinforcement of the road construction is likely to be required.

5.1.9 However, in the context of land that has been subject to opencast coal extraction, this site can be considered relatively low risk given the limited depths of fill (c. 12m) anticipated. Fill thicknesses mean that consideration can be given to a piled foundation solution and/or a heavily reinforced strip footing.

5.1.10 If piled foundations are adopted for plots underlain by opencast backfill there should be a reduced need for further significant geotechnical analysis / modelling, although specialist piling contractors will require more data (i.e. cable percussion boreholes, possibly with rotary core follow-on).

5.1.11 Conversely, if reinforced strips (or rafts) are preferred, significant further investigation and assessment will be required. This should commence with a review of the data obtained during Lithos' investigation, and case studies data relating to other deep backfill sites, to enable preliminary estimates of anticipated settlement.

6 PRELIMINARY CONCEPTUAL SITE MODEL

6.1.1 Opencast mining has taken place in the north, west and far southeast of the site. Potential pollutants associated with this operation and the backfilled waste may include:

- Metals and asbestos
- PAH
- Sulphates

6.1.2 A preliminary conceptual site model, presented as Drawing 3407/5 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 4 inclusive of this report.

6.1.3 Clearly, the conceptual model will be subject to modification in light of data arising from the proposed intrusive ground investigation.

6.1.4 Potential contaminant linkages are shown on the preliminary conceptual site model.

6.1.5 Potential contaminant pathways include:

- Ingestion
- Dermal contact
- Inhalation of contaminated particulates
- Surface water run-off, including existing drainage infrastructure
- Downward infiltration of leachable/mobile contaminants to groundwater
- Migration of hazardous gas

Receptors

6.1.6 Potential contaminant receptors include:

- The environment – Secondary A aquifer and field drains leading to off-site surface watercourse
- End users of the site (residents)

7 GROUND INVESTIGATION DESIGN

7.1 Anticipated ground conditions & potential issues

7.1.1 Based on the data reviewed in Section 4 (Environmental Setting), anticipated ground conditions are expected to comprise:

Anticipated condition	Remarks
Made ground	Deep made ground (up to c. 11m) of variable composition anticipated within areas of former opencast which is likely to include oversize material and obstructions

Anticipated condition	Remarks
Natural soils	Topsoil over residual soils (gravelly clay/clayey gravel) from weathering of bedrock
Bedrock	Mudstone, siltstone and sandstone at shallow depth beyond areas of former opencast with bedrock at c. 6m to 12m depth 'inside' opencast area
Mineworkings	Possible unrecorded workings at shallow depth beyond areas of former opencast
Groundwater	Perched water likely present in made ground with 'true' groundwater likely at depth in bedrock

7.1.2 Based on the data above and that in Sections 2 (Site Description) and 3 (History), potential ground-related issues associated with this site are likely to include:

Type of issue	Specific issue	Remarks
Potential on-site contamination sources	1. Naturally occurring contaminants 2. Farming related activities 3. Opencast backfill	1. Metals in topsoil 2. See Section 4 3. Backfill material may include asbestos and be potentially combustible
Potential off-site contamination sources	1. Landfill	1. Generation and migration of hazardous gas
Potential geotechnical hazards	1. Below ground obstructions (boulders) 2. Deep made ground 3. Opencast high walls 4. Shallow workings	1. Opencast backfill likely to contain oversize material 2. Unsuitable founding stratum 3. Layout should take account of high walls to ensure plots do not span these 4. Possible unrecorded workings leading to surface instability
Other potential constraints	1. Overhead utilities	1. Overhead electric (11kV) cables

7.2 Ground investigation design & strategy

7.2.1 The preliminary conceptual site model was used as a basis for design of an appropriate ground investigation, the scope of which is summarised below.

Exploratory holes	Purpose
Twenty trial pits	To determine the general nature of soils underlying the site, including the: • Nature, distribution and thickness of made ground • Nature, degree and extent of contamination • Proportion of undesirable elements e.g. biodegradable matter, foundations etc • Suitability of the ground for founding structures and highways
Ten trial trenches	To delineate the line of the opencast highwall
Six cable percussion boreholes	To retrieve geotechnical data from depth including confirming the strength (density) of opencast backfill via SPTs.
Twenty-five probeholes	To check for the presence of voids or broken ground associated with possible unrecorded shallow mine workings
Fourteen boreholes	To install monitoring wells across the site in order to: • Monitor for hazardous gas • Determine groundwater levels and assess flow direction • Inform foundation design
Three rotary cored boreholes	To recover rock samples from beyond the base of the opencast for geotechnical testing

7.2.2 Proposed exploratory hole locations were selected to provide a representative view of the strata beneath the site and to target potential areas of interest identified in Section 7 above. A nominal 40m grid spacing was proposed. Additional exploratory locations might be scheduled by the site engineer in light of the ground conditions actually encountered.

7.2.3 The number of representative samples taken will be reflective of the geological complexity actually encountered. However, in general about 3 samples will be taken from most trial pits.

8 FIELDWORK

8.1 Objectives

8.1.1 The original investigation strategy is outlined in Section 7.2 above.

8.1.2 Trial trenches were initially intended to investigate the location and geometry of buried opencast highwall. However, due to ground conditions encountered (shallow groundwater) this was not possible in all locations and therefore the additional exploratory holes listed below were advanced.

Exploratory holes	Purpose
ST201 to ST207	To obtain additional information on the location and geometry of opencast highwalls

8.2 Exploratory hole location constraints

8.2.1 No access was available to a linear belt running northeast-southwest through the centre of the site due to overhead electric cables.

8.3 Scope of works

8.3.1 Fieldwork was initially supervised by Lithos on 16th April 2019 (pitting and trenching) with supplementary rotary drilling between 30th July and 6th August 2020. Additional fieldwork was undertaken between 30th November 2021 and 26th January 2022 and comprised the exploratory holes listed below.

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs 01 to 07 & 201 to 213	1.8m to 5.5m	Vane tests in cohesive soils
Trial trenching (machine dug)	TTs 01 to 03 & TTs 201 to 209	1.0m to 6.0m	Trenches to investigate opencast highwalls
Cable percussive boreholes	BHs 201 to 207	4.0m to 11.1m	SPTs typically at 1m centres. Monitoring wells installed
Rotary cored boreholes	RCs 201 to 203	15.4m to 17.0m	
Rotary open-hole probeholes	PHs 101 to 125	10.5m to 39.0m	
	PHs 102A, 105A, 107A, 108A, 110A, 115A, 121A & 122A	5.5m to 6.0m	Monitoring wells installed
	Stitch drilling	4.5m to 13.9m	Stitch drilling to investigate opencast highwalls

8.3.2 Notes describing ground investigation techniques, in-situ testing and sampling are included in Appendix A to this report.

8.3.3 Exploratory hole logs are presented in Appendices F to K to this Report. These logs include details of the:

- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of the in-situ testing

- The monitoring wells installed

8.3.4 Exploratory hole locations are shown on Drawing 3407/6 presented in Appendix B. With the exception of TPs 02, 03 & 07 and TTs 01 to 03, exploratory holes were picked-up by a surveyor and co-ordinates/ground levels are included on the logs.

9 GROUND CONDITIONS

9.1 General

9.1.1 A complete record of strata encountered beneath the proposed development site is given on the various exploratory hole records, presented in Appendices F to K.

9.1.2 Typical ground conditions encountered at the site are described below in Sections 9.2 (made ground) and 9.4 (natural ground), with a summary provided in the table on pages 19 to 21.

9.2 Made ground

9.2.1 The made ground on site can be categorised as one of 4 broad types:

- **Made Ground Topsoil:** encountered in the majority of exploratory holes as Clay with gravel of mixed lithologies including mudstone, sandstone, brick and coal with a typical thickness of 200mm.
- **Reworked Natural Ground:** firm to stiff yellow Clay with gravel of predominantly sandstone encountered across the site immediately beneath the topsoil to an average depth of 0.6m (max. 1.1m).
- **Burnt Shale:** encountered locally along the eastern highwall of the Craven I opencast at shallow depth as thin beds (typically 0.3m thick) of clayey/sandy Gravel of burnt shale.
- **Opencast Backfill:** encountered in the north, west and far southeast and typically comprises grey gravelly Clay or clayey Gravel of predominantly mudstone with lesser amounts of coal, sandstone, burnt shale, brick and metal. Contains variable coble and boulder content of brick, concrete and mudstone (further details in Section 9.3).

9.2.2 The nature of the Opencast Backfill within the Craven II opencast (far southeast) was found to be more variable than that encountered in the Craven I opencast (north and west). Mudstone formed a lower proportion of the gravel content with an increased presence of brick, concrete, sandstone, metal and glass.

9.2.3 Deep made ground (in excess of 2m deep) was encountered in all exploratory holes advanced within the former opencasts and is present across c. 40% of the site. Where fully penetrated within the backfilled opencasts (boreholes and probeholes) its thickness was found to vary between 2.4m and 11.9m (average 7.2m). The approximate distribution of deep made ground is shown on Drawing 3407/12.

9.2.4 Beyond the footprint of the former opencasts, a veneer of made ground is typically present to between 0.6m and 1.2m depth (average 0.9m) comprising Made Ground Topsoil and Reworked Natural Ground (locally with thin beds of Burnt Shale).

9.2.5 All four of the above made ground types are interpreted as being made up of site-won materials (although it cannot be discounted that some soils could have been imported during the site's history).

9.2.6 Whilst not encountered during this investigation, the possibility of 'burial pits' cannot be entirely discounted.

9.3 Obstructions (boulders)

9.3.1 Based on review of historical OS Plans (see Section 3) it appears the site has remained undeveloped throughout history with no record of buildings or areas of hardstand being present. However, the north, west and far southeast of the site have been subject to coal extraction by opencast methods with these areas subsequently backfilled and the surface reinstated.

9.3.2 Within the former Craven I opencast (north and west), significant concrete and mudstone/siltstone boulders up to 1.6m across were often encountered in the vicinity of the highwall, and to a lesser extent within the backfill. The concrete boulders appeared to be sections of a former "slab" often tabular in shape.

9.3.3 The nature of the backfill encountered within the former Craven II opencast (far southeast) was more variable than that encountered in the north and west of the site (see Section 9.2 above). Obstructions were also encountered although these predominantly comprised reinforced concrete beams, with fewer concrete "slab" boulders and no mudstone boulders encountered. The beams were often broken up during excavation with sections up to c. 1.2m long recovered.

9.3.4 Further details of obstructions encountered are provided in the table below.

Hole	Area of site	Depth (m)	Obstruction encountered
TP02	Within Craven I opencast	0.8	Boulders of concrete up to 0.5m across
		1.3	Concrete obstruction running length of pit
TP03		2.0	Mudstone boulder in north wall
TP203		2.0	Sandstone boulder measuring 0.9m x 0.4m x 0.3m
BH205		2.0	Unidentified obstruction within borehole
		5.0	Mudstone cobble/boulder
ST207B		2.0	Siltstone boulder(s) between 2.0m and 2.5m
ST202C		1.4	Siltstone boulder(s) between 1.4m and 1.9m
		4.8	Unidentified boulder(s) between 4.8m and 5.5m
TT03S	Northern highwall of Craven I	1.3	Mudstone boulder 600mm across
TT202S		4.3	Two siltstone boulders measuring 1.0m x 0.6m x 0.2m
TT204S		1.7	Mudstone boulder measuring 0.8m x 0.6m x 0.3m
TT206C	Eastern highwall of Craven I	0.9	High boulder content of concrete up to 1.6m across
ST202C		1.5	Mudstone boulder(s) between 1.5m and 2.8m
TT208SE	Northern highwall of Craven II	0.9	Concrete boulder measuring 1.4m x 0.7m x 0.2m
		1.9	High cobble content of reinforced concrete beams (recovered as up to 1.2m lengths)

9.4 Natural ground

9.4.1 Natural ground was encountered in all exploratory holes advanced beyond the areas of former opencasts (including at the location of highwalls), and typically comprised:

- **Topsoil:** gravelly Clay was identified beyond areas of made ground to a typical depth of 200mm.

- **Cohesive Residual Soil:** firm to stiff sandy/gravelly Clay encountered beneath topsoil and the Thin Coal (where encountered) to between 0.6m and 3.5m depth (average 2.4m).
- **Granular Residual Soil:** encountered beneath Cohesive Residual Soil comprising clayey/sandy Gravel to between 1.5m and 4.2m depth (average 2.9m).
- **Thin Coal:** weak black Coal was encountered in trial pits and trenches advanced in the far north and centre, immediately beyond the footprint of the former Craven I opencast, at between 1.0m and 2.6m depth with a typical thickness of 0.3m (max. 0.5m).
- **Coal Measures:** typically encountered as very weak to weak thinly laminated Mudstone and Siltstone at between 1.5m and 4.2m depth (average 2.9m). Medium strong thickly laminated Sandstone was encountered locally in the east.

9.4.2 Locally, a thin (5cm to 20cm thick) bed of coal was encountered c. 0.6m beneath the Thin Coal within underlying weathered bedrock.

9.4.3 Within the backfilled opencast, Coal Measures bedrock was encountered at between 5.8m (west) and 11.9m depth (centre north) as shown on Drawing 3407/12 in Appendix B. The bedrock comprises interbedded extremely weak Mudstone, weak to moderately weak Siltstone and medium strong Sandstone.

9.4.4 The in-situ relative density/strength of opencast backfill on site was established by carrying out Standard Penetration Tests (SPTs) during the drilling of the boreholes; see Sections 13.6 & 13.6.3.

Summary of Ground Conditions

Hole	Final depth (m)	Depth to Base of Made Ground (m)	Depth to Base of (m)									Depth to Coal Measures Bedrock (m)	Remarks
			Made Ground				Natural Soils						
			Made Ground Topsoil	Reworked Natural Ground	Burnt Shale	Opencast Backfill	Topsoil	Cohesive Residual Soil	Thin Coal	Cohesive Residual Soil	Granular Residual Soil		
Lithos (2019)													
TP01	2.0	-	-	-	-	-	0.2	1.3	-	-	1.7	1.7	
TP02	1.3	>1.3	0.2	0.5	-	>1.3	-	-	-	-	-	-	Concrete obstruction at 1.3m
TP03	3.2	>3.2	0.2	0.4	-	>3.2	-	-	-	-	-	-	Groundwater inflow at 2.2m
TP04	1.8	1.0	0.3	1.0	-	-	-	1.5	-	-	1.7	1.7	
TP05	2.9	1.1	0.2	1.1	-	-	-	>2.9	-	-	-	-	
TP06	3.5	>3.5	0.2	0.5	-	>3.5	-	-	-	-	-	-	Groundwater inflow at 3.1m
TP07	2.9	>2.9	0.2	0.5	-	>2.9	-	-	-	-	-	-	Groundwater inflow at 2.1m
TT01SE	2.6	0.9	0.2	0.3	-	0.9	-	1.9	2.4	>2.6	-	-	
TT01C	2.7	1.7	0.2	-	-	1.7	-	-	2.0	>2.7	-	-	
TT01NW	2.7	>2.7	0.2	-	-	>2.7	-	-	-	-	-	-	Groundwater inflow at 2.2m
TT02E	1.0	-	-	-	-	-	0.2	0.6	-	-	>1.0	-	
TT02C	1.9	-	-	-	-	-	0.2	0.6	-	-	1.5	1.5	
TT02W	2.3	>2.3	0.2	0.5	-	>2.3	-	-	-	-	-	-	
TT03N	2.4	1.0	0.2	0.5	-	1.0	-	-	1.3	2.1	2.4	2.4	
TT03S	3.0	>3.0	0.4	0.7	-	>3.0	-	-	-	-	-	-	Groundwater inflow at 2.9m
Lithos (2021)													
TP201	3.5	0.6	0.2	0.6	-	-	-	1.5	1.8	2.7	3.1	3.1	Groundwater seepage at 1.8m
TP202	3.7	1.1	0.3	1.1	-	-	-	1.6	1.9	2.8	3.1	3.1	Groundwater seepage at 2.7m
TP203	5.5	>5.5	0.3	0.8	-	>5.5	-	-	-	-	-	-	
TP204	3.9	0.6	0.2	0.4	0.6	-	-	2.9	-	-	3.6	3.6	Groundwater seepages at 0.4m and 3.9m
TP205	3.9	>3.9	0.2	0.6	-	>3.9	-	-	-	-	-	-	
TP206	4.0	>4.0	0.3	0.6	-	>4.0	-	-	-	-	-	-	Groundwater inflow at 2.5m
TP207	5.0	>5.0	0.2	0.6	-	>5.0	-	-	-	-	-	-	Groundwater inflow at 3.3m
TP208	2.8	>2.8	0.2	0.5	-	>2.8	-	-	-	-	-	-	Groundwater inflow at 1.1m

Hole	Final depth (m)	Depth to Base of Made Ground (m)	Depth to Base of (m)									Depth to Coal Measures Bedrock (m)	Remarks
			Made Ground				Natural Soils						
			Made Ground Topsoil	Reworked Natural Ground	Burnt Shale	Opencast Backfill	Topsoil	Cohesive Residual Soil	Thin Coal	Cohesive Residual Soil	Granular Residual Soil		
TP209	3.7	0.7	0.3	0.7	-	-	-	2.3	-	-	3.2	3.2	
TP210	3.7	0.6	0.2	0.6	-	-	-	2.2	2.9	3.5	2.6	3.5	Groundwater seepage at 3.4m
TP211	2.1	-	-	-	-	-	0.3	2.0	-	-	-	2.0	Groundwater seepage at 2.0m
TP212	4.2	-	-	-	-	-	0.2	1.0	-	2.4	1.8, then 3.3	3.3	Groundwater seepage at 1.6m
TP213	4.3	-	-	-	-	-	0.3	2.1	-	-	2.9	2.9	
TT201NW	4.3	1.0	0.3	-	-	1.0	-	3.8	-	-	4.2	4.2	Groundwater seepage at 4.2m
TT201SE	6.0	>6.0	0.3	-	-	>6.0	-	-	-	-	-	-	
TT202N	3.2	1.2	0.3	0.8	-	1.2	-	1.7	2.0, then 2.7	2.5, then 3.2	-	3.2	
TT202S	5.2	>5.2	0.3	0.8	-	>5.2	-	-	-	-	-	-	
TT203	2.0	>2.0	0.3	0.5	-	>2.0	-	-	-	-	-	-	Abandoned due to water inflow from field drain
TT204N	3.0	1.2	0.4	1.0	-	1.2	-	>3.0	-	-	-	-	
TT204S	3.2	>3.2	0.3	0.8	-	>3.2	-	-	-	-	-	-	Groundwater inflow at 2.0m
TT205SE	4.2	0.8	0.2	0.4	0.8	-	-	1.5	1.9	3.2	4.2	4.2	
TT205NW	4.9	>4.9	0.2	0.4	0.8	>4.9	-	-	-	-	-	-	Groundwater inflow at 3.0m
TT206SE	1.2	0.8	0.2	0.5	0.8	-	-	>1.2	-	-	-	-	
TT206C	3.4	1.7	0.2	0.4	-	1.7	-	3.0	-	-	3.4	3.4	
TT206NW	4.8	>4.8	0.2	0.4	-	>4.8	-	-	-	-	-	-	
TT207SE	1.0	0.6	0.2	0.6	-	-	-	>1.0	-	-	-	-	
TT207C	1.4	1.0	0.2	0.5	-	1.0	-	>1.4	-	-	-	-	
TT207NW	3.4	>3.4	0.2	0.5	-	>3.4	-	-	-	-	-	-	Groundwater inflow at 1.8m
TT208NW	3.0	0.5	0.2	0.5	-	-	-	1.8	-	-	2.5	2.5	
TT208SE	3.4	>3.4	0.2	-	-	>3.4	-	-	-	-	-	-	Groundwater inflow at 1.7m
TT209E	1.6	1.1	0.2	0.5	1.1	0.9	-	>1.6	-	-	-	-	
TT209C	3.0	2.1	0.2	0.4	1.1	0.9, then 2.1	-	2.6	-	-	-	2.6	
TT209SW	5.8	>5.8	0.2	0.4	1.1	0.9, then >5.8	-	-	-	-	-	-	

Hole	Final depth (m)	Depth to Base of Made Ground (m)	Depth to Base of (m)									Depth to Coal Measures Bedrock (m)	Remarks
			Made Ground				Natural Soils						
			Made Ground Topsoil	Reworked Natural Ground	Burnt Shale	Opencast Backfill	Topsoil	Cohesive Residual Soil	Thin Coal	Cohesive Residual Soil	Granular Residual Soil		
BH201	8.0	7.9	0.3	0.6	-	7.9	-	-	-	-	-	7.9	Groundwater at 6.5m
BH202	6.6	5.9	0.2	0.7	-	5.9	-	-	-	-	-	5.9	Groundwater at 5.9m
BH203	10.1	9.0	0.2	1.0	-	9.0	-	-	-	-	-	9.0	Groundwater at 3.5m
BH204	10.6	10.5	0.3	0.9	-	10.5	-	-	-	-	-	10.5	Groundwater at 6.0m
BH205	11.1	11.0	0.4	1.1	-	11.0	-	-	-	-	-	11.0	Groundwater at 3.0m
BH206	9.6	9.5	0.3	1.0	-	9.5	-	-	-	-	-	9.5	Groundwater at 1.2m
BH207	4.0	>4.0	0.3	1.0	-	>4.0	-	-	-	-	-	-	

9.5 Visual & olfactory evidence of organic contamination

9.5.1 No evidence of significant organic contamination was noted in any of the exploratory holes.

9.5.2 Selected samples were scheduled for chemical testing to determine the nature and extent of any contamination, and to confirm the suitability of existing topsoil for re-use; see Section 10.

9.6 Groundwater

9.6.1 Significant inflows of perched water were encountered in the opencast backfill during the investigation at between 1.1m and 3.3m depth. Beyond the backfilled opencast, groundwater was encountered locally as seepages typically on encountering granular soils or bedrock.

9.6.2 Groundwater levels recorded in the monitoring wells on a single visit (16th February 2022) are summarised below.

Hole	Response zone (depth range & strata)	Groundwater body	Typical standing water level	
			m bgl	m AoD#
BH201	2.0m to 7.5m - (Opencast Backfill)	Perched water	5.15	80.95
BH202	2.0m to 5.0m - (Opencast Backfill)		4.00	81.15
BH203	2.0m to 9.0m - (Opencast Backfill)		2.40	80.60
BH204	1.7m to 9.8m - (Opencast Backfill)		1.70	80.60
BH205	3.0m to 10.0m - (Opencast Backfill)		-0.20	80.75
BH206	2.0m to 9.0m - (Opencast Backfill)		-0.05	80.60
BH207	1.5m to 4.0m - (Opencast Backfill)		0.30	80.25
PH107	3.0m to 6.0m - (Opencast Backfill)		2.45	80.40
PH110	2.5m to 5.5m - (Opencast Backfill)		3.75	80.80
PH102	3.0m to 6.0m - (Coal Measures)	Solid aquifer	1.40	80.50
PH105	3.0m to 6.0m - (Coal Measures)		-0.15	79.35
PH108	3.0m to 6.0m - (Coal Measures)		0.70	82.65
PH115	3.0m to 6.0m - (Coal Measures)		1.90	77.65
PH122	3.0m to 6.0m - (Coal Measures)		2.70	82.95

levelled-in by survey to inform foundation design

9.6.3 Dip data to date suggests that perched waters within the backfilled opencast are very shallow in the west becoming **artesian** in the northeast. The resting water level within the backfilled opencast is at c. 81mAOD in the southwest rising to c. 80.5mAOD in the northeast.

9.6.4 The site is topographically the lowest point in the local area with land to the southeast falling towards the site. In addition, the lowest point in the Craven I opencast is also beneath the site thereby potentially acting as a 'sump' for all perched water within the backfill.

9.6.5 It is likely that the shallow Reworked Natural Ground or cohesive Opencast Backfill is acting as a confining layer across the northeast preventing widespread issuing of perched waters at the surface.

9.6.6 However, a large area of permanently waterlogged ground in the centre north (see Section 2.2.3) may be an indication the perched water is locally issuing at the surface in this area.

9.6.7 Beyond the backfilled opencast, groundwater levels roughly reflect the perched waters as detailed above. Groundwater is deepest in the south (PH122) becoming artesian in the far north (PH105). It is possible the artesian groundwater recorded in PH105 is being influenced by perched waters in the backfilled opencast.

9.6.8 After an initial dip to record standing water level, the wells were bailed-out to establish an approximate rate of **recharge**. Findings were:-

Hole	Vol. removed /litres	Water level lowered by /m	From / to m bgl	Water level recovered to /m bgl	After / mins	Recovery rate
BH203	12	0.01	2.38 to 2.39	2.38	0	Rapid
BH204	7	0.01	1.68 to 1.69	1.68	0	Rapid
BH205	5	0.00	-	-	0	Rapid
BH206	12	0.00	-	-	0	Rapid
BH207	20	3.49	0.31 to 3.80	3.40	192	Slow
PH102	12	2.72	1.40 to 4.12	3.24	86	Fast
PH105	24	2.34	-0.14 to 2.20	0.86	148	Fast
PH107	6	1.12	2.47 to 3.59	3.10	115	Slow
PH108	24	3.89	0.71 to 4.60	0.86	122	Fast
PH115	8	3.64	1.90 to 5.54	3.42	139	Slow

Note: In a 50mm diameter well pipe there is approximately 2 litres of water per metre of water column.

9.6.9 It is apparent from the above that permeability of the ground is typically high – unsurprising given the observations made in the trial pits). Groundwater levels are considered to be reflective of the true water table (rather than "trapped" waters associated with drilling or surface water run-off).

9.6.10 These results will be required by the foundation designer, drainage designer, and groundworker (especially if/where deep excavation is required).

9.7 Stability

9.7.1 Stability of excavations within natural ground was generally good. However, within the backfilled opencasts stability was often very poor with spalling and collapse (typically where groundwater was encountered).

9.8 Mining investigation

Shallow workings (rotary probeholes)

9.8.1 It is clear from the desk study that the site **could** be underlain by shallow mineworkings associated with the Thin and Swallow Wood coals, although no workings are recorded by the Coal Authority or indicated on opencast abandonment plans.

9.8.2 The conjectured outcrop of the shallow coal seams is shown on Drawing 3407/7 in Appendix B to this report.

9.8.3 Consequently, a mining investigation has been undertaken, comprising the drilling of 25 rotary open-hole probeholes. The strata encountered are summarised in the table on page 27.

9.8.4 The Gawber Coal was targeted through the drilling of PH108. Remaining probeholes were all drilled beyond this outcrop, therefore, the Gawber Coal was not anticipated in remaining holes.

9.8.5 The Gawber coal was not encountered during Lithos' investigation and it is likely that this seam outcrops beneath/just beyond the south eastern corner, dipping away from the site towards the northeast.

Within footprint of opencast

9.8.6 PHs 103, 104, 107, 109 to 113 & 119 to 121 were advanced within the footprint of the **Craven I** opencast. The base of the **Craven I** opencast has been found to range from 5.8m (PH110) & 10.6m (PH104), with the deepest areas of fill being located in the north-east and the shallowest to the south-west.

9.8.7 PHs 124 & 125 were advanced in the footprint of the **Craven II** opencast on the southern boundary. PH124 encountered rockhead at 6.5m (likely a terrace/shelf on the quarry highwall) and PH125 refused on an unknown (possible metal) obstruction at 10.5m.

9.8.8 Within the footprint of opencast, the **'Thin'** coal is always absent, and the **Swallow Wood** coal is typically absent (having been removed), with the exception of PH109 (possibly residual coal at base of opencast), PH104 (likely part way up the highwall), and PH113 (in the east where only the shallower Thin coal was extracted).

9.8.9 The **Top Haigh Moor** and **Low Haigh Moor** coal seams were recorded from depths of c. 14m & 23m respectively beneath the base of the opencast. No evidence (voids, broken ground, soft push or flush loss) of unrecorded workings were encountered in either seam (11 probeholes were advanced through the Top Haigh, and 3 through the deeper Low Haigh). Furthermore, even if the Top Haigh coal has been worked beneath the opencast, there would be sufficient competent cover present to mitigate potential risk to surface stability. However, the thickness of competent cover above the Top Haigh Moor would not always be sufficient if piled foundations were to penetrate bedrock by more than c. 0.5m.

Beyond footprint of opencast

9.8.10 Beyond the footprint of opencast (PHs 101, 102, 105, 106, 108, 114 to 118, 122 & 123) the **'thin' Coal** and the **Swallow Wood** coal were recorded from 0.7m depth and 5.9m depth respectively. At c. 0.6m thick (**'thin' Coal**) and c.1.0m thick (**Swallow Wood**) neither seam has a sufficient thickness of competent cover to mitigate potential risks posed to surface stability if worked.

9.8.11 However, the **'thin' Coal** and the **Swallow Wood** were recorded in all 12 of the probeholes drilled beyond the opencast footprints. As such although the possibility of shallow workings cannot be entirely discounted, it is considered unlikely that either seam has been worked beyond the opencast footprints.

9.8.12 The **Top Haigh Moor** coal seam was encountered in 9 probeholes advanced beyond the quarry footprint from 14.2m (typically c. 23m) with a thickness of up to 1.3m. The **Low Haigh Moor** coal seam was encountered from 20.2m (typically c. 31m) with a thickness of up to 1.2m. No evidence of unrecorded workings was encountered in either seam. Furthermore, even if these seams have been worked, there is a sufficient thickness of competent cover above both.

9.8.13 Given the number of probeholes drilled, and the absence of any evidence of voids, broken ground, soft push or flush loss it is considered **highly unlikely** that the site is underlain by shallow mineworkings in the **any** of the shallow coal seams present beneath the site.

9.8.14 A further 7 probeholes were taken to shallow depth to enable the installation of gas monitoring wells.

Opencasts (rotary probeholes)

9.8.15 It is clear from the desk study that the majority of the site is underlain by former opencast workings. The conjectured position of the highwall taken from a Coal Authority abandonment plan is shown on Drawing 3407/11A in Appendix B.

9.8.16 The plan indicates the opencast may be divided into two areas. The majority of the former opencast is likely to be deep (c. 9m to 12m) associated with the Swallow Wood Coal, with a small area in the northeast being shallower (2m to 5m) associated with extraction of the Thin Coal.

9.8.17 Given the age of the opencast and the quality of the closure records, it should be assumed that the depth of the opencast and location of highwalls can be taken with a good degree of certainty.

9.8.18 The depth of the backfilled opencast has been established by the drilling of 13 rotary openhole probeholes, 7 cable percussion boreholes and 3 rotary cored boreholes.

9.8.19 Drawing 3407/12 shows the approximate depth to bedrock within the opencast, which is typically shallowest in the west (c. 6m) becoming deeper towards the northeast (c. 12m).

9.8.20 Trial trenching was initially undertaken to expose the highwall and therefore determine the location, orientation and gradient. In the majority of trenches, fast groundwater inflows at shallow depth prevented detailed inspection of the highwalls. The location of the highwall was recorded by the rapid deepening of made ground.

9.8.21 Given the above, stitch drilling at 6 locations perpendicular to the highwall was carried out to gain further information on the location and gradient of the highwalls.

9.8.22 Details obtained from trenches and lines of stitch drilling are outlined in the table below.

Hole	Depth to rock at crest of highwall (mbgl)	Angle of highwall (from horizontal)	Opencast	Remarks
TT01	c. 2.7	n/a	Craven I	Groundwater inflow prevented detailed observation of highwall face
TT02	1.9	51°	Craven II	-
TT03	2.4	50°	Craven I	-
TT201	4.2	45°		-
TT202	3.2	50°		-
TT203	n/a	n/a		Unable to locate highwall due to groundwater inflow
TT204	c. 3.0	c. 50°		Groundwater inflow prevented detailed observation of highwall face
TT205	4.2	c. 50°		Groundwater inflow prevented detailed observation of highwall face
TT206	3.4	35°		-
TT207	c. 3.0	c. 60°		Groundwater inflow prevented detailed observation of highwall face
TT208	3.0	c. 50°	Craven II	Groundwater inflow prevented detailed observation of highwall face
TT209	3.0	44°	Craven II	-
ST201	2.4	50°	Craven II	-
ST202	4.6	30°	Craven I	-

Hole	Depth to rock at crest of highwall (mbgl)	Angle of highwall (from horizontal)	Opencast	Remarks
ST203	2.0	c. 20°		Variable angle found between probeholes (14° to 28°)
ST204	2.5	36°		-
ST205	3.4	11°		Possibly a ramp associated with access to the shallow 'shelf'
ST207	4.5	48°		Internal highwall

9.8.23 An internal highwall has been identified in ST207 between a shallow 'shelf' likely associated with extraction of the Thin Coal and the deeper opencast associated with the extraction of the Swallow Wood Coal.

9.8.24 In addition to the highwalls investigated above, a **'spur'** of unmined land shown in the west of the site has been investigated in TP207 and STs 206A to 206C.

9.8.25 Similar to the trenches advanced to investigate highwalls, a significant groundwater inflow at 3.3m in TP207 prevented any detailed inspection although made ground was encountered to in excess of 5.0m.

9.8.26 Consequently, a line of stitch drilling was advanced across the **'spur'** which found deep made ground (between 7.4m and 8.9m) with no evidence of shallow natural ground. Consequently, it appears this spur has either been extracted as part of the mining operations, or was possibly a ramp leading offsite to the west.

Summary of Ground Conditions – Mining Investigation

Hole ID	Final Depth (mbgl)	Depth to base (mbgl)		Depth to base (mbgl), thickness (m) & competent cover (m)																Evidence [A] of workings?
					Thin Coal				Swallow Wood Coal				Top Haigh Moor Coal				Low Haigh Moor Coal				
		Opencast Backfill	Weathered Coal Measures	Gawber Coal	Depth to base (m)	Thickness (m)	Required cover (m)	Cover present (m)	Depth to base (m)	Thickness (m)	Required cover (m)	Cover present (m)	Depth to base (m)	Thickness (m)	Required cover (m)	Cover present (m)	Depth to base (m)	Thickness (m)	Required cover (m)	Cover present (m)	
PH101	28.0	-	0.7	n/a	1.7	1.0	11.0	0.0	11.5	1.0	11.0	9.8	26.3	1.1	12.1	24.5	n/a				No.
PH102	15.0	-	1.4	n/a	2.6	1.2	13.2	0.0	10.3	1.0	11.0	7.9	n/a				n/a				No.
PH103	28.5	10.2	-	n/a	n/a				n/a				24.7	1.3	13	13.2	n/a				No.
PH104	36.0	10.6	-	n/a	n/a				11.0	0.4	4.4	0.0	25.0	1.0	11.0	13.4	33.0	1.2	13.2	21.2	No.
PH105	36.0	-	1.6	n/a	3.8	0.7	7.7	1.5	12.7	1.0	11.0	10.1	27.0	1.0	11.0	24.4	34.5	1.0	11.0	31.9	No.
PH106	30.0	-	1.5	n/a	3.5	0.5	5.5	1.5	12.5	1.0	11.0	10.0	28.0	1.0	11.0	25.5	n/a				No.
PH107	27.0	9.6	-	n/a	n/a				n/a				24.3	1.0	11.0	13.7	n/a				No.
PH108	30.0	-	1.7	n/a	6.9	0.6	6.6	4.6	16.1	1.1	12.1	13.3	n/a				n/a				No.
PH109	30.0	9.0	-	n/a	n/a				9.4	0.4	4.4	0.0	22.5	1.0	11.0	12.5	n/a				No.
PH110	33.0	5.8	-	n/a	n/a				n/a				19.5	1.1	12.1	12.6	n/a				No.
PH111	24.0	6.6	-	n/a	n/a				n/a				21.1	1.0	11.0	13.5	n/a				No.
PH112	36.0	10.5	-	n/a	n/a				n/a				24.2	1.2	13.2	12.5	32.5	0.8	8.8	21.2	No.
PH113	36.0	10.0	-	n/a	n/a				14.5	0.5	5.5	4.0	24.2	1.0	11.0	13.2	32.4	1.0	11.0	21.4	No.
PH114	27.0	-	1.7	n/a	6.5	0.6	6.6	4.2	15.5	1.3	14.3	12.5	21.1	0.9	9.9	18.5	n/a				No.
PH115	30.0	-	1.8	n/a	7.1	1.0	11	4.3	16.0	1.0	11.0	13.2	n/a				n/a				No.
PH116	39.0	-	1.6	n/a	2.2	0.6	6.6	0.0	10.4	1.1	12.1	7.7	24.7	1.0	11.0	22.1	33.5	1.0	11.0	30.9	No.
PH117	30.0	-	1.5	n/a	2.4	0.9	9.9	0.0	10.0	1.0	11.0	7.5	25.5	1.0	11.0	23	n/a				No.
PH118	30.0	-	1.0	n/a	n/a				9.3	0.7	7.7	7.6	24.5	1.0	11.0	22.5	n/a				No.
PH119	27.0	8.7	-	n/a	n/a				n/a				22.4	1.0	11.0	12.7	n/a				No.
PH120	36.0	7.9	-	n/a	n/a				n/a				22.0	1.0	11.0	13.1	n/a				No.
PH121	27.0	8.0	-	n/a	n/a				n/a				22.0	1.0	11.0	13	n/a				No.
PH122	30.0	-	1.2	n/a	3.0	0.6	6.6	1.2	n/a				27.4	1.0	11.0	25.2	n/a				No.
PH123	30.0	-	1.7	n/a	5.5	0.5	5.5	3.3	15.0	1.0	11.0	12.3	20.0	0.7	7.7	17.6	n/a				No.
PH124	12.0	6.5	-	n/a	n/a				n/a				n/a				n/a				No.
PH125	10.5	>10.5	-	n/a	n/a				n/a				n/a				n/a				No.

Notes: n/a – Probehole drilled beyond outcrop of seam, coal seam not anticipated in this hole
0.0 – Required competent cover not present if workings were present
A – Evidence of workings constitutes voids, broken ground, soft push and loss of flush

	Probehole drilled through opencast backfill
	Probehole drilled beyond opencast

9.9 Revised conceptual ground model (ground conditions)

9.9.1 The Preliminary Conceptual Site Model has been revised in light of data obtained during the ground investigation, most notably with respect to:

- The nature and distribution of made ground, including the presence of significant buried obstructions
- The strength, nature and depth of underlying natural strata
- The absence of shallow workings
- The nature and distribution of contamination (based on visual/olfactory evidence only)

9.9.2 Further refinement of the Conceptual Site Model is presented in Sections 11.2, where the results of laboratory testing for contaminants have been considered.

10 CONTAMINATION (ANALYSIS)

10.1 General

10.1.1 The site has remained undeveloped throughout history and has been formerly used as grazing land. However, the north, west and far southeast of the site have been subject to coal extraction by opencast methods in the 1950s and 1960s.

10.1.2 The site's former usage is likely to have given rise to some ground contamination. Furthermore, significant thicknesses of made ground were encountered in many of the exploratory locations during the ground investigation.

10.1.3 An assessment of potential contaminants associated with the former uses has been undertaken; see Section 6.

10.1.4 In the context of risks to human health associated with residential redevelopment, the Tier 1 Soil Screening Values referenced in this report have been derived via the CLEA default conceptual site model (CSM) used for generating SGVs, but amended, where appropriate, to be more specific to redevelopment within the planning process.

10.1.5 Where available, Category 4 Screening Levels (C4SL) have also been referenced.

10.1.6 Generic Note 04 in Appendix A provides further details with respect to current guidance and the interpretation of analytical data.

10.2 Testing scheduled

10.2.1 Based on the above assessment, Lithos submitted a test schedule (summarised in the table below) to a UKAS accredited laboratory.

Type of sample	No. of samples	Determinands
Made ground	24	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID TOC, Speciated Polycyclic Aromatic Hydrocarbons (PAH), Banded Total Petroleum Hydrocarbons (TPH)
	15	Water soluble sulphate, chloride, nitrate and magnesium Calorific Value (CV)
Topsoil & Made Ground Topsoil	10	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID TOC & Speciated Polycyclic Aromatic Hydrocarbons (PAH)

Type of sample	No. of samples	Determinands
	5	Clay/sand/silt content and visible contaminants, sharps (glass etc) to check compliance with BS3882:2015

10.3 Soil contamination results

10.3.1 The soil contamination test results are summarised in the tables on pages 30 to 33.

10.3.2 Laboratory test certificates as received from the laboratory are presented in Appendix L to this report.

Summary of degree of soils contamination (inorganics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in BLUE and assume a **residential with gardens** end-use.												
			pH	As ∞	B~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg*	Ni	Se	Zn$	Vn	CV	Asbestos
				37	5	26	4000	100	200	199	109	434	200	584	2	
TP211	0.1	Topsoil	7.1	17	0.6	0.3	16	25	43	0.1	15	0.7	32	63	-	N.D.
TP213	0.1	Topsoil	6.6	14	0.7	0.4	20	36	44	0.1	13	< 0.5	37	65	-	N.D.
TP201	0.1	Made Ground Topsoil	6.1	9.9	0.7	0.4	20	23	32	0.1	15	< 0.5	32	72	-	N.D.
TP202	0.1	Made Ground Topsoil	6.3	14	0.7	0.4	19	23	35	0.1	16	< 0.5	35	71	-	N.D.
TP208	0.1	Made Ground Topsoil	6.1	14	0.6	0.4	24	27	36	0.1	20	< 0.5	44	82	-	N.D.
TP209	0.1	Made Ground Topsoil	6.7	13	0.5	0.4	22	27	32	0.1	22	< 0.5	37	86	-	N.D.
TT204S	0.1	Made Ground Topsoil	7.4	14	0.5	0.3	23	27	33	0.1	20	< 0.5	37	72	-	N.D.
TT205SE	0.1	Made Ground Topsoil	5.9	11	0.5	0.4	20	24	30	0.1	17	< 0.5	34	74	-	N.D.
TT206C	0.1	Made Ground Topsoil	6.3	9.3	0.5	0.3	16	22	23	< 0.1	15	0.5	27	57	-	N.D.
TT209C	0.1	Made Ground Topsoil	5.7	11	0.7	0.4	22	22	28	0.1	15	< 0.5	40	69	-	N.D.
TP204	0.3	Reworked Natural Ground	8.2	7.9	< 0.2	0.2	16	32	19	< 0.1	41	< 0.5	17	93	-	N.D.
TP203	0.4	Reworked Natural Ground	7.7	11	0.3	0.2	20	24	19	< 0.1	21	< 0.5	28	66	-	N.D.
TP205	0.4	Reworked Natural Ground	6.6	8.1	0.2	0.2	21	27	16	< 0.1	20	< 0.5	28	62	-	N.D.
TP202	0.5	Reworked Natural Ground	7.7	7.3	0.3	0.2	18	22	21	< 0.1	21	< 0.5	27	65	-	N.D.
TP210	0.5	Reworked Natural Ground	7.7	10	0.5	0.2	18	23	23	< 0.1	20	< 0.5	27	67	-	N.D.
TP204	0.5	Burnt Shale	7.9	16	0.6	0.2	20	22	20	< 0.1	25	< 0.5	26	55	-	N.D.
TT205NW	0.5	Burnt Shale	8.1	14	0.6	< 0.1	15	19	12	< 0.1	19	< 0.5	19	40	-	N.D.
TT206SE	0.6	Burnt Shale	8.2	14	0.5	0.1	19	20	14	< 0.1	22	< 0.5	22	53	-	N.D.
TT209E	1.0	Burnt Shale	7.7	12	0.5	0.1	15	21	15	< 0.1	22	< 0.5	20	54	-	N.D.
TT208SE	0.4	Opencast Backfill	8.0	13	0.5	0.3	20	40	28	0.1	30	< 0.5	30	88	< 1.0	N.D.
TT209E	0.6	Opencast Backfill	8.1	9.3	0.4	0.2	18	36	21	< 0.1	37	< 0.5	21	92	< 1.0	N.D.
TP206	0.7	Opencast Backfill	7.9	6.7	< 0.2	0.2	21	37	18	< 0.1	40	< 0.5	23	94	< 1.0	N.D.
TP208	0.7	Opencast Backfill	7.9	7.9	< 0.2	0.1	21	37	17	< 0.1	42	< 0.5	19	92	< 1.0	N.D.
TT201SE	0.7	Opencast Backfill	7.6	6.3	< 0.2	0.2	17	34	22	< 0.1	36	< 0.5	17	91	< 1.0	N.D.
TP205	0.8	Opencast Backfill	7.7	13	0.3	0.3	20	43	21	< 0.1	31	< 0.5	25	79	< 1.0	N.D.
TP207	0.9	Opencast Backfill	7.8	7.4	< 0.2	0.1	18	32	21	< 0.1	32	< 0.5	19	70	< 1.0	N.D.

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in BLUE and assume a **residential with gardens** end-use.												
			pH	As ∞	B~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg*	Ni	Se	Zn$	Vn	CV	Asbestos
				37	5	26	4000	100	200	199	109	434	200	584	2	
TT204S	0.9	Opencast Backfill	7.6	7.2	0.5	0.2	21	35	29	< 0.1	31	< 0.5	30	91	< 1.0	N.D.
TT207C	0.9	Opencast Backfill	7.4	7.6	< 0.2	0.2	16	43	19	< 0.1	34	< 0.5	19	88	< 1.0	N.D.
TT206C	1.0	Opencast Backfill	7.8	15	0.5	0.3	18	40	30	< 0.1	24	< 0.5	26	70	< 1.0	N.D.
TP203	1.1	Opencast Backfill	7.7	9.1	0.3	0.2	16	33	19	< 0.1	29	< 0.5	25	75	< 1.0	N.D.
TT204S	1.5	Opencast Backfill	7.8	6.5	0.3	0.2	19	38	24	< 0.1	32	< 0.5	23	87	< 1.0	N.D.
TT207NW	1.6	Opencast Backfill	8.0	9.6	< 0.2	0.1	13	29	19	0.1	53	< 0.5	15	66	**3.5**	N.D.
TT202S	1.8	Opencast Backfill	7.8	5.7	< 0.2	0.2	15	31	15	< 0.1	31	< 0.5	19	86	< 1.0	N.D.
TP203	2.0	Opencast Backfill	9.0	5.3	< 0.2	0.1	15	32	14	< 0.1	30	< 0.5	16	78	1.4	N.D.

Key	
36	Parameter tested for and found to be in excess of Tier 1 value.
179	Parameter tested for and found to be > 5 x Tier 1 value.
12	Parameter tested for but not found to be in excess of Tier 1 value.
-	Parameter not tested for.
♣	Tier 1 Value is pH dependent.
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI Tier 1 would be 21mg/kg.
N.D.	No fibres detected (asbestos screen)

Source of guidance trigger level	
With the exception of those annotated with one of the symbols below (∞, $, ~), all Soil Screening Values in brackets above have been derived using CLEA v1.071.	
∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).
$	MAFF. Code of Practice for Agricultural Practice for the Protection of Soil, 1998.
~	Engineering judgement (Lithos). Boron is a phytotoxic, although most phytotoxic compounds can pose a risk to human health if sufficient concentrations are present. However, plants represent the most sensitive receptor, and a Tier 1 value which is protective of flora is therefore also protective of human health.
*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.

Summary of degree of soils contamination (organics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in BLUE and assume a **residential with gardens (and no cover)** end use					
			% TOC	PAH		TPH - C6 to C40		
				B(a)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				5	6	22	215	3299
TP211	0.1	Topsoil	6.9	0.1	< 0.1	-	-	-
TP213	0.1	Topsoil	5.8	< 0.1	< 0.1	-	-	-
TP201	0.1	Made Ground Topsoil	4.7	< 0.1	< 0.1	-	-	-
TP202	0.1	Made Ground Topsoil	3.0	< 0.1	< 0.1	-	-	-
TP208	0.1	Made Ground Topsoil	3.6	< 0.1	< 0.1	-	-	-
TP209	0.1	Made Ground Topsoil	2.7	< 0.1	< 0.1	-	-	-
TT204 S	0.1	Made Ground Topsoil	2.9	< 0.1	< 0.1	-	-	-
TT205SE	0.1	Made Ground Topsoil	4.2	< 0.1	< 0.1	-	-	-
TT206C	0.1	Made Ground Topsoil	3.7	< 0.1	< 0.1	-	-	-
TT209C	0.1	Made Ground Topsoil	4.6	< 0.1	< 0.1	-	-	-
TP204	0.3	Reworked Natural Ground	8.5	< 0.1	< 0.1	< 0.1	< 10	< 10
TP203	0.4	Reworked Natural Ground	1.3	< 0.1	< 0.1	< 0.1	< 10	< 10
TP205	0.4	Reworked Natural Ground	0.9	< 0.1	< 0.1	< 0.1	< 10	< 10
TP202	0.5	Reworked Natural Ground	0.9	< 0.1	< 0.1	< 0.1	< 10	< 10
TP210	0.5	Reworked Natural Ground	2.0	< 0.1	< 0.1	< 0.1	< 10	< 10
TP204	0.5	Burnt Shale	< 0.5	< 0.1	< 0.1	< 0.1	< 10	< 10
TT205NW	0.5	Burnt Shale	< 0.5	< 0.1	< 0.1	< 0.1	< 10	< 10
TT206SE	0.6	Burnt Shale	< 0.5	< 0.1	< 0.1	< 0.1	< 10	< 10
TT209E	1.0	Burnt Shale	1.0	< 0.1	< 0.1	< 0.1	< 10	< 10
TT208SE	0.4	Opencast Backfill	5.0	< 0.1	< 0.1	< 0.1	**820**	1538
TT209E	0.6	Opencast Backfill	1.7	< 0.1	< 0.1	< 0.1	< 10	< 10
TP206	0.7	Opencast Backfill	0.9	< 0.1	< 0.1	< 0.1	< 10	< 10
TP208	0.7	Opencast Backfill	1.9	< 0.1	< 0.1	< 0.1	< 10	< 10
TT201SE	0.7	Opencast Backfill	1.5	< 0.1	< 0.1	< 0.1	< 10	< 10

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in **BLUE** and assume a **residential with gardens (and no cover)** end use					
			% TOC	PAH		TPH - C6 to C40		
				B(a)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				5	6	22	215	3299
TP205	0.8	Opencast Backfill	1.2	< 0.1	< 0.1	< 0.1	< 10	< 10
TP207	0.9	Opencast Backfill	4.6	< 0.1	< 0.1	< 0.1	< 10	< 10
TT204 S	0.9	Opencast Backfill	2.4	< 0.1	< 0.1	< 0.1	< 10	< 10
TT207C	0.9	Opencast Backfill	3.6	< 0.1	< 0.1	< 0.1	< 10	< 10
TT206C	1.0	Opencast Backfill	2.9	< 0.1	< 0.1	< 0.1	**347**	561
TP203	1.1	Opencast Backfill	14.0	0.1	< 0.1	< 0.1	< 10	< 10
TT204 S	1.5	Opencast Backfill	2.0	< 0.1	< 0.1	< 0.1	< 10	< 10
TT207NW	1.6	Opencast Backfill	9.2	< 0.1	< 0.1	< 0.1	< 10	< 10
TT202 S	1.8	Opencast Backfill	1.4	< 0.1	< 0.1	< 0.1	< 10	< 10
TP203	2.0	Opencast Backfill	3.8	< 0.1	< 0.1	< 0.1	< 10	< 10

Key		Source of guidance trigger level	
60	Parameter tested for and in excess of Tier 1 concentration.	All Soil Screening Values in brackets above have been derived using CLEA v1.071. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
0.3	Parameter tested for but not in excess of Tier 1 concentration.	~	Assumes all GRO is aromatic fraction C7 to C8.
-	Contaminant not tested for.	◊	Assumes all DRO is aliphatic fraction C10 to C12.
		∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).

Inorganic determinands

10.3.3 Of the 34 samples of Topsoil and made ground analysed for inorganic parameters, all can be classified as uncontaminated.

10.3.4 These samples have been classified by comparison with Tier 1 Soil Screening Values for an end use including domestic gardens and any area where plants are to be grown (the most sensitive of proposed end-uses).

10.3.5 Current UK guidance regarding the statistical analysis of soil contamination data obtained during a site investigation is provided by CL:AIRE[1], and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

10.3.6 However, in the context of site investigation to assess the significance of contamination on brownfield sites which are typically underlain by heterogenous made ground, some remediation is almost always required (placement of soil cover, excavation of gross contamination etc). Consequently, in such circumstances, it is not usually necessary to demonstrate that made ground soils are "clean" and therefore there is no need to test large numbers of samples and undertake statistical analysis. Heterogenous made ground sample results can simply be compared directly with appropriate screening values (e.g. Lithos Tier 1 values).

10.3.7 The difference between the old and new approaches, including how Lithos apply the statistical assessment is detailed in Generic Note 04, included as Appendix A to this report.

10.3.8 Lithos can confirm that statistical assessment of the Reworked Natural Ground, Burnt shale and Opencast Backfill is not appropriate because:

- Made Ground is considered too heterogenous
- There are insufficient samples from each strata type to allow representative statistical assessment to be undertaken.

Calorific value

10.3.9 The calorific value of 15 samples of Opencast Backfill have yielded 13 results below the limit of detection (1.0 MJ/kg). The two samples which yielded results above this returned results of 1.4 MJ/kg and 3.5 MJ/kg.

10.3.10 Materials whose CVs exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn. Consequently, these results are not considered to be significant.

Asbestos

10.3.11 No asbestos fibres were identified in any of the 34 samples screened.

Organic determinands

10.3.12 This site is brownfield and underlain by a significant thickness of made ground. However, no significant inorganic contamination has been detected and therefore, the Tier 1 Soil Screening Values for organic compounds used in this report have been derived with reference to a CSM that assumes a residential with gardens end use, with no clean soil cover placed in gardens/landscaped areas (Lithos Scenario A).

[1] *CL:AIRE, 2020.Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.*

10.3.13 Lithos have used the CLEA model to derive risk-based screening values for hydrocarbons, in accordance with the methodology detailed by the TPHCWG, and reviewed by a UK workshop of experts with respect to UK adoption of the method.

10.3.14 However, these screening values assume a Soil Organic Matter (SOM) of 6% (equivalent to a TOC of 3.5%). Many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with lower screening values may be required.

10.3.15 In order to check the validity of Lithos' Tier 1 Soil Screening Values, the average TOC for each common fill type (beyond any areas of obvious hydrocarbon impact) have been determined.

Fill type	Typical TOC (%)	Comparison of soil results with revised screening value necessary?
Topsoil & Made Ground Topsoil	4.2	No
Reworked Natural Ground	2.7	
Opencast Backfill	3.7	
Burnt Shale	1.0	Yes, but no significant organic contamination was recorded in this soil type. All determinands well below "6%" screening value; most below limit of detection.

Hydrocarbons (TPH & PAH)

10.3.16 Given the previous uses of the site and absence of visual/olfactory evidence of any hydrocarbon contamination, only a simple banded TPH (cf full speciation) was scheduled on 24 samples.

10.3.17 TPH can be associated with a variety of sources and elevated TPH concentrations do not automatically infer a petroleum product is present; indeed the absence of petroleum products on this site is reflected in the preliminary conceptual model. TPH analysis will detect most hydrocarbons and is not restricted to those detailed within the TPHCWG reports.

10.3.18 Whilst not necessarily associated with a petroleum product, the significance of these hydrocarbons, with respect to health, should still be assessed. Providing no other sources are present on site (solvents, degreasers etc), it can be assumed that the most problematic compounds detected within the banded TPH screen are polycyclic aromatic hydrocarbons (PAHs).

10.3.19 The significance of PAHs can be determined by considering indicator compounds. In most cases, benzo(a)pyrene (BaP) is adopted as an indicator (due to the wealth of toxicological data available) and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food.

10.3.20 A C4SL toxicity assessment using the surrogate marker approach can be used to estimate the significance of a mixture of PAHs in soil, using toxicity data for indicator compounds within that mixture. Exposure to the indicator (or surrogate marker) is assumed to represent exposure to all PAHs in that matrix.

10.3.21 The elevated DRO hydrocarbons detected are at the heavier end of the range and are therefore not considered to be an inhalation risk. It is likely that the elevated concentrations are associated with isolated fragments of organic material within the Opencast backfill.

10.3.22 The sample profiles here are sufficiently similar to the toxicity study adopted for the C4SL assessment, and B(a)P concentrations are below Lithos' Tier 1 Value. Consequently, the hydrocarbons detected are unlikely to pose an unacceptable risk to end users, meaning remediation is not required.

10.3.23 Concentrations of B(a)P and naphthalene are below their respective Tier 1 Values, and therefore the DRO hydrocarbons detected are unlikely to pose an unacceptable risk to end users, meaning remediation is not required.

BS3882 Topsoil testing

10.3.24 The presence of visible contaminants, sharps (glass etc) was assessed by the Engineer in the field (inspection of initial trial pit arisings); none were identified. BS3882 considers visual contaminants to comprise 'undesirable potentially injurious foreign object(s) visible to the naked eye'.

10.3.25 The clay/sand/silt content of 5 topsoil samples have been determined to check compliance with BS3882[2] requirements.

10.3.26 It should be noted that this is a reduced suite of analysis, and no N-P-K etc. testing has been undertaken.

10.3.27 The results are summarised below:

Parameter	BS3882 Specification	TP211, 0.2m	TP213, 0.2m	TP207, 0.1m	TT206C, 0.2m	TP209, 0.2m
Retained on 2mm sieve	< 30%	2	10	13	9	11
Retained on 20mm sieve	< 10%	0	0	0	0	3
Retained on 50mm sieve	0%	0	0	0	0	0
Clay content	5 to 35%	32	**36**	33	**36**	34
Silt content	0 to 65%	39	41	39	43	41
Sand content	0 to 90%	27	13	15	12	14
Visible contaminants	< 0.5%	0	0	0	0	0

Note: Values in **bold** type fail the required specification for multipurpose topsoil

10.3.28 The clay content of 2 of the 5 samples tested slightly exceeded the maximum permissible level (36% *cf* upper threshold of 35%). However, the average clay content (34%) from the 5 samples is within the specified range.

10.3.29 The above results suggest that the topsoil at this site locally does not fully comply with the standards set out in BS3882. In terms of textural classification, the topsoil falls into the 'silty clay' class. This is likely associated with the underlying natural clay soils and Opencast Backfill – from which the topsoil has likely been derived by weathering, and which is likely to have been mixed with the topsoil by ploughing.

10.3.30 Further advice could be sought from an agricultural soils expert, but at this stage it seems likely that if existing topsoil is retained in proposed gardens, it will need blending with sand and manure to generate a more suitable material.

11 CONTAMINATION (QUALITATIVE RISK ASSESSMENT & REMEDIATION)

11.1 Summary of significant contamination

11.1.1 Topsoil or Made Ground Topsoil is present across the entire site. Testing suggests this is chemically suitable for re-use. However, it falls into the 'silty clay' textural class and therefore will either require blinding with 100mm of imported topsoil, of blended with sand to generate a more suitable material.

[2] *BS3882:2015. Specification for topsoil. Published by BSI Standards Limited.*

11.1.2 Deep made ground is present within the footprint of the former opencast which primarily comprises a veneer of Reworked Natural Ground underlain by Opencast Backfill (clay with gravel of coal, brick) to depths of up to 11m. Localised beds of Burnt Shale are present along the boundaries of the opencast.

11.1.3 Beyond the former opencast, a veneer of made ground is present which is typically less than 1m thick.

11.1.4 The made ground has been found to be essentially "clean" although it contains materials (e.g. coal, brick, glass, concrete, etc.), which would generally be considered undesirable as a near-surface material in garden areas.

11.1.5 No areas of significant organic (hydrocarbon) contamination have been identified.

11.1.6 No significant remediation should be necessary, but substantial preparatory works will be necessary to render the site suitable for development; see Section 15.2.

11.2 Revised conceptual ground model (contamination)

11.2.1 The Preliminary Conceptual Site Model has been amended in light of data obtained during the ground investigation, most notably with respect to the distribution of made ground and contaminants. A revised Conceptual Site Model is presented as Drawing 3407/10 in Appendix B.

11.2.2 With the exception of hazardous gas (see Section 122), no plausible contaminant linkages have been identified.

11.2.3 However, although the made ground has been found to be essentially "clean" (i.e. it has not yielded elevated concentrations of any contaminants), it does include "unsuitable" materials (e.g. they contain a significant proportion e.g. brick, coal, glass, concrete, etc).

11.2.4 Therefore, where residual made ground remains beneath garden and landscaped areas (i.e. not beneath hardstanding) a **450mm** thick surface cover of "clean" soil is recommended. This thickness is in accordance with NHBC Standards, Chapter 10.2, although any old foundations, concrete bases and similar obstructions should be removed from within 450mm of the finished ground surface in proposed garden areas.

11.2.5 Waterlogging of garden areas within 3m of the habitable parts of the home should be prevented by appropriate soil selection and management and if necessary, by drainage or other suitable means (NHBC Standards, Chapter 10.8.2).

11.3 Summary of potential contaminant linkages & mitigation

11.3.1 In terms of the proposed redevelopment, plausible contaminant linkages, and feasible remediation options, can be summarised as follows:

Receptors	Pathways	Contaminants	Plausible contaminant linkage? (and remediation options where required)
Buildings	Migration & accumulation of explosive gas	Methane	To be assessed on completion of monitoring and gas risk assessment

◊ transient risks to construction workers will be addressed by the adoption of appropriate health and safety measures in accordance with the Health and Safety at Work Act 1974 and regulations made under the Act including for example the COSHH Regulations.

11.4 Waste classification

11.4.1 Disposal of the made ground off site is generally not considered appropriate, economically viable, nor in line with current Government philosophy regarding sustainable development. However, some excess arisings may be generated by excavations for foundations, sewers etc. Disposal to landfill (or an appropriate soil / aggregate transfer station) may be the most practical solution, if redistribution and retention on site is not feasible.

11.4.2 Following excavation and stockpiling, sampling will be required prior to disposal.

11.4.3 As there is no WRAP protocol for soils, the characterisation, sampling and classification of soils arising from brownfield sites has been incorporated within the Environment Agency's Technical Guidance WM3[3]. Classification of soils as non-hazardous or hazardous in accordance with WM3 is quite a complex process, although it ultimately results in a simple classification as hazardous or non-hazardous. Note: inert is not a class under WM3; WAC testing is required to determine whether a waste soil can be considered inert.

11.4.4 If waste soil is classed as hazardous following classification under WM3, and destined for landfill, waste acceptance criteria (WAC) leachate testing will need to be undertaken. Similarly, if waste soil destined for landfill is classed as non-hazardous under WM3, and suspected to be inert, WAC leachate testing will need to be undertaken. However, non-hazardous soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required.

11.4.5 WAC analysis is different to the 'routine' laboratory testing (such as that included earlier in this Section) undertaken in order to determine hazardous properties. Lithos typically only include WAC analysis if significant off-site disposal (of soil classified as hazardous waste) is anticipated.

11.4.6 It is critical if material is to be exported from site that this is allocated an appropriate waste code, following the steps within WM3. Waste carriers transporting, and sites accepting, this material should have a corresponding code within their permits. It is the responsibility of those generating the waste (i.e. the site), to ensure that the waste is handled and disposed of appropriately.

11.4.7 Soil treatment facilities (STFs) provide an alternative to landfill. STFs are regulated by the Environment Agency and allow soils to be treated and screened (effectively recycled to be used at other sites). Export to an STF does not require WAC testing and suitability of various soil types will be dependent on material waste codes, which may be allocated after consideration of the data in Section 11 but will often need supplementing with further testing after soils have been stockpiled (see also advice in Section 15.3).

11.4.8 Most STFs are permitted to accept soils with waste code 17 05 04 (i.e. soils which do not exhibit hazardous properties). Lithos has a list of permitted STFs and can help identify one local to this development site.

11.4.9 With respect to **asbestos**, waste soils will be classed hazardous if the soil mass contains more than 0.1% asbestos fibres that are free and dispersed. However, WM3 states that where the waste contains identifiable pieces of asbestos (i.e. any particle of a size that can be identified as potentially being asbestos by a competent person if examined by the naked eye), then the waste is hazardous if the concentration of asbestos in the pieces alone is 0.1%. If a stockpile of soil contained rare fragments of broken asbestos-cement sheeting, the whole stockpile would be classed as hazardous unless all the fragments could be picked-out (even though the concentration of asbestos in the soil mass might be orders of magnitude less than 0.1%).

[3] *Technical Guidance WM3 – Guidance on the classification and assessment of waste. Environment Agency 2015*

11.4.10 Contractors exporting waste from the site should review the site investigation data and make their own assessment. Alternatively, Lithos could undertake this assessment once exported waste streams have been identified.

12 HAZARDOUS GAS

12.1 General

12.1.1 Consideration of the conceptual site model and potential linkages has enabled a preliminary qualitative assessment of risks associated with gas:-

Source	Receptors	Hazard	Pathway	Initial risk
On-site made ground	Human health	Asphyxiation & explosion	Vertical migration, ingress & accumulation	**Very low**: made ground essentially inert, with little degradable matter
	Buildings	Explosion		
Off-site landfills	Human health	Asphyxiation & explosion	Lateral migration, ingress & accumulation	**Low**: natural strata to at least 5m depth are generally of low permeability
	Buildings	Explosion		
	Buildings	Explosion		

12.1.2 The backfill encountered within the former Craven I opencast (north and west) has been found to be essentially inert, predominantly comprising reworked mudstone and clay, with no significant putrescible / anthropogenic materials.

12.1.3 The backfill encountered in the former Craven II opencast (far southeast), contained more anthropogenic material (brick, concrete, glass, metal) although still contained no significant amounts of putrescible materials.

12.1.4 Consequently, the gas generation potential of the Opencast Backfill material is considered to be very low.

12.1.5 In addition to the above, redevelopment proposals will require turnover and compaction of the made ground which will reduce permeability of surface materials and therefore decrease the potential for gas migration from depth to the surface.

12.1.6 However, given the need for groundwater monitoring for geotechnical purposes, monitoring wells have been installed in 15 boreholes across the site which will also be monitored for gas. Details of the installations are given on the borehole logs presented in Appendices H & I to this the report.

12.1.7 The generation potential of the gas source was initially considered to be Low and this has been confirmed by the monitoring results obtained. Consequently, in accordance with CIRIA Report C665[4], given the proposed residential end use, 9 visits have been scheduled over a 6-month period.

12.2 Scope of works

12.2.1 To date, monitoring of the wells for gas has only been possible on one occasion (post field work) due to adverse weather conditions in January / February 2022 (heavy storms & high winds) which are likely to have produced unrepresentative results.

12.2.2 During monitoring visits, a standard procedure will be followed in accordance with CIRIA guidance:

- Ambient oxygen concentration

[4] *CIRIA C665: Assessing risks posed by hazardous ground gases to buildings (2007).*

- Atmospheric temperature & pressure
- Methane, oxygen and carbon dioxide concentrations and flow rates using a Gas Data GFM436 infra-red gas analyser
- Standing water level using a dipmeter
- Ambient oxygen concentration (check for instrument drift)

12.3 Monitoring results

12.3.1 As discussed above, monitoring of the wells for gas has only taken place on one visit to date due to adverse weather conditions. The table below includes details of monitoring well response zones and first round of monitoring data.

Well	Response zone	Range of methane concentrations (% v/v)	Range of carbon dioxide concentrations (% v/v)	Range of steady flow rates (litre/hour)
BH201	2.0m to 7.5m (Opencast backfill)	ND	2.6	ND
BH202	2.0m to 5.0m (Opencast backfill)	ND	3.3	ND
BH203	2.0m to 9.0m (Opencast backfill)	ND	1.7	ND
BH204	1.7m to 9.8m (Opencast backfill)	-	-	-
BH205	3.0m to 10.0m (Opencast backfill)	-	-	-
BH206	2.0m to 9.0m (Opencast backfill)	-	-	-
BH207	1.5m to 4.0m (Opencast backfill)	ND	7.9	ND
PH102A	3.0m to 6.0m (Coal Measures)	ND	1.7	ND
PH105A	3.0m to 6.0m (Coal Measures & thin coal)	-	-	-
PH107A	3.0m to 6.0m (Opencast backfill)	-	-	-
PH108A	3.0m to 6.0m (Coal Measures)	ND	1.2	ND
PH110A	3.0m to 6.0m (Opencast backfill)	ND	6.8	ND
PH115A	3.0m to 6.0m (Coal Measures)	ND	0.8	ND
PH121A	3.0m to 6.0m (Opencast backfill)	-	-	-
PH122A	3.0m to 6.0m (Coal Measures & thin coal)	ND	0.4	ND

12.4 Discussion

12.4.1 Generic Note 05 in Appendix A outlines how monitoring results are interpreted.

12.4.2 A hazardous gas risk assessment incorporating all of the results will be issued on completion of monitoring, which is expected in August 2022.

12.5 Radon

12.5.1 Requirements with respect radon measures are set out in Building Regulations Approved Document C. Probability bandings (based on the proportion of properties in a given area that exceed the Action Level; currently 200 $Bq.m^{-3}$) are used to determine whether a property requires no, basic or full measures.

12.5.2 At present Approved Document C advocates basic measures for the probability banding 3% to 10% (full measures if >10%). However, Public Health England would like to see all new build include basic measures.

12.5.3 The Public Health England UK radon map and the Landmark report indicate that the site is in an area where **between 1% and 3%** of homes are estimated to be above the action level.

12.5.4 Consequently, basic radon protection measures are not required. However, in light of Public Health England advice, the Developer might consider providing all new dwellings with basic radon protection measures.

13 GEOTECHNICAL TESTING

13.1 General

13.1.1 A total of 51 samples of natural soil and made ground were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.

13.1.2 The geotechnical laboratory test results are presented in Appendix M to this report.

13.2 Atterberg limits

13.2.1 The plasticity indices (PI) of 51 samples of cohesive soil have been determined; results are summarised below.

Soil type	No. samples tested	Moisture content range % (average)	Range of Plasticity Indices % * (average)	Shrinkability
Reworked Natural Ground	5	10 to 31 (20)	18 to 32 (25)	Low to Medium
Opencast Backfill	34	8 to 28 (15)	N.P to 23 (15)	N.P to Medium
Cohesive Residual Soil	12	13 to 28 (20)	10 to 41 (25)	Low to High

* Modified where appropriate in accordance with Chapter 4.2 of the NHBC Standards.

N.P. Non plastic

Note. The term Shrinkability is equivalent to the term Volume Change Potential used in Chapter 4.2.

13.2.2 Of the 12 samples of natural cohesive soil tested, 11 returned a modified PI of less than 40% (i.e. low or medium shrinkability) with only a single sample returning a value of slightly greater than 40% (i.e. high shrinkability).

13.2.3 Of the 39 samples of made ground tested, 4 were found to be non-plastic with a further 3 samples returning modified Plasticity Indices of less than 10% (i.e. not shrinkable). However, given the number of samples tested, engineering observations of the material and the grading results (see Section 13.3), the Opencast Backfill should be regarded as shrinkable.

13.2.4 Therefore, for the purposes of foundation design, it is recommended that all cohesive soils be regarded as being of **Medium** shrinkability.

13.3 Particle size distribution

13.3.1 The grading of 13 samples has been determined by wet sieving and the results are summarised in the tables below:

Opencast Backfill

Sample & depth	Field description	% passing 37.5mm sieve	% passing 20mm sieve	% passing 2mm sieve	% fines	Material description (based on grading & plasticity)
TT206C, 0.8m	Slightly sandy, gravelly CLAY	94	90	62	38	Slightly sandy, gravelly CLAY
TT208SE, 0.9m	Slightly sandy, gravelly CLAY	91	84	59	42	Slightly sandy, gravelly CLAY
TT201SE, 1.2m	Slightly sandy, gravelly CLAY	79	71	51	36	Slightly sandy, slightly gravelly CLAY
TP207, 1.4m	Slightly sandy, slightly gravelly CLAY	91	84	64	43	Slightly sandy, gravelly CLAY
TP205, 1.6m	Very clayey, sandy GRAVEL	97	82	63	36	Slightly sandy, gravelly CLAY
TP208, 1.7m	Very clayey sandy GRAVEL	94	77	45	23	Clayey, sandy GRAVEL
TT207NW, 2.4m	Clayey, sandy GRAVEL	100	92	69	38	Clayey SAND & GRAVEL
TP203, 2.5m	Slightly sandy, gravelly CLAY	83	68	51	39	Slightly sandy, gravelly CLAY
TP207, 3.9m	Slightly sandy, very gravelly CLAY	75	66	48	37	Slightly sandy, gravelly CLAY

Cohesive Residual Soil

Sample & depth	Field description	% passing 37.5mm sieve	% passing 20mm sieve	% passing 2mm sieve	% fines	Material description (based on grading & plasticity)
TP201, 0.8m	Slightly sandy, slightly gravelly CLAY	100	92	65	44	Slightly sandy, gravelly, CLAY
TP212, 0.8m	Slightly sandy, gravelly CLAY	100	97	93	81	Slightly sandy, slightly gravelly CLAY
TP209, 1.0m	Slightly gravelly CLAY	100	100	93	82	Slightly sandy, slightly gravelly CLAY
TT205SE, 1.0m	Slightly sandy, gravelly CLAY	100	100	94	86	Slightly sandy, slightly gravelly CLAY

13.3.2 NHBC Chapter 4.2 considers shrinkable soils to be those containing more than 35% fines and having a Modified Plasticity Index greater than 10%.

13.3.3 Fines (silt and clay) were found to comprise between 23% and 43% (average 36%) of the Opencast Backfill sampled. Of the 34 samples tested, 27 returned a modified PI of greater that 10%. Therefore, the Opencast Backfill encountered on this site should therefore be regarded as shrinkable.

13.3.4 Additionally, all samples of Cohesive Residual Soil returned modified Plasticity Indices of greater than 10% and therefore, it can also be regarded as shrinkable.

13.4 Soluble sulphate and pH

13.4.1 In accordance with BRE SD1[5], this site has been classified as brownfield with a mobile groundwater regime.

13.4.2 It is envisaged foundations may extend to depths of between 9m and 15m (if piled foundations utilised) through made ground and natural strata and samples taken from this depth range have been submitted for pH and water-soluble sulphate (2:1 soil/water extract).

13.4.3 The concentrations of sulphate in the aqueous soil extracts of 56 samples of made ground and 12 samples of natural soil were determined. In addition, the pH value of each sample has also been determined.

13.4.4 Where 10 or fewer samples of a material type have been tested, the highest water-soluble sulphate concentration and the lowest pH value are reported in the table below. Where greater than 10 samples have been tested, the mean of the highest 20% of sulphate results and lowest 20% of pH results are reported.

Soil type	No. samples tested	Lowest pH value, or mean of lowest 20%	Highest soluble sulphate concentration, or mean of highest 20% (mg/l)
Reworked Natural Ground	10	6.9	673
Burnt Shale	4	7.7	690
Opencast Backfill	42	6.9	449
Cohesive Residual Soil	12	6.9	114

13.4.5 Of the 42 samples of Opencast Backfill tested, only a single sample returned a pH value of less than 5.5. Consequently, concentrations of chloride and nitrate are considered insignificant.

13.4.6 In accordance with Tables C1 and C2 of SD1, sub-surface concrete should be Design Sulphate Class **DS-2**, with the site allocated an ACEC Classification of **AC-2**. Where made ground is not present and concrete is only in contact with Cohesive Residual Soil, this could be revised to **DS-1** and **AC1**.

13.5 Compaction tests

13.5.1 Laboratory compaction tests are useful wherever ground improvement is anticipated, for example to provide a satisfactory CBR beneath proposed highways.

13.5.2 In accordance with BS5930[6] engineered fill is defined as material which is selected, placed and compacted to an appropriate specification so that it will exhibit the required engineering behaviour.

13.5.3 Grading and moisture content control the degree to which materials can be effectively compacted. If the grading or moisture content of an in-situ material is not suitable to facilitate its compaction then screening, wetting, or lime addition may be required.

13.5.4 Laboratory compaction testing was scheduled on 8 samples of Opencast Backfill and 4 samples of Cohesive Residual Soil (using a 4.5kg rammer) to determine their suitability for re-engineering.

[5] *BRE Special Digest 1 (2005) – Concrete in aggressive ground.*
[6] *BS5930 (2015) - Code of practice for ground investigations.*

13.5.5 Laboratory compaction tests are only appropriate if:

- At least 90% of the material passes the 37.5mm sieve; and/or
- At least 70% of the material passes the 20mm sieve

13.5.6 If particle sizes are only slightly in excess of the above limits, compaction tests can be useful in order to indicate target densities, but the results should be treated with caution and used for guidance only. However, if a particular material type is significantly coarser than the above limits allow, the results of laboratory compaction testing would be meaningless and a field trial would be necessary.

13.5.7 As detailed in Section 13.3, of the 8 samples of Opencast Backfill tested, two contained coarse material (greater than 37.5mm or 20mm) in excess of the limits specified in Section 13.5.5. All samples of Cohesive Residual Soil are considered suitable for testing.

13.5.8 The material particle density (Gs) is required in order to plot the 0, 5 and 10% air voids lines on the compaction graph for each material type.

13.5.9 The results are summarised in the tables below:

Opencast Backfill

Sample location & depth	Material description	Gs (Mg/m^3)	MDD (Mg/m^3)	OMC (%)	Allowable mc range for 95% MDD & <5% air voids	Typical in-situ moisture content (%)
TT206C, 0.8m	Slightly sandy, gravelly CLAY	2.57	1.94	11	11 to 15	14
TT208SE, 0.9m	Slightly sandy, gravelly CLAY	2.55	1.71	17	17 to 22	23
TT201SE, 1.2m	Slightly sandy, gravelly CLAY	2.69	1.86	15	14 to 20	15
TP207, 1.4m	Slightly sandy, slightly gravelly CLAY	2.65	2.02	10	9 to 14	13
TP205, 1.6m	Very clayey, sandy GRAVEL	2.20	1.68	13	12 to 17	9.4
TP208, 1.7m	Very clayey sandy GRAVEL	2.68	2.01	11	11 to 15	15
TT207NW, 2.4m	Clayey, sandy GRAVEL	2.30	1.67	15	14 to 20	15
TP203, 2.5m	Slightly sandy, gravelly CLAY	2.70	1.87	15	14 to 19	18

Samples shown as red falls outside the allowable moisture content range.

13.5.10 It is apparent that the in-situ moisture content of the Opencast Backfill is generally within the allowable moisture content range to achieve 95% MDD (4.5kg rammer) and less than 5% air voids. On this basis it is considered that this material is generally suitable for re-engineering.

13.5.11 The recorded moisture content range of Opencast Backfill from all testing is between 8% and 28%, but more typically between 10% and 20%, with no appreciable trend (increase or decrease) with depth.

13.5.12 Therefore, local correction of soil moisture contents should be allowed for during earthworks at this site, notably drying of the Cohesive Opencast Backfill.

13.5.13 Drying out of the opencast backfill will require careful management on site. They should be placed in sealed stockpiles during periods of wet weather, or while the site is unattended. During periods of favourable weather (ideally warm & windy) the soils should be spread in thin layers over as wide an area as possible and aerated by turning with an excavator. Alternatively, consideration could be given to lime modification, using nominal lime percentages of 0.5% to 2% (maximum).

13.5.14 However, as previously noted, some of the samples of Opencast Backfill tested were in excess of the criteria for the proportion of coarse material. Additionally, a significant proportion of this material was noted to contain cobbles and locally boulders in the field.

13.5.15 This material will be crushed and processed following recovery (which is not possible during the ground investigation) and that the above samples provide an initial overview only. Any material recovered, crushed and processed on site should be tested prior to placement.

Cohesive Residual Soil

Sample location & depth	Material description	Gs (Mg/m³)	MDD (Mg/m³)	OMC (%)	Allowable mc range for 95% MDD & <5% air voids	Typical in-situ moisture content (%)
TP201, 0.8m	Slightly sandy, slightly gravelly CLAY	2.71	1.84	15	15 to 21	19
TP212, 0.8m	Slightly sandy, gravelly CLAY	2.70	1.79	16	16 to 22	19
TP209, 1.0m	Slightly gravelly CLAY	2.70	1.88	14	13 to 19	17
TT205SE, 1.0m	Slightly sandy, gravelly CLAY	2.65	1.69	19	18 to 24	25

Samples shown as red falls outside the allowable moisture content range.

13.5.16 The in-situ moisture content of the Cohesive Residual Soil is generally within the allowable moisture content range to achieve 95% MDD (4.5 kg rammer) and less than 5% air voids. On this basis it is considered that this material is generally suitable for re-engineering.

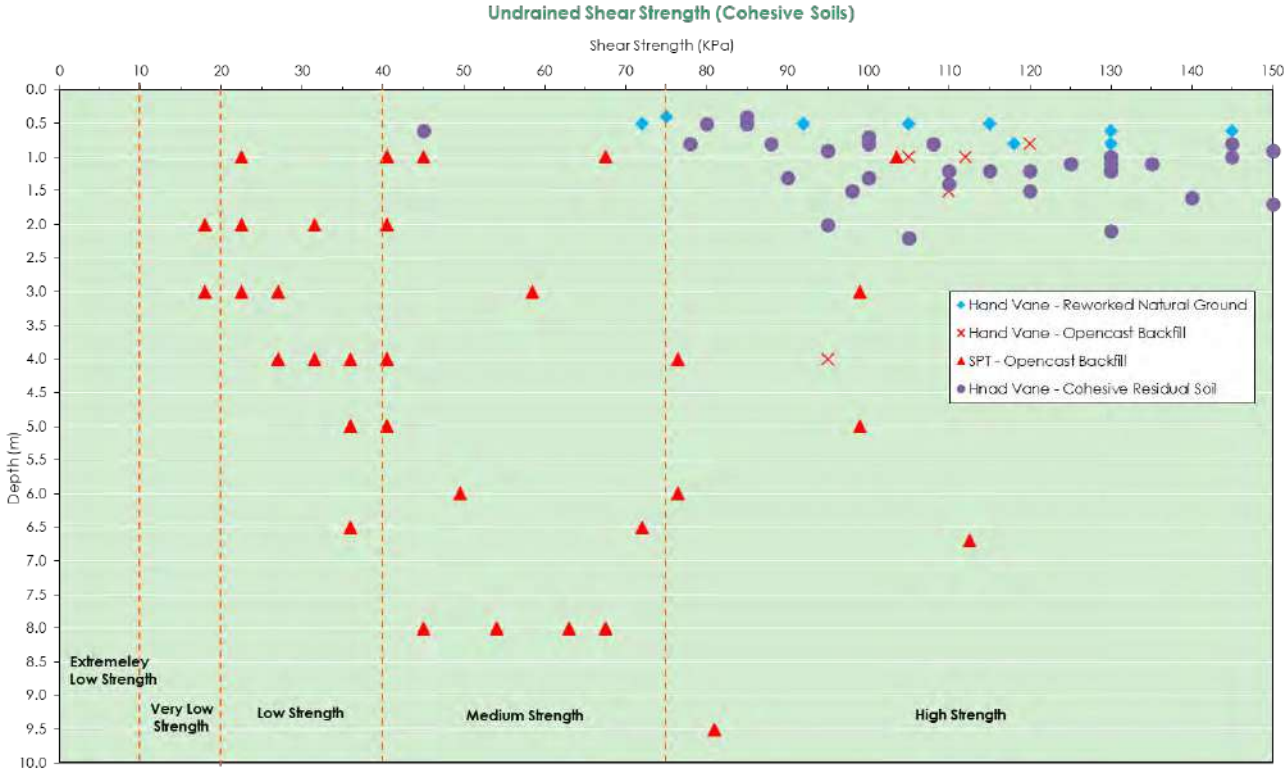
13.5.17 Acceptability of the made ground and natural soils for use in the proposed controlled earthworks will need detailed appraisal by the Earthworks Designer in light of the required performance characteristics.

13.6 Undrained shear strength testing

Hand shear vane testing

13.6.1 Hand shear vane testing was undertaken within trial pits in-situ to around 1.2m depth and from larger blocks of excavated clay below that depth. The Opencast Backfill was typically too gravelly to undertake hand vane shear testing.

13.6.2 The plot below provides a summary of undrained shear strengths.



13.6.3 The shallow Reworked Natural Ground recorded shear strengths of greater than 70kPa and was typically high strength, unsurprising given the origin of this material.

13.6.4 Hand shear vane testing carried out in the underlying Opencast Backfill typically recorded results of greater than 100kPa although given the gravelly nature of the clay only limited testing has been possible.

13.6.5 The Cohesive Residual Soil has been found to be typically of high strength with an undrained shear strength of greater than 70kPa. A single result (TP211 at 0.6m) recorded a lower shear strength of 45kPa (i.e. medium strength) although this is not considered to be representative of the material type and may be associated with an area of localised softening.

Standard penetration test (SPT)

13.6.6 An estimation of shear strength has been made by applying a correction factor to 'N' values from Standard Penetration Tests (SPTs) carried out in the Opencast Backfill during the drilling of cable percussion boreholes.

13.6.7 Stroud[7] published a range of correction factors for over consolidated clays based on the plasticity commonly ranging from 4.5 to 5.5. Therefore, Lithos have used a conservative value of 4.5 to convert SPT 'N' value to shear strength.

13.6.8 When results obtained from hand shear vane testing are combined with the calculated shear strengths from SPTs, the Opencast backfill appears to be highly variable in strength ranging from very low to high, as shown on the plot above.

13.6.9 The majority of the lowest values (i.e. 'N' values of <10) indicating very low or low strength were recorded at depths of between 2.0m and 5.0m depth. This may be associated with softening of the clay by groundwater.

[7] *The Standard Penetration Test – its application and interpretation. Penetration testing in the UK. M.A. Shroud. 1989.*

13.6.10 The average SPT 'N' value for tests carries out at depths of less than 2.0m and greater than 5.0m is N = 13 (i.e. medium strength), with several results greater than 75kPa.

13.7 Density

Standard penetration test (SPT)

13.7.1 The in-situ relative density of granular soils and strength of cohesive soils was established by carrying out Standard Penetration Tests (SPTs) at approximately meter intervals during the drilling of the cable percussion boreholes.

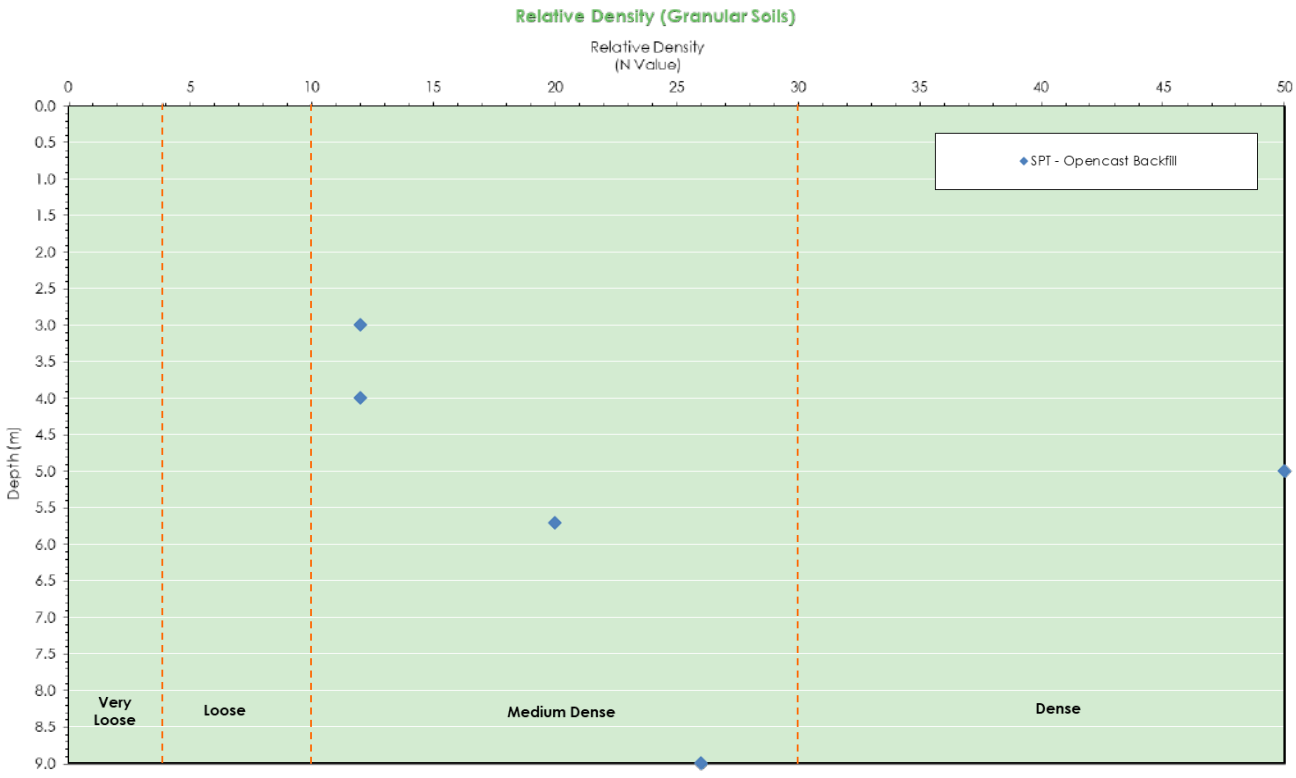
13.7.2 The SPT results are summarised in below:

Stratum	Ave. SPT 'N' value	Estimated strength or density	Remarks
Opencast Backfill	24	Medium dense (granular)	Only 5 results obtained

13.7.3 Only a limited amount of testing within granular Opencast Backfill was possible due to the limited occurrence of this material type. However, where testing was possible the granular soil was found to be typically medium dense.

13.7.4 The 'N' value of 50 recorded at 5.0m depth is likely to have been caused by a cobble or boulder within the Opencast Backfill and is therefore not considered representative of the stratum.

13.7.5 The plot below presents a summary of SPT 'N' values for granular soils.



13.8 Point load & UCS rock testing

13.8.1 UCS rock testing was undertaken on 5 samples of rock. In addition to each UCS value, the density of each sample has also been reported. Point load testing was undertaken on 15 samples of rock with each test undertaken along axial and diametral orientations where possible.

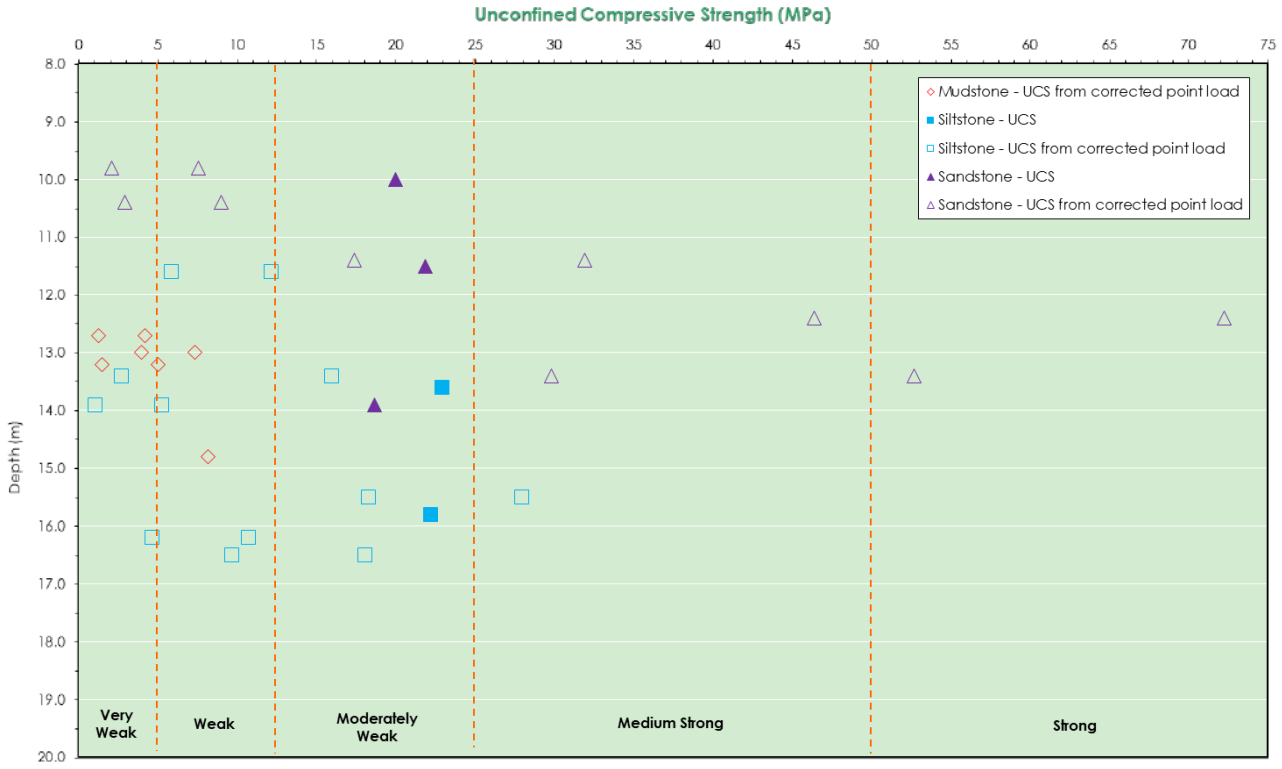
13.8.2 Samples submitted for point load testing were typically recovered from 'weaker' strata, whilst Unconfined Compressive Strength testing was typically carried out on 'stronger' samples.

13.8.3 Point Load testing in an axial orientation (i.e. vertical/perpendicular to bedding) produces a value for Is50 in MPa. This value is not a direct reflection on the strength of the in-situ rock due to the concentrated area of force applied to the rock sample by the testing tool (the point). In order to gain a value in MPa comparable to the strength of the rock sample, and directly equivalent to the unconfined compressive strength, a correction factor must be applied.

13.8.4 Whilst a variety of correction factors have been published. Mark and Rusnak[8] published a conversion factor of 21 following a case study of Coal Measures bedrock across North America.

13.8.5 Therefore, Lithos have adopted a correction factor of 21 to convert the Is50 into a uniaxial Compressive Strength equivalent in MPa.

13.8.6 The UCS from direct measurement and UCS derived from point load data is shown in the graphs below. The measured UCS for the Sandstone and Siltstone are broadly similar although the Sandstone shows a broader UCS range from corrected point load data.



[8] *Using the point load test to determine the uniaxial compressive strength of Coal Measure Rock. J Rusnak & C Mark. August 200. Proceedings on the 19th international conference on ground control in mining. Pgs. 362 - 371*

14 GEOTECHNICAL ISSUES

14.1 Conceptual site model

14.1.1 The north and west of the site (c. 1.9ha) is underlain by a backfilled opencast (former Craven I site) which has been found to be between 5.8m (west) and 11.9m (northeast) deep. The backfill typically comprises Made Ground Topsoil over Reworked Natural Ground (gravelly clay) to c. 0.6m depth, underlain By Opencast Backfill (gravelly clay).

14.1.2 Perched water within the backfilled opencast typically lies at 81mAOD in the west (c. 4mbgl) rising to 80.5mAOD in the northeast which is **artesian** (i.e. above existing ground level).

14.1.3 A small area in the far southeast (c. 350m^2) is also underlain by deep made ground associated with the former Craven II opencast which has been found to be up to 10.5m deep.

14.1.4 External highwalls associated with the former opencasts have been found to be cut at between c. 10° and c. 60°, but typically 45° to 50°. In the northeast of the Craven I opencast a shallow shelf (c. 4m depth) has been identified, with an internal highwall at c. 50° down to the base of the deeper opencast.

14.1.5 Land beyond the areas of backfilled opencast (east and south) are underlain by Cohesive Residual Soil (firm/stiff gravelly clay) and Granular Residual Soil (clayey gravel) to an average depth of 2.4m and 2.9m respectively.

14.1.6 Bedrock was encountered in all trial pits advanced beyond the backfilled opencasts at between 1.5m and 4.2m (average 2.9m) as weak Mudstone and Siltstone (locally Sandstone in the east). Bedrock at the base of the opencast comprises interbedded very weak Mudstone, moderately weak to medium strong Siltstone, and medium strong to strong Sandstone.

14.2 Mining

14.2.1 The majority of the site is located within a Coal Mining Development High Risk Area associated with the former Craven I and Craven II opencasts. Land beyond these in the south and east lie within a Coal Authority Low Risk area.

14.2.2 However, 4 shallow coal seams (Thin, Swallow Wood, Top Haigh Moor & Low Haigh Moor) are present beneath the site and therefore a mining investigation was undertaken.

14.2.3 The table below summarises the potential risks to surface stability associated with underground mineworkings at this site:

Coal Seam	Opencast (Y/N)	Typical cover ratio beneath opencast	Typical cover ratio beyond opencast	Remarks
Gawber	N	n/a	n/a	Seam not encountered beneath the site
'Thin'	Y	n/a	0 to 5	Seam removed by opencast
Swallow Wood	Y	n/a	9 to 15	Seam removed by opencast
Top Haigh Moor	N	c. 10	15 to 20	-
Low Haigh Moor	N	c. 17	17 to 25	-

Note: Competent cover highlighted red is <10x seam thickness and as such considered insufficient should the seam be worked (assuming seam thickness of: 0.6m (Thin coal); 1.1m (Swallow Wood Coal); 1.3m (Top Haigh); and 1.1m (Low Haigh).

14.2.4 It is clear that the only shallow coal seams to pose a risk to surface stability if worked are the '**Thin**' coal and the **Swallow Wood** coal, beyond areas of opencast extraction. However, the thickness of competent cover above the Top Haigh Moor within the area of opencast extraction (Craven I) would not always be suffice if piled foundations were to penetrate bedrock by more than c. 0.5m.

14.2.5 However, during Lithos' investigation **no** evidence of underground mineworkings was encountered in any of the coal seams. In addition, examination of the Coal Authority abandonment plans for the Craven I opencast suggest that no 'old', underground workings were encountered during opencast extraction in either of the 'Thin' or Swallow Wood coals.

14.2.6 Given the number of probeholes drilled, and the absence of any evidence of voids, broken ground, soft push or flush loss it is considered **highly unlikely** that the site is underlain by shallow mineworkings in the any of the shallow coal seams present beneath the site.

14.3 Opencasts

14.3.1 Approximately 40% of the site (north and west) is underlain by the former Craven I opencast which extracted the Thin Coal and Swallow Wood Coal. The majority of this area has been found to be between 5.8m and 11.9m deep, deepening from southwest to northeast. A shallow 'shelf' is present in the northeast, where only the Thin Coal has been extracted, and is between c. 3m and c. 6m deep.

14.3.2 Opencast Backfill has been found to typically comprise gravelly clay and clayey gravel with variable cobble and boulder content. Locally, beds of Burnt Shale are present along the eastern highwall.

14.3.3 Perched water in the Opencast Backfill is moderately shallow in the west (c. 4mbgl) which shallows towards the northeast where it becomes **artesian**.

14.3.4 A small area (<1% of total site area) in the far southeast is also underlain by deep made ground associated with the former Craven II opencast. Depths of made ground in this area are highly variable likely associated with obstructions encountered.

14.3.5 Trial trenches have been excavated in the north, centre and far south east, supplemented by lines of stitch drilling, in an attempt to delineate and characterise buried highwalls. The external highwalls have been located in close proximity to the recorded positions on Coal Authority abandonment plans, dipping at between 11° and 63° (typically 45° to 50°).

14.3.6 An internal highwall between the shallow 'shelf' and deeper opencast has been identified dipping at c. 48°.

14.3.7 The CA abandonment plan recorded the presence of a 'spur' in the east of the site, investigation in this area via trial trenching and rotary stitch drilling has found no evidence of its existence to depths of between 7.4m and 8.9m. Consequently, it appears this spur has either been extracted as part of the mining operations, or was possibly a ramp leading offsite to the west.

14.4 Ground improvement

14.4.1 Made ground currently underlies the areas of the former Craven I (north and west) and Craven II (far southeast) opencasts, to between 5.8m and 11.9m depth (average of 7.2) as shown on Drawing 3407/12.

14.4.2 This made ground is of variable and poor strength and is therefore not considered a suitable foundation material in its current state. It also contains materials (e.g. brick, concrete, coal, etc), which would generally be considered undesirable as a near-surface material in garden areas.

14.4.3 Given the substantial volume of made ground present, export to landfill is not considered economically viable.

14.4.4 Consideration should be given to turnover (excavation, screening and replacement in engineered layers) of the uppermost 2m of made ground beneath the site, assuming new plots are constructed on piled foundations. Should a ground bearing foundation solution be utilised, an increase thickness of turnover to a minimum of 3m will necessary, with compaction to an End Product specification required.

14.4.5 Turnover is considered an appropriate ground improvement solution since significant excavation of the made ground will be required in any case to remove obstructions (boulders).

14.4.6 Screened and engineered fill should yield CBR values in excess of 3%, thereby reducing abnormals associated with the construction of estate roads and car parking areas. Excavations through the engineered fill, for drainage etc and foundations will not encounter significant obstructions or grossly contaminated ground and should be stable (not accounting for groundwater) with little overbreak.

14.4.7 It should be noted that turnover earthworks will encounter **significant** water inflows and therefore dewatering is likely to be required.

14.5 Foundation recommendations

General

14.5.1 It is understood that consideration is being given to redevelopment of the site with two & three storey domestic dwellings, associated gardens, POS, adoptable roads and sewers.

14.5.2 A site layout showing 140 units has been provided by Countryside Properties (Drawing reference SKPY-004-A-PL-01 Rev. N, dated 12th January 2022) which is reproduced as Drawing 3407/2 in Appendix B to this report.

14.5.3 Foundation recommendations assume that development will be two or three storey construction and that line loads will not exceed 90kN/m run. If this is not the case significant alteration to these recommendations will be required.

14.5.4 We have assumed that final development levels will not differ significantly from ground levels existing at the time of investigation. Any digital terrain modelling undertaken, or commissioned, by Countryside Properties should consider implications for the foundation recommendations outlined below.

14.5.5 Foundation depths (and types) will depend on thicknesses of fill following the anticipated earthworks regrade.

14.5.6 Following the anticipated 2m turnover earthworks, replaced fill materials will not contain obstructions and should be relatively stable with little overbreak. At this stage, it is assumed that fill will be placed with nominal compaction only, and reinforced footings on engineered fill are not the preferred option.

14.5.7 If this is not the case, an increase thickness (3m minimum) of turnover will be required and an **End Product** specification for compaction prepared.

14.5.8 In its current state, made ground is not considered a suitable foundation material and foundations should therefore be taken through these materials into underlying natural strata of adequate bearing capacity.

14.5.9 Sub-surface concrete in contact with the **made and natural ground** should be Design Sulphate Class **DS-2**, with the site allocated an ACEC Classification of **AC-2.** Where made ground is not present and concrete is only in contact with **Cohesive Residual Soil**, this could be revised to **DS-1** and **AC1**.

14.5.10 Three main foundation solutions are considered likely to be most appropriate for two or three storey residential properties constructed on this site:

- Strip/trench-fill for plots located beyond the backfilled opencast
- Piles or rafts/doubly reinforced strips for plots located within the former opencast and **beyond** the zone of influence of buried highwalls
- Piles for plots located within the former opencast and **within** the zone of influence of buried highwalls. Where plots are beyond the highwall, but within the zone of influence of the buried highwall, the use of stiff rafts may be possible (subject to detailed design).

14.5.11 Any plot layout for this site should take account of the known highwalls.

Strip/trench fill footings

14.5.12 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for two or three storey houses constructed beyond areas of former opencasts. This solution is viable where the made ground is less than about 2.5m thick, and residual soils or competent rock is the founding material.

14.5.13 Reinforcement, as a precaution against differential settlement, is recommended only where foundation excavations encounter significant lateral and vertical variations in strata. One layer of B385 mesh placed 75mm above the base of the footing is likely to provide suitable reinforcement, but further advice should be sought from the Structural Engineer.

14.5.14 Foundations will be required to be placed below a line drawn up at 45° from the base of any service or similar excavation.

14.5.15 Deepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.3.

14.5.16 In order to minimise softening and swelling of cohesive soils or loosening of granular soils, it is recommended that footings are cast as soon as formation level is reached (or alternatively formation could be blinded using concrete with as low a water:cement ratio as possible).

14.5.17 Countryside Properties should review proposed plot designs and layouts, since deeper excavations for trench fill are likely to be unstable where the centre-lines of parallel trenches are closer than about 2m (assuming 600mm widths). Countryside Properties should supervise their groundworker to ensure footings are excavated in a controlled and safe manner.

14.5.18 Countryside Properties or their groundworker should seek further advice from Lithos if unexpected ground conditions are encountered in foundation or sewer excavations, including any conflict between soft ground associated with a backfilled trial pit excavation and the line of a proposed footing.

Cohesive Residual Soil

14.5.19 Atterberg tests suggest that natural cohesive soils at the site are of **medium** shrinkability. A minimum founding depth of 900mm (not accounting for any existing or proposed vegetation) is therefore required for all soils on the site where strip footings are proposed.

14.5.20 In accordance with NHBC Standards, founding depths in cohesive soils should be taken from original or finished ground level, whichever is the lower, to the underside of the footing.

14.5.21 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that up to 40% of the site area (beyond backfilled opencasts) may be affected by trees.

14.5.22 The current layout suggests some plots in the south will be built on ground from which hedgerows will be removed. Whilst the hedgerows at the site are relatively low (<2.5m height) and appear to have been maintained at that height by trimming, it is often difficult to definitively prove that they have not desiccated soils to significant depth. In theory, if mature Hawthorn is removed from within the footprint of a plot, founding depth (in medium shrinkability clay) would be >2.5m.

14.5.23 Granular Residual Soil or bedrock may be encountered at shallower depth which would be a suitable founding stratum. However, where this is not the case a foundation depth of greater than 2.5m would be required.

14.5.24 Trench fill foundations should be designed in accordance with NHBC Standards, Chapter 4.2. Heave precautions (a suitable approved compressible void former) should be used on the internal face of all external walls where the foundation is within the zone of influence of trees and greater than 1.5m deep.

14.5.25 Any trench fill foundation deeper than 2.5m will need to be designed by a Chartered Engineer, whose status is accepted by NHBC (NHBC Standards, Technical Requirement R5).

14.5.26 It would therefore be prudent to prepare a detailed foundation schedule and seek approval from NHBC in order to determine likely foundation abnormals.

14.5.27 A safe bearing capacity of around 150kPa, allowing a maximum foundation line load of 90kN/m run, can be assumed if the following are true

- A foundation length of 8m
- A foundation breadth of 0.6m
- A foundation thickness of 225mm
- A foundation depth of 0.9m depth
- An undrained shear strength of 70kPa for the firm clay (typical minimum recorded on site)

14.5.28 Assuming the foundation geometry detailed above, settlements of less than 25mm would be anticipated. This is considered likely to be acceptable. However, further advice should be sought from the Structural Engineer responsible for foundation design.

Granular Residual Soil

14.5.29 The weathered in-situ mudstone, siltstone and sandstone (sand, gravel and cobbles) is assumed to have a relative density of at least medium dense (in accordance with BS5930).

14.5.30 A safe bearing capacity of at least 150kPa, allowing a maximum foundation line load of 90kN/m run, can be assumed if the following are true:

- A foundation length of 8m
- A foundation breadth of 0.6m
- A foundation thickness of 225mm
- A foundation depth of 0.6m depth
- An angle of shearing resistance of ϕ=34° for the granular deposits

14.5.31 Assuming the foundation geometry detailed above, settlements of less than 25mm would be anticipated. This is considered likely to be acceptable. However, further advice should be sought from the Structural Engineer responsible for foundation design.

14.5.32 In accordance with NHBC Standards, a minimum founding depth of 450mm (due to potential frost susceptibility) is required in granular soils.

14.5.33 However, in order to reduce the risk of unacceptable amounts of settlement a minimum depth of 600mm is recommended at this site.

14.5.34 This depth should be taken from finished ground level to the underside of the footing. If finished ground level is to be above existing ground level then the foundation excavation simply needs to ensure that there is sufficient depth of excavation to allow casting of the footing entirely within natural ground (not made ground or topsoil).

14.5.35 However, if the excavation is dug from original ground level in cold conditions when freezing is expected, then foundation depth should be taken from the existing, not finished, ground level.

14.5.36 Where ground level is being raised, it would be prudent to proof roll the exposed granular soils after stripping topsoil (to mitigate any near-surface disturbance), and ideally fill should be placed prior to construction (otherwise the Developer will need to consider the potential for movement associated with placement of the fill).

14.5.37 It should also be noted that the footing may require deepening or stepping in order to allow plot drainage to exit the plot footprint (either over or under the footing).

Bedrock

14.5.38 The Coal Measures bedrock (mudstone, siltstone and sandstone) is generally considered to have a safe bearing capacity of at least 300kPa and minimal settlements would be anticipated.

14.5.39 Where rock is encountered at shallow depth foundations should be placed entirely on rock and not partially on rock and partially on soil. This may, depending on surface gradient, necessitate significant deepening of foundations.

14.5.40 Locally, bedrock at the site comprises mudstone which can be easily excavated using a backhoe excavator and will be recovered as a tabular gravel. Where in-situ mudstone is encountered at founding depth (minimum of 450mm), it will provide a suitable founding stratum for two or three storey dwellings and need only be penetrated by the proposed foundation thickness. Note: any overlying residual soil (typically clay with gravel-sized lithorelicts of mudstone) is likely to be a shrinkable soil; Mudstone is not.

14.5.41 Given the proximity to buried highwalls, it will be necessary for Plots 2 and 55 to 57 to be founded entirely on competent strata. It may also be prudent to excavate additional trial pits in these areas to confirm they are located beyond the highwalls.

Coal

14.5.42 Some excavations for foundations in the north and centre of the site (close to highwall locations) may come into contact with coal. Care should be taken not to unnecessarily overdeepen foundations, in order to minimise the chance of encountering coal.

14.5.43 Where foundation excavations do come into contact with coal, the foundation should be taken through the coal seam, into underlying natural in-situ strata of adequate bearing. The full thickness of coal should then be sealed with concrete to create a trench fill foundation. To prevent the ingress of air, the mass concrete fill should be placed as soon as possible after exposing the seam.

14.5.44 By virtue of the provisions of the Coal Industry Act 1994 interests in unworked coal and coal mines previously vested in the British Coal Corporation are now vested in the Coal Authority. The developer will need to contact the Coal Authority to dig or carry away such coal as they encounter in connection with redevelopment of the site (this is often referred to as incidental coal).

Piled foundations

14.5.45 At this stage, it should be assumed that plots constructed over buried highwalls will require a piled foundation solution. Additionally, piled foundations are likely to be the most robust foundation solution for plots constructed within the area of former opencast where deep made ground is present.

14.5.46 The following general comments relating to piling are provided for guidance, and further advice should be sought from a specialist-piling contractor. Piles are likely to be end bearing in bedrock.

14.5.47 The made ground locally contains significant **boulders** (up to c. 1.5m diameter), and the depths to competent bedrock vary significantly over relatively short distances. Obstructions may deflect or refuse piles during installation and there may be a need for pre-boring prior to pile placement.

14.5.48 Turnover (excavation, screening and replacement in engineered layers) of the uppermost 2m of made ground beneath the site is anticipated in order to remove shallow boulders. However, it will not be feasible to turnover the full thickness of made ground and therefore some boulders may remain at depth.

14.5.49 Away from buried highwalls, driven piles may be suitable although it should be noted driven precast concrete piles are likely to encounter problems with terminating on obstructions. An allowance would need to be made for changing piling locations and ground beam design to account for any difficulties encountered with piles terminating on boulders. Further advice should be sought from a specialist-piling contractor.

14.5.50 Given the presence of highwalls and variable depths to bedrock across the site (see Drawings 3407/11A and 3407/12), care should be taken to ensure that piles are not allowed to deflect off any steep under-ground gradients within the rock. This could be achieved by socketing and will likely require pre-drilling and casing of piles. An allowance should also be made for changing piling locations and ground beam design to account for any difficulties encountered with steep rock gradients associated with the former opencast.

14.5.51 Warranty providers generally require pile lengths to be at least 3m (measured from pile cut off level to pile toe level). Short piles are likely to become dislodged during pile trimming operations, creating additional costs associated with remedial works. Where depths to bedrock vary significantly beneath a plot, pre-boring of piles may be necessary to reach required depths.

14.5.52 Piled foundations should extend into the underlying bedrock. The safe working load that may be supported on a pile is dependent on the pile diameter, its founding depth and the method of installation.

14.5.53 Boreholes indicate that competent Coal Measures bedrock (mudstone, siltstone and sandstone) lies at depths of between 5.8m and 11.9m below current ground levels within the former opencast.

14.5.54 As piles would be founded in bedrock, they will be essentially end bearing, although there may also be some shaft adhesion in the engineered made ground.

14.5.55 Consequently, preliminary estimates for pile lengths in the order of 8m to 14m.

14.5.56 Given the presence of cohesive Opencast Backfill, it is essential that pile design allows for down-drag (negative skin friction).

14.5.57 In accordance with NHBC Standards, Chapter 4.2, heave precautions should be provided where a plot is within the zone of influence of trees. Table 3b in Chapter 4.2 defines the zone of influence as a function of tree height (between 0.5 and 1.25) dependant on the water demand. Figure 6 in Chapter 4.2 shows where heave precautions are required for pile foundations.

14.5.58 There is the potential for **settlement** of the ground in external areas around piled plots, and consideration should be given to mitigation, including:-

- Extending facing brickwork so that ground settlement does not result in exposing the underground portions of walls and foundations. Two additional courses should be more than adequate.
- Threshold issues
- Flexible connections (e.g. rocker pipes) in drainage and service pipes passing through the buildings.
- Ensuring drainage is laid with generous falls.

14.5.59 Driven piles may lessen the volume of potentially contaminated made ground requiring off-site disposal (cf arisings associated with say pre-boring). However, driven piles are likely to refuse on obstructions/boulders within the Opencast Backfill. In addition, driving can induce some ground vibration. Assessment of any vibration risk to adjacent structures and/or existing site features should be undertaken by pile designer.

14.5.60 Should any impenetrable shallow obstructions be encountered, i.e. boulders, the piling layout could be re-designed (although might also require design of foundations able to span and/or cantilever as necessary).

14.5.61 New houses can be built off ring beams designed to span the piles. In order to bond them to the piles, the tops of the piles must be broken out to expose the reinforcement, which can then be tied to that of the beams.

14.5.62 Ground conditions at this site are considered likely to require provision of a piling mat (working platform) and further advice should be sought from the appointed specialist-piling contractor regarding the proposed plant loadings and resulting pressures. This data, together with a knowledge of the strength and variability of the near-surface ground conditions is required in order that design of a mat can be undertaken in accordance with guidance provided in the 2004 BRE document, "BR 470: Working platforms for tracked plant".

14.5.63 The design of working platforms for tracked plant is a geotechnical design process and should be carried out by a competent person. The following parties should have input into the design:

- Permanent works designer, to consider additional uses for platform material as part of the overall development
- Principal contractor, to define any other purposes for which the platform might be used
- Contractor or subcontractor, to specify requirements for the platform, including gradients, ramps and edges

14.5.64 The number of plots affected by piling will depend on layout proposals and preferred foundation type, however, based on the current layout it is considered likely to be about 45% of the total number (assuming all plots within former opencast are piled).

14.5.65 Piles can provide an enhanced pathway for the vertical migration of mobile contaminants. The Environment Agency may therefore object to the adoption of piles as a foundation solution. However, objection is considered unlikely given the nature of the contamination encountered, and the fact that quarry backfill is currently resting directly on the underlying mudstone bedrock.

14.5.66 Pile design should be undertaken in accordance with the Environment Agency's guidance booklet "Piling into Contaminated Sites".

Reinforced strip or raft foundations (on engineered fill)

14.5.67 As discussed in Section 14.4, turnover of the uppermost 2m of made ground would be prudent in order to remove any obstructions/oversize and to improve the ground beneath plots and highways. However, this would not be sufficient to enable adoption of a ground bearing foundation solution.

14.5.68 As an alternative to piled foundations, doubly reinforced strip or raft foundations may be suitable for plots constructed within the area of former opencast (beyond the zone of influence of buried highwalls).

14.5.69 If this foundations solution is proposed, an increased thickness of turnover will be required beneath the footprint of plots. The uppermost 3.0m (minimum) of made ground should be excavated, screened and placed in engineered layers (turned over) to an **End Product** specification. Excavation and screening will enable the removal of obstructions/boulders, and any grossly contaminated soil/fill (not encountered to date).

14.5.70 The zone of influence for the buried highwalls encountered has been calculated in general accordance with BRE guidance[9], conservatively assuming there is the potential for significant vertical compression (Cotβ = 1). The overall width of the zone of influence and the offset from the crest of the highwall are summarised in the table below.

Location	Depth to crest of highwall (m)	Height of highwall (m)	Overall width of zone of influence (m)	Distance back from highwall to start of zone of influence (m)
Craven I				
North	3	8	12	0.85
Northeast	2	3	6	0.85
East	4	7	10.5	0.9
Internal highwall[1]	4.5	7.5	15	2.0
Craven II				
North	3	7	14	1.5

Note: [1] The internal highwall is associated with the 'shelf' located in the eastern part of Craven I opencast.

14.5.71 The calculated zone of influence is shown on Drawing 3407/14.

14.5.72 However, it should be noted that the any proposed earthworks / levels regrade will have an effect on the extent of the zone of influence and significant revision will likely be required once final levels have been determined.

14.5.73 The suitability of made ground for placement as engineered fill should be confirmed by field trials and laboratory testing.

[9] *BRE Building on fill: geotechnical aspects 3rd edition 2015 – Appendix D: Delineation of exclusion zone over a highwall*

14.5.74 The field trials should be carried out in accordance with Lithos' Specification for Engineered Fill. The field trial will enable estimation of tolerable settlement characteristics and an achievable safe bearing capacity, with a view to establishing new dwellings on raft foundations. It will also yield the following information:

- Number of passes with the compaction plant (to be used during subsequent earthworks)
- Maximum and minimum layer thickness (plant dependent)
- Acceptance criteria; minimum dry density and moisture content range

14.5.75 The engineered fill should achieve at least 95% maximum dry density (4.5kg rammer), with air voids comprising less than 5%; as determined by appropriate laboratory compaction tests (refer to Lithos' Specification for Engineered Fill).

14.5.76 Raft or beam-grillage design should be in accordance with NHBC Standards, Chapter 4.4. Granular sub-base product should be placed in accordance with Table 8/1 of the Highways Agency Specification for Highway Works (1998).

14.5.77 NHBC generally require any spread foundation on Opencast Backfill to be capable of achieving a minimum spanning capability of 3m and a minimum cantilever capability of 1.5m. For reinforced strip foundations, NHBC also require continuity of reinforcement across orthogonal beams, ensuring a "grillage type" (not a true grillage) arrangement with cross wall / stiffening beams.

14.5.78 For reinforced strip foundations, NHBC typically require the aspect ratios (in plan) of all 'cells' of the 'grillage' to be no greater than 2:1, to ensure there is sufficient rigidity to the foundation. The maximum permissible angular distortion (tilt) is typically 1:400.

14.5.79 Should any long terraces/blocks be proposed they should incorporate structural movement joints to mitigate the risk of differential settlement across the block/terrace.

14.5.80 NHBC generally recommend that rafts be founded on a minimum 150mm thickness of DoT granular sub-base product. Granular sub-base should extend laterally for at least 0.5m beyond the raft. The base of the granular sub-base must be at least 600mm below original or finished level, whichever is the lower. At most reclaimed brownfield sites, original level is generally equivalent to the top of engineered fill.

14.5.81 Where rafts are within the influence of mature trees, the depth of crushed stone placed should be equal to 50% of the trench fill foundation depth determined in accordance with NHBC Chapter 4.2.

14.5.82 Placement of blankets of a granular sub-base, directly on top of engineered fill would normally be acceptable immediately after placement of the final layer of fill. However, if placement is delayed, climatic factors can lead to a deterioration of the near surface fill.

14.5.83 Where the engineered fill is cohesive, rainfall, (softening) or sunshine (desiccation) may cause deterioration. Cohesive fill should therefore be "blinded" with granular sub-base within 48 hours of placement of the final layer of fill. Wherever this is not possible, it is recommended that a minimum 300mm depth of fill is excavated from beneath the plot footprint, prior to placement of the granular sub-base. Furthermore, it may be necessary to remove any desiccated material if the engineered fill is left exposed during a prolonged spell of dry weather.

14.5.84 Where the engineered fill is granular, deterioration may be caused by frost (unless the fill contains less than 10% fines). Granular fill should therefore be "blinded" with granular sub-base prior to frosty weather.

14.5.85 Given the timescales & costs involved with field trials to determine the viability of reinforced strip/raft foundations, and the need for an increased thickness of made ground turnover to enable the use of a ground bearing foundation solution in the former opencast, it may be more cost effective to pile all plots within the former opencasts.

Summary of foundation recommendations

14.5.86 In summary, the following foundation solutions are likely to be most appropriate (subject to Countryside Properties preferences regarding site preparatory works, final levels, timescales & costs associated with each foundation option).

Plot Nos	Foundation solution(s)	Remarks (influencing factors)
2 to 33, 48 to 61, 66 to 72 & 76 to 78	Strips/trench-fill at minimum depths of 0.9m in cohesive soil, or 0.6m in granular soils/bedrock	Medium shrinkability clays Deepened where necessary due to tree influence
34 to 47, 73 to 75 & 86 to 88	Trench-fill at greater than 2.5m depth in cohesive soil	Medium shrinkability clay and removed hedgerow Excavations may encounter granular soil/bedrock at shallower depth
1, 62 to 65, 79, 80, 84, 85, 89 to 91,, 126 to 129	Pre-bored piles socketed in bedrock at variable depths	Buried opencast highwalls
81 to 83, 92 to 115 to 117 to 125 & 130 to 140	Piles to about 8m to 14m, OR doubly reinforced strips/rafts on Engineered fill	Deep opencast backfill beyond influence of buried highwalls Field trials and increased thickness of turnover required to enable use of reinforced strips/rafts

14.5.87 A 'simple' foundation zoning plan is presented as Drawing 3407/14 in Appendix B.

14.5.88 Lithos could prepare a detailed Foundation Schedule if provided with: an External Works Drawing (with proposed FFLs & infrastructure details); a topographic survey; a tree survey; data from a 'tighter' grid of pits (due to the variable ground conditions encountered).

14.5.89 The foundation solutions outlined in the above table assume that ground levels will not change significantly from those existing at present. If this is not to be the case, further advice should be sought from Lithos.

14.6 Floor slabs

14.6.1 Floors for low rise housing (2-3 storeys) constructed on piled foundations typically utilise reinforced concrete ground beams which rest on pre-cast or in-situ pile caps. A suspended 'Beam and Block' ground floor is then usually constructed using concrete or polystyrene blocks placed between further concrete beams suspended across the ring beams.

14.6.2 Suspended floor slabs should be utilised where the depth of made ground or engineered stone exceeds 600mm in accordance with NHBC Standards Chapter 5.1 (to negate potential settlement problems).

14.6.3 It is estimated that the thickness of made ground is likely to exceed 600mm beneath at least 50% of the plots.

14.6.4 Where shallow foundations are within the influence of existing or proposed trees (and are underlain by shrinkable soils), NHBC require a suspended floor slab, with sub-floor void. The floor slab is most commonly a precast block and beam construction, but alternatively could comprise a suspended timber floor, or a slab cast on a suitable compressible void former. Ground-bearing and cast in-situ suspended slabs (other than those cast on a void former) are not acceptable where foundations are within the influence of trees.

14.6.5 In accordance with NHBC Standards Chapter 4.2, a minimum void height of 250mm should be adopted for a precast block and beam (or suspended timber) floor; this includes a 150mm ventilation allowance. If a suspended, cast in-situ slab (on a void former) is proposed, a minimum clear void height of 100mm should be adopted; of course, the actual thickness of the void former will be significantly greater.

14.6.6 Beyond the influence of existing or proposed trees, it is considered that the natural ground is generally suitable for the use of ground bearing floors. However, ground bearing slabs should not be cast on topsoil. Where plots are elevated for design reasons, the depth of engineered stone below a ground bearing slab should not exceed 600mm, in accordance with NHBC guidance.

14.6.7 The natural ground beneath this site includes cohesive soils and is therefore subject to seasonal variation in moisture content. If ground slabs were constructed on desiccated soil, heave of the slab would occur on re-hydration of the ground. If any significantly desiccated soil is present, a suspended floor slab, with sub-floor void will be required.

14.6.8 It should be noted that NHBC have suffered a significant number of claims resulting from the use of ground bearing floor slabs. Consequently, if ground bearing slabs are proposed, care should be taken to ensure correct and careful construction. For example, if fill to the internal face of the foundation excavation is not properly compacted, subsequent settlement can result in cracking of the slab.

14.6.9 In the unlikely event that coal is exposed beneath the floor void, it would be prudent to prevent air ingress and the potential for spontaneous combustion by blinding with concrete or removing the coal.

14.6.10 Floor slab design should be finalised/take account of the results of the gas monitoring and protection measures required, which will be detailed in Lithos' gas risk assessment, to be issued on completion of monitoring in August 2022.

14.7 Settlement of Opencast Backfill

14.7.1 Settlement of deep made ground, such as at this site, is initially (first 5 years or so) predominantly associated with consolidation, early creep and inundation. After this initial period, creep is usually the dominant mechanism.

14.7.2 **Consolidation** settlement is associated with a reduction in volume caused by expulsion of water from soil pores and transfer of load from excess porewater pressure to soil particles. Consolidation of opencast backfill under self-weight largely occurs during placement but may continue for a short period thereafter.

14.7.3 Such movements are likely to be variable between plots due to fill heterogeneity. Nonetheless, some predictions can be made using published coefficient of volume compressibility (Mv) correlations (e.g. Carter & Bentley 1991). The Opencast Backfill was found to be typically firm / medium dense, equating to a moderately compressible soil. The range of Mv used for this preliminary assessment is 0.1 to 0.25 m^2/MN. Loadings from proposed plots were initially estimated to be a maximum of c.100kPa.

14.7.4 **Creep** compression occurs as the particles of fill become more closely packed, under conditions of constant effective stress (arising from self-weight of the fill). Although the movements caused by creep can be relatively small, often it is these long-term movements that are of most interest to foundation performance. Shallow fills show an approximately linear relationship between settlement and the logarithm of the time that has elapsed since the fill was placed (i.e. settlement that occurs during the first 10 years is similar to that from years 10 to 100).

14.7.5 Using published data from ICE Earthworks; a guide 2nd Edition, which references Hodgetts et al. (1993), Hills and Denby (1996), the following range of alpha values are provided:

- Full scheme of backfill compaction, alpha = **0.2%**
- Partial backfill compaction, alpha = **0.4%**
- Uncompacted backfill, alpha = **0.8%**

14.7.6 Although the strength / density of the Opencast Backfill was found to be typically firm / medium dense, to allow for potential variability, and local differences, the ICE alpha values selected in this preliminary assessment are 0.4% (partial), 0.8% (uncompacted) and an average of the two values 0.6%.

For this preliminary assessment, t0, t1 and t2 were assumed to be 1952 (date of backfill), 2022 and 2082 respectively (allowing for NHBC's expected 60-year design life). The tables below provide a summary of the preliminary settlement assessment:

Depth of Fill (m)	Alpha α (%)			Potential creep settlement by 2082 (mm)			Initial compression & consolidation (mm)	
	Partial [C]	Uncompacted [C]	Ave [C]	Partial [C]	Uncompacted [C]	Ave [C]	Mv = 0.1 [D]	Mv = 0.25 [D]
12 [A]	0.4	0.8	0.6	15	25	20	15	35
7 [B]	0.4	0.8	0.6	10	15	12	15	35

Notes

[A] = Typical maximum depth of Opencast Backfill

[B] = Typical depth of Opencast Backfill

[C] = ICE Earthworks: a guide (2nd Edition) p62, partial compaction, no compaction and the average of partial and no compaction.

[D] = Carter & Bentley (1991) Table 5.1 - Firm Clays of Medium Compressibility

Depth of Fill (m)	Total potential settlement (mm)					
	α=0.4[C], Mv=0.1[D]	α=0.4[C], Mv=0.25[D]	α=0.8[C], Mv=0.1[D]	α=0.8[C], Mv=0.25[D]	α=0.6[C], Mv=0.1[D]	α=0.6[C], Mv=0.25[D]
12[A]	30	50	40	60	35	55
7[B]	25	45	30	50	27	47

Notes

[A] = Typical maximum depth of Opencast Backfill

[B] = Typical depth of Opencast Backfill

[C] = ICE Earthworks: a guide (2nd Edition) p62, partial compaction, no compaction and the average of partial and no compaction.

[D] = Carter & Bentley (1991) Table 5.1 - Firm Clays of Medium Compressibility

14.7.7 The above preliminary settlement assessment indicates that the potential range of total settlement for the deepest area of backfill post development over the 60-year design life of the properties is between c. 30mm and c. 60mm. In areas of typical backfill depths, the potential range of total settlement is between c. 25mm and c. 50mm.

14.7.8 Settlements of this magnitude are greater than is normally accepted by NHBC (25mm), however, on deep fille sites, there is an understanding that total settlement in excess of 25mm is not necessarily of concern, provided it is uniform, it is differential settlement that causes structural defects. Differential settlement will be of greatest concern in the highwall zone of influence (Drawing 3407/14), however, this will be mitigated via the use of a more robust foundation type. Away from the highwall zone of influence, differential settlement beneath individual plots is not expected to be more than c. 15mm (c. 25% of total maximum settlement).

14.7.9 The settlement predictions above should not be considered absolute, rather they represent predictions of the potential range of consolidation and creep settlement that may occur across the site, following construction of the proposed residential properties. Predictions will need to be verified by post earthworks monitoring.

14.7.10 Settlement due to **inundation** is caused by changes in the water table depth (e.g. groundwater rebound) and/or surface water infiltration. Given the time since the opencasting was complete (c. 70 years), groundwater rebound is expected to have reached equilibrium with pre-opencasting levels.

14.8 Designated concrete mixes

14.8.1 Designated mixes are considered in BRE SD1[10] and BS 8500[11]. However, in addition to soil chemistry (sulphate class), there are a number of other considerations relating to structural design that need to be taken into account when determining an appropriate concrete mix.

14.8.2 Consequently, Countryside Properties should seek advice from their appointed Structural Engineer.

14.9 Excavations

14.9.1 Based on the results of the investigation it is considered likely that major groundwater flows will be encountered in shallow excavations within the backfilled opencast, especially in the centre and north. Groundwater control over and above normal site pumping practices will be required for any excavations in excess of 1.0m deep.

14.9.2 Groundwater should be controlled in accordance with CIRIA Report R113[12].

14.9.3 Excavations beyond the former opencasts should remain stable in the short term but if left open for any significant period of time may require shoring most notably in granular soils.

14.9.4 The stability of even shallow excavations within the footprint of former opencasts is likely to be poor, most notably in saturated granular fill, and therefore allowance should be made for shoring.

14.9.5 Bedrock was encountered in all exploratory holes advanced beyond the footprint of former opencasts. Based on the exploratory hole logs, excavation greater than 4m is likely to prove difficult across about 50% of the site. It would therefore be prudent to allow for excavation of hard rock in any deep excavations such as those that may be required for drainage etc.

[10] *BRE Special Digest 1 (2005) – Concrete in aggressive ground.*

[11] *BS 8500-1&2:2015+A2:2019. Concrete. Complementary British Standard to BS EN 206. Method of specifying and guidance for the specifier (1) & Specification for constituent materials and concrete (2).*

[12] *CIRIA Report R113 (1986) - Control of Groundwater for Temporary Works.*

14.10 Drainage

14.10.1 Given the shallow perched/groundwater and significant thicknesses of made ground encountered on-site soakaway construction will be highly problematic. It should be noted that soakaways cannot be allowed to infiltrate into made ground due to the risk of settlement caused by wash out of fine soil particles.

14.10.2 Consequently, soakaways will not provide a suitable drainage solution for surface water run-off at the site. Consequently, it will be necessary to consider alternative sustainable drainage systems (SUDS), and there may be a need for surface water balancing.

14.10.3 Alternative SUDS options (see CIRIA C753[13] for further details) include:

- Swales – linear grassed features in which surface water can be stored or conveyed. Where suitable, swales can be designed to allow infiltration.
- Infiltration basins – vegetated depressions designed to store runoff and infiltrate it gradually into the ground.
- Pervious Pavements – provide a surface suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate into subsurface storage, with subsequent infiltration or controlled discharge. Pavement could be porous (water able to infiltrate across entire surface material; e.g. reinforced grass), or permeable (water infiltrates via joints between concrete blocks).
- Ponds – designed to have permanent pool of water, but with capacity to provide temporary storage-controlled discharge.

14.10.4 Yorkshire Water have published a guide[14] for developers and designers outlining their design requirements for surface water attenuation assets.

14.10.5 With respect to detention basins, which should normally be dry, water table levels should be taken from borehole monitoring wells over 4 consecutive seasons, for at least 3 points in the basin area. The detention basin should be designed to ensure that there is a minimum of 1m of unsaturated soil between the maximum groundwater level and the lowest part of the structure.

14.10.6 It is Lithos' understanding that ground does not have to be free-draining (i.e. sands/gravels), but where clay is present the basin needs to be designed to prevent waterlogging - because this renders maintenance (grass cutting) difficult. It would be prudent to seek confirmation of this from Yorkshire Water and/or the appointed drainage designer.

14.10.7 Appropriate design usually comprises a fall across the short axis (to centre of basin), and then along the long axis (possibly inclusive of a pipe in gravel trench) to the outfall.

14.10.8 The guide also discusses required access to flow control chambers, large diameter (i.e. >900mm) surface water storage pipes, and surface water storage tanks.

14.10.9 Land drains were encountered within the site investigation trial pits. Provision of surface drainage infrastructure will negate the need for field drainage. However, field drainage encountered during construction of the infrastructure works, should where practicable and where the layout allows, be maintained.

14.10.10 It is recommended that the developer contact Yorkshire Water Services with respect to capacity in existing foul and surface water sewers in the vicinity of the development area.

[13] *CIRIA C753 (2015) – The SuDS Manual.*

[14] *Design Requirements for Surface Water Attenuation Assets, February 2017.*

14.11 Highways

14.11.1 The routes, formation level and total length, of proposed estate roads are unknown and consequently, there was no merit in obtaining CBR values at this stage.

14.11.2 The natural soils present beyond former opencasts at shallow depth (anticipated formation) are predominantly cohesive. Based on visual inspection of the natural materials and the recorded plasticity indices at the site, published tables[15] indicate that the Cohesive Residual Soil would be expected to provide a CBR value of at least 3%. This value should be verified prior to or during construction.

14.11.3 Whilst the CBRs estimated above should be achievable, significant deterioration during/after periods of significant rainfall and/or site trafficking is likely. Consequently, it would be prudent to consider flexibility in the groundworks programme to enable highway construction during prolonged dry/warm weather (typically between May and September) when formation will be least vulnerable to deterioration. Alternatively, a minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) could be placed along the line of proposed highways to protect formation during the construction phase.

14.11.4 Deep made ground is present across north, west and far southeast with a veneer of made ground present elsewhere and consultation with the adopting authority, regarding the specification of the highways, is strongly recommended.

14.11.5 The Opencast Backfill is highly variable in terms of both composition, and strength/density. Furthermore, it often contains a significant amount of oversize (boulders etc) which represent potential 'hard-spots'.

14.11.6 Consequently, ground improvement will be required likely comprising excavation of the uppermost 2m (minimum) of opencast backfill and either:

- replaced with suitable aggregate in accordance with Series 600 (Earthworks) of The Highways Agency (HA) "Specification for Highway Works" 1998; or
- screened, to allow selection of suitable material, before being replaced in engineered layers (in accordance with Series 600). Unsuitable materials include any soft or wet materials, biodegradables including topsoil, wood, scrap metal, frozen material and oversize.

14.11.7 A specification will need to be agreed with the adopting authority, but at this stage, where any new highway spans an opencast 'high-wall', precautions to protect highway and drainage infrastructure from damage due to differential settlement will likely comprise:

- Excavation of Opencast Backfill over the full width of the adoptable highway to at least 1.0m below deepest sewer invert.
- Reinforcement of the excavation base, 5m either side of the high wall, with two layers of Tensar Triax TX160 (or equivalent) geogrid sandwiched within at least 300mm of suitable aggregate (i.e. nominally 75mm aggregate, geogrid, 150mm aggregate, geogrid and then another 75mm aggregate).

14.11.8 Some refinement of the above advice might be possible after highways design (with consideration of the proposed formation level cf existing ground level), and via inspection (and usually CBR testing) of the proposed formation during site preparatory groundworks.

14.11.9 Any residual made ground materials in the base of the excavation should be inspected and (where necessary) any soft spots removed and replaced with suitable engineered fill.

[15] *Interim Advice Note 73/06 Revision 1 (2009), Chapter 5. Characterisation of Materials Design Guidance for Road Pavement Foundations - Draft HD25*

14.11.10 Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.

14.12 External works

14.12.1 Any digital terrain modelling undertaken, or commissioned, by Countryside Properties should be made available to their Engineering Designer prior to issue of an External Works Drawing.

14.12.2 When designing retaining walls, consideration should be given clause 10.2.3 of NHBC standards which states that flexible retaining walls such as gabion and timber structures should not be used to provide support to homes, garages, roads, drives, car parking areas or drainage systems.

15 REDEVELOPMENT ISSUES

15.1 General

15.1.1 This report has presented options with respect to foundation solutions, re-use of topsoil etc that are considered technically feasible and in line with current good practice. Consequently, we would expect to obtain regulatory approval for whichever option is adopted, although this cannot be guaranteed. Copies of this report should be forwarded to the relevant regulatory authorities (Warranty Provider & Local Authority) for their comment/approval.

15.1.2 Even after an appropriate preliminary investigation and ground investigation, with exploratory holes on a closely spaced grid (say trial pits at 30m centres), a geoenvironmental appraisal is typically based on inspection of the ground underlying less than 0.5% of the total site area (and much less at depths in excess of about 3.5m). Consequently, there is always a possibility that unanticipated ground conditions will be encountered during the construction phase.

15.1.3 If unanticipated ground is encountered during the construction phase, the Contractor should immediately seek further advice from the Engineer.

15.2 Remediation strategy

15.2.1 Given the absence of any significant contamination, a remediation strategy is not considered necessary. Nonetheless, some preparatory works will be required.

15.2.2 Whilst a detailed remediation strategy report is unlikely to be required, preparation of a Remediation Statement would be prudent and should include:

- General background information, including site location, site description and a summary of ground investigation data
- An overview of existing constraints on development and the aims of the proposed remediation works
- Specific details of the anticipated site remediation/preparatory works
- Details of site supervision and verification
- A summary of implications for redevelopment

15.2.3 The Remediation statement will describe what is required, but not how it is achieved; the appointed Contractor would normally be expected to undertake an Options Appraisal, and then prepare a Method Statement.

15.2.4 The anticipated remediation works are summarised below:

- General site clearance of surface materials and vegetation

- Post diversion investigation of the ground beneath the existing overhead electric utilities which was inaccessible during the earlier investigations
- Crushing of all suitable artificial hard material (i.e. concrete/brick etc)
- Turnover (excavation, screening and replacement in engineered layers, with the type of compaction dependant on foundations) of the uppermost 2m (if piled foundations) of made ground to enable:
  - Inspection of the made ground
  - Removal of below ground obstructions
  - Preparation of the ground for highway construction
- Backfill of all resultant excavations, with appropriate compaction
- Re-grade of site to levels specified by Countryside
- Excavation of up to a maximum depth of 2m beneath proposed adoptable road footprints and controlled re-engineering of selected materials in layers to approximately 650mm below final road levels
- Provision of a minimum **450mm** thick cover layer of 'clean' soils in all garden and landscaped areas. Following re-engineering and removal of oversized materials from within the opencast backfill, the thickness of clean cover could be reduced to **300mm**.

15.2.5 If a ground bearing foundation solution is proposed within the backfilled opencast, the above works will require revision; most notably an increased thickness of turnover will be required (likely minimum of c. 3m) placed in accordance with an **End Product** specification.

15.2.6 Given the nature of preparatory works involved, preparation of an Earthworks Specification is considered essential.

15.2.7 The remediation contractor should survey reduced levels during the proposed turnover, prior to the placement of any fill.

15.2.8 Subsoil excavated from beyond the backfilled opencast (east and south) during the site preparatory works, is suitable for subsequent use as cover in gardens and landscaped areas, would be best placed during the construction phase; i.e. it should be left in stockpile(s) on completion of the site preparatory works.

15.2.9 A minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) could be placed along the line of proposed haul roads to provide a firm and stable running layer for the subsequent construction works.

15.2.10 It is strongly recommended that the earthworks contractor should chase-out all significant buried structures, and survey-in the resultant excavations before making them safe by backfilling.

15.3 Control of excavation arisings

15.3.1 Excavations into made ground may yield contaminated arisings. The groundworker should carefully segregate (and stockpile separately) made ground arisings from arisings of "clean" natural soils, in order that an excessive volume of unsuitable material is not generated.

15.3.2 The groundworker should appreciate the need for good materials management. Most notably the importance of not mixing different materials within a given stockpile; i.e. there should be separate stockpiles of: topsoil; concrete; excess clean, natural soil arisings; general construction waste etc.

15.3.3 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed. See also comments in Section 11.4 regarding asbestos.

15.3.4 Made ground arisings could be:

- Placed in area deliberately left low on completion of the remediation works in order to accommodate construction arisings
- Redistributed beneath concrete oversite, or areas of hardstanding, where they would be satisfactorily isolated from end users;
- Isolated beneath the 450mm thick cover layer in garden or landscaped areas
- Exported from site to a suitably licensed landfill facility

15.3.5 Natural ground arisings should be suitable for use as subsoil in the proposed soil cover.

15.4 Good practice guidance

15.4.1 The construction phase groundworker should follow good environmental practice to minimise the risks of spillage, leakage etc with reference, but not limited, to the following documents:

- CIRIA C741[16]
- EA Pollution Prevention Guidelines[17]:
  - PPG6 - Working at construction and demolition sites
  - PPG2 - Above ground oil storage tank
  - PPG7 – The safe operation of refuelling facilities.
  - PPG21 – Incident Response Planning

15.4.2 Site preparatory works associated with this project are likely to involve the re-use of both natural and made ground soils on site.

15.5 New utilities

15.5.1 It is strongly recommended that all statutory service bodies are consulted at an early stage with respect to the ground conditions within which they will lay services in order to enable them to assess at an early stage any potential abnormal costs.

15.5.2 Drainage and other utilities should not be placed within any coal seam; the seam should either be removed to below the base of the lowest service, or services should be placed in oversize trenches cut into the seam & backfilled with inert material.

15.5.3 Water Companies have a statutory duty to supply wholesome water, which could be compromised by the selection of an inappropriate pipe material. For example, compounds such as petroleum hydrocarbons and solvents can permeate commonly used plastics pipes, and/or corrosive chemicals can reduce the service life of metallic pipes. Guidance has been developed for the selection of pipes in brownfield sites and is contained in a UKWIR Report[18].

15.5.4 At the time of writing, significant preparatory earthworks are anticipated, and ground currently present along proposed supply pipe routes will almost certainly be redistributed. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance has not been undertaken.

15.5.5 However, given the site's history and the relatively consistent ground conditions reported, the use of 'standard' polyethylene water supply pipes should be acceptable, although Countryside Properties should consult Yorkshire Water at the earliest opportunity to confirm this.

[16] *CIRIA C741 (2015) - Environmental Good Practice on Site*
[17] *Whilst this has formally been withdrawn it can still be accessed via the EA archives and provides useful information on managing risks.*
[18] *UKWIR Report 10/WM/03/21 – 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'.*

15.6 Health & safety issues - construction workers

15.6.1 Access into excavations etc. must be controlled and undertaken in accordance with the CDM Regulations 2015, most notably Regulation 22, to mitigate risk of collapse or asphyxiation.

15.6.2 Before site operations are started, the necessary COSHH statements and Health & Safety Plan should be drafted in accordance with the CDM regulations.

15.6.3 The bulk of the made ground will be retained on site. Workers involved in excavations for foundations, drainage, utilities etc are likely to come into direct contact with the made ground.

15.6.4 Although workers will only be exposed to the soil for a relatively short time, simple precautionary measures are required, i.e. good personal hygiene and basic personnel protective equipment. See also comments in Section 11.4 regarding asbestos.

15.6.5 Consequently, during the remediation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. General guidance on these matters is given in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land".

15.7 Coal extraction

15.7.1 The Thin Coal (c. 0.7m thick) and Swallow Wood Coal (c. 0.8m thick) underlie the site typically at depths of less than 5m and c. 10m respectively.

15.7.2 Prior extraction of coal is encouraged by both the Coal Authority and Planning Authorities, largely because a potential mineral resource will not be sterilised by the development. However, it is worth noting that the UK market for coal is changing (driven by government carbon emission targets) – most notably very few power stations are still burning coal. Consequently, prior extraction of coal has become less attractive in recent times.

15.7.3 The majority of the site has already been subject to opencast coal extraction and consequently shallow coal of economic value has largely been removed from the majority of the site's area.

15.7.4 Consequently, it is considered unlikely that prior extraction of coal from this site would be economically viable.

15.8 Shallow coal in garden areas

15.8.1 Whilst there is no explicit guidance in NHBC Standards, liaison with NHBC suggests their stance is essentially the same as that they would apply to potentially combustible fills (such as Ash & Clinker). So where significant coal is present at very shallow depth in garden areas (uppermost 1m), it should either be removed, or covered with inert subsoil/topsoil so that it lies at greater than 1m depth.

15.8.2 In theory this could be an issue for about 10% of the total site area. However, given seam dip and topography it seems likely that coal will only be present at such shallow depth beneath less than 2% of the area.

15.8.3 The most pragmatic way of dealing with shallow coal in gardens will be to inspect foundation excavations, and where coal is recorded within the uppermost 1m or so then excavate an inspection pit in the rear garden. Further advice should be sought from Lithos during the construction phase.

15.8.4 As with foundation arisings, the developer will need to contact the Coal Authority to dig or carry away excavated (incidental) coal.

15.9 Potential development constraints

15.9.1 Significant deterioration of the surface is likely to be caused by trafficking, especially after topsoil has been stripped and during/after periods of significant rainfall. Consequently, it would be prudent to consider placement of a minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) along the line of proposed highways and any temporary haul roads to protect formation during the construction phase.

15.9.2 It would be prudent to allow flexibility in the groundworks programme to take advantage of any prolonged dry\warm weather (typically between May and September) to enable footings to be cast and blockwork brought up to DPC level well in advance of the build programme (i.e. so it is never necessary to dig deep footings in winter/early spring, when the groundwater table is likely to be higher).

15.9.3 The overhead electric cables present a potential development constraint unless they can be relocated. Additional enquiries are required to ascertain the feasibility of such diversionary works and the particular easement required by each service undertaker if they remain in-situ.

15.9.4 Deep opencast backfill (see Drawing 3407/12) is present beneath c. 40% of the site in the north and west, with buried highwalls have been identified around the perimeter. Foundation abnormals associated with this area are likely to be significant. It might be prudent to consider revision of the layout with some public open space over the backfilled quarry.

15.9.5 Groundwater control over and above normal site pumping practices will be required for any excavations in excess of 1.0m deep within the backfilled former opencast.

15.9.6 A watercourse (drainage ditch) flows east along the site's northern boundary. Therefore, it is recommended that a silt and surface water management plan be developed prior to construction activities commencing.

16 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

16.1 General

16.1.1 The site is located off Barugh Green Road, approximately 3km northwest of Barnsley town centre, and currently comprises grassed fields used as grazing pasture. The north and west of the site have been subject to extensive opencast workings (Craven I) with further opencast workings (Craven II) in the far southeast. The remaining site area has remained undeveloped throughout history.

16.1.2 It is understood that consideration is being given to redevelopment of the site with two & three storey domestic dwellings, associated gardens, POS, adoptable roads and sewers. A site layout showing 140 units has been provided by Countryside Properties.

16.1.3 The north and west of the site (c. 1.9ha) is underlain by a backfilled opencast (former Craven I site) which has been found to be between 5.8m (west) and 11.9m (northeast) deep. The backfill typically comprises Made Ground Topsoil over Reworked Natural Ground (gravelly clay) to c. 0.6m depth, underlain By Opencast Backfill (gravelly clay).

16.1.4 Perched water within the backfilled opencast typically lies at 81mAOD in the west (c. 4mbgl) rising to 80.5mAOD in the northeast which is **artesian** (i.e. above existing ground level).

16.1.5 A small area in the far southeast (c. 350m^2) is also underlain by deep made ground associated with the former Craven II opencast which has been found to be up to 10.5m deep.

16.1.6 External highwalls associated with the former opencasts have been found to be cut at between c. 10° and c. 60°, but typically 45° to 50°. In the northeast of the Craven I opencast a shallow shelf (c. 4m depth) has been identified, with an internal highwall at c. 50° down to the base of the deeper opencast.

16.1.7 Land beyond areas of backfilled opencasts (east and south) is underlain by Cohesive Residual Soil (firm/stiff gravelly clay) and Granular Residual Soil (clayey gravel) to an average depth of 2.4m and 2.9m respectively.

16.1.8 Bedrock was encountered in all trial pits advanced beyond the backfilled opencasts at between 1.5m and 4.2m (average 2.9m) as weak Mudstone and Siltstone (locally Sandstone in the east). Bedrock at the base of the opencast comprises interbedded very weak Mudstone, moderately weak to medium strong Siltstone, and medium strong to strong Sandstone.

16.2 Underground mining

16.2.1 The majority of the site is located within a Coal Mining Development High Risk Area.

16.2.2 The site is underlain by the Thin, Swallow Wood, Top Haigh Moor and Low Haigh Moor coals with no evidence of underground mineworkings encountered in any seam.

16.2.3 Given the number of probeholes drilled, and the absence of any evidence of voids, broken ground soft push or loss of flush, it is considered highly unlikely that the site is underlain by shallow mineworkings in the any of the shallow coal seams present beneath the site.

16.3 Opencasts

16.3.1 Approximately 40% of the site (north and west) is underlain by the former Craven I opencast which extracted the Thin Coal and Swallow Wood Coal. The majority of this area has been found to be between 5.8m and 11.9m deep, deepening from southwest to northeast. A shallow 'shelf' is present in the northeast, where only the Thin Coal has been extracted, and is between c. 3m and c. 6m deep.

16.3.2 Opencast Backfill has been investigated and found to typically comprise gravelly clay and clayey gravel with variable cobble and boulder content. Locally, beds of Burnt Shale are present along the eastern highwall.

16.3.3 Perched water in the Opencast Backfill lies at c. 4mbgl in the west which shallows towards the northeast where it becomes **artesian**.

16.3.4 A small area (<1% of total site area) in the far southeast is also underlain by deep made ground associated with the former Craven II opencast. Depths of made ground in this area are highly variable likely associated with obstructions (**boulders**) encountered.

16.3.5 Trial trenches have been excavated in the north, centre and far south east, supplemented by lines of stitch drilling, in an attempt to delineate and characterise buried highwalls. The external highwalls have been located in close proximity to the recorded positions on Coal Authority abandonment plans, dipping at between 11° and 63°, but typically 45° to 50°.

16.3.6 An internal highwall between the shallow 'shelf' and deeper opencast has been identified dipping at 48°.

16.3.7 The made ground within the opencasts locally contains significant **boulders** (up to c. 1.5m diameter), and the depths to competent bedrock vary significantly over relatively short distances.

16.4 Hazardous gas

16.4.1 The site is in an area where between 1% and 3% of homes are estimated to be above the radon action level. Radon protection is not required, but the Developer might consider providing new dwellings with basic measures in light of Public Health England advice.

16.4.2 Gas monitoring is currently underway to determine the need for special precautions against hazardous gas.

16.5 Contamination & remediation

16.5.1 Testing suggests Topsoil and Made Ground Topsoil is chemically suitable for re-use. However, it is locally too clayey and may therefore need to be blended with sand to generate a more suitable material.

16.5.2 Made ground present in the north and west of the site (predominantly Opencast Backfill) has been found to be essentially "clean" although it contains materials (e.g. coal, brick, glass, concrete, etc.), which would generally be considered undesirable as a near-surface material in garden areas.

16.5.3 Consequently, a minimum **450mm** thickness of clean topsoil / sub-soil will be required in all garden and landscaped areas. Following re-engineering and removal of oversized materials from within the opencast backfill, the thickness of clean cover could be reduced to **300mm**.

16.6 Preparatory works

16.6.1 Significant preparatory works will be required to render the site suitable for redevelopment, mainly associated with the backfilled opencast in the north and west.

16.6.2 Assuming a piled foundation solution, turnover of the uppermost 2m of made ground is required to remove relict obstructions and boulders and prepare the ground for highway construction. It should be assumed that excavations will encounter shallow groundwater and therefore dewatering will be required.

16.6.3 If a ground bearing foundation solution is to be used an increased thickness of turnover beneath proposed plots will be required, with an **End Product** specification for compaction prepared.

16.7 Foundations

16.7.1 Three main foundation solutions are considered likely to be most appropriate for two or three storey residential properties constructed on this site:

- Strip/trench-fill for plots located beyond the backfilled opencast
- Piles or rafts/doubly reinforced strips for plots located within the former opencast and **beyond** the zone of influence of buried highwalls
- Piles for plots located within the former opencast and **within** the zone of influence of buried highwalls. Where plots are beyond the highwall, but within the zone of influence of the buried highwall, the use of stiff rafts may be possible (subject to detailed design).

16.7.2 Pre-boring of piles will be required for plots located over buried highwalls to ensure piles do not deflect off any steep under-ground gradients within the rock.

16.7.3 Driven piles within the opencast may encounter problems with terminating on **boulders** in the Opencast Backfill.

16.8 Flooding

16.8.1 The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low.

16.9 Drainage

16.9.1 Due to high groundwater levels and the presence of deep made ground across the majority of the site, soakaways will not provide a suitable drainage solution for surface water run-off at the site. Consequently, it will be necessary to consider alternative sustainable drainage systems (SuDS), and there may be a need for surface water balancing.

16.10 Highways

16.10.1 Based on visual inspection of the shallow natural materials beyond the former opencast and published guidance, the Cohesive Residual Soil should provide a CBR value of at least 3%. This value should be verified prior to or during construction.

16.10.2 However, made ground is present across the north and west to depths of up to c.12m, and consultation with the adopting authority, regarding the specification of the highways, is strongly recommended.

16.10.3 Where made ground is present the uppermost 2m (minimum) should be excavated and either replaced with suitable aggregate, or screened, to allow selection of suitable material, before being replaced in engineered layers. Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.

16.11 Further works

16.11.1 Completion of the monitoring and completion and issue of a Hazardous Gas Risk Assessment.

16.11.2 Given the constraints discussed in Section 8.2 (existing overhead utilities), it may be prudent to advance additional trial pits in the linear belt on completion of diversionary works in order to remove residual uncertainties with respect to ground and provide more definitive recommendations with respect to foundations.

16.11.3 Preparation of a Remediation Statement.

16.11.4 Preparation of an Earthworks Specification.

16.11.5 Preparation of a Materials Management Plan (MMP) if import of materials is required.

16.11.6 Further settlement assessment once proposed final ground levels are known, taking into account areas of cut (net stress reduction) and fill (net stress increase).

Appendix A

General Notes

01 - Environmental setting
Generic notes – geoenvironmental Investigations

General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the "Search Responses" Appendix of this Geoenvironmental Report.

Geology, mining & quarrying

In order to establish the geological setting of a site, Lithos refer to BGS maps for the area, and the relevant geological memoir. Further information is sourced by reference to current and historical OS plans.

In July 2011, the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology. The CA, using its extensive records has prepared plans for all coalfield Local Planning Authorities, which effectively refines the defined coalfield areas into High Risk and Low Risk areas. **High Risk** areas are likely to be affected by a range of legacy issues that pose a risk to surface stability, including: mine entries; shallow coal workings; workable coal seam outcrops; mines gas; and previous surface mining sites. **Low Risk** areas comprise the remainder of the defined coalfield, and are areas where no known defined risks have been recorded; although there may still be unrecorded issues. Where a site lies within either a High or Low Risk area, a mining report is obtained from the CA.

Landfills

Reference is made to publicly available Government held digital data via **QGIS** (an Open Source Geographic Information System), data from Landmark or Groundsure, and sometimes the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site.

Historical OS plans are also inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Radon

Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite), and can move though fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, Lithos refer to BRE Report BR211[1], and the Public Health England website. Advice on the limitation of exposure of the population to radon in buildings was originally published in 1990 by the National Radiological Protection Board (NRPB), which joined the Health Protection Agency (HPA) in 2005; the HPA updated NRPB advice in July 2010[2]. The HPA became part of Public Health England in 2013.

The HPA recommended that the NRPB radon Action Level for homes be retained, and a new Target Level for radon in homes be introduced. The values of the Action Level and Target Level, expressed as the annual average radon concentration in the home, are 200 Bqm^{-3} and 100 Bqm^{-3} respectively. The Target Level was to provide an objective for remedial action in existing homes and preventive action in new homes.

The term 'radon Affected Area' is defined as those parts of the country with >1% of homes estimated to be above the Action Levels. The NRPB first indicated which parts of the country should be regarded as radon Affected Areas in 1990. A more detailed mapping method was developed by the HPA in conjunction with the British Geological Survey in 2007[3]. The level of protection needed is site-specific and can be determined by reference to this mapping on the Public Health England website, which indicates the highest radon potential within each 1km grid square. Each 1km grid square is classified on the basis of the percentage of existing homes within that grid square estimated to have radon concentrations above the Action Level. There are 6 'bands': <1%; 1 to 3%; 3 to 5%; 5 to 10%; 10 to 30%; and >30%.

The NRPB advised that action should be taken to reduce radon concentrations in existing homes if the radon concentration exceeded the Action Level of 200 Bqm^{-3} in room air averaged over a year; ten times the average UK domestic radon concentration. NRPB advice informed changes in the requirements for radon protection in new buildings.

- **Basic** preventive measures are required in new buildings, extensions, conversions and refurbishments if the probability of exceeding the Action Level is **>3%** in England and Wales, and >1% in Scotland and Northern Ireland.
- Provision for further preventive (**Full**) measures is required in new buildings if the probability of exceeding the Action Level is **>10%**.

At present Building Regulations Approved Document C advocates basic measures for the probability banding 3% to 10%, and full measures if >10%. However, Public Health England would like to see all new build include basic measures.

Action & Target Levels should also be applied to non-domestic buildings with public occupancy exceeding 2,000 hrs/yr and to all schools.

Hydrogeology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure with respect to:

- Groundwater quality
- Recorded pollution incidents
- Licensed groundwater abstractions

From April 2010 the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply), but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are split into two different types of aquifer designation:

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

The maps display the following aquifer designations:

Principal aquifers: These are layers of rock or superficial deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary aquifers: These include a wide range of rock layers or superficial deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into three types:

- **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
- **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers
- Secondary undifferentiated - In most cases, this is because the rock type in question has previously been designated as both a minor and non-aquifer in different locations due to the variable characteristics.

[1] BRE Report BR211, 2015: "Radon: guidance on protective measures for new buildings.

[2] Limitation of Human Exposure to Radon, Documents of the Health Protection Agency - Radiation, Chemical and Environmental Hazards, RCE-15. July 2010.

[3] Miles JCH, Appleton JD, Rees DM, Green BMR, Adlam KAM and Myers AH (2007). Indicative Atlas of Radon in England and Wales. Chilton, HPA-RPD-033.

Unproductive strata: These are rock layers or superficial deposits with low permeability that have negligible significance for water supply or river base flow.

The EA maps only display the principal and secondary aquifers as coloured areas. All uncoloured areas on the map will be unproductive strata. However, for uncoloured areas on the superficial (drift) designation map it is not possible to distinguish between areas of unproductive strata and areas where no superficial deposits are present; to do this, it is necessary to consult the published geological survey maps.

For the purposes of the EA's Groundwater Protection Policy the following default position applies, unless there is site specific information to the contrary:

- If no superficial (drift) aquifers are shown, the bedrock designation is adopted
- In areas where the bedrock designation shows unproductive strata (the uncoloured areas) the superficial designation is adopted
- In all other areas, the more sensitive of the two designations is used (e.g. If secondary superficial overlies principal bedrock, an overall designation of principal is assumed)

The EA have also designated groundwater Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone is a function of the aquifer, volume of groundwater abstracted and the effective rainfall, and may vary from tens to several thousand hectares.

Hydrology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure with respect to:

- Surface water quality
- Recorded pollution incidents
- Licensed abstractions (groundwater & surface waters)
- Licensed discharge consents
- Site susceptibility to flooding

The EA have set **water quality** targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality classification scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are 6 GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to **flooding** is assessed by reference to a Flood Map on the Environment Agency's website. These maps show natural floodplains - areas potentially at risk of flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas. There are two different kinds of area shown on the Flood Map:

1. Dark blue areas (Flood Zone 3) could be flooded by the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or by a river by a flood that has a 1% (1 in 100) or greater chance of happening each year
2. Light blue areas (Flood Zone 2) show the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Where there is no blue shading (Flood Zone 1), there is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

The maps also show all flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, or floods from the sea with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, older defences and defences which protect against smaller floods.

The Agency's assessment of the likelihood of flooding from rivers and the sea at any location is based on the presence and effect of all flood defences, predicted flood levels, and ground levels.

It should also be noted that as the floodplain shown is the 1 in 100 year, areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley, the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within a floodplain, it is recommended that a flood survey be undertaken by a specialist who can advise on appropriate mitigating measures; i.e. raising slab levels, provision of storage etc. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for: proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and any new development in Flood Zones 2 and 3.

COMAH & explosive sites

Lithos obtain information from Landmark or Groundsure with respect to Control of Major Accident Hazards (COMAH) or explosive sites within 1km of the proposed development site. Lithos' report refers to any that are present, and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise its emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH site may object to a proposed development (although it is the Local Authority who have final say, and they are likely to place more weight on advice from the HSE).

Preliminary conceptual site model

The site's environmental setting (and proposed end use) is used by Lithos to assess the significance of any contamination encountered during the subsequent ground investigation.

Assessment of contaminated land is based on an evaluation of pollutant linkages (source-pathway-receptor). Contaminants within the near surface strata represent a potential source of pollution. The environment (most notably groundwater), site workers and end users are potential receptors.

Potential pollutant linkages are shown on a preliminary conceptual site model (pCSM). A CSM is essentially a cross-section through a site that reflects both the surface topography and underlying geology, and shows surface features of interest. The most significant sources of contamination are then superimposed onto this cross-section together with potential receptors (human health & controlled waters), and plausible pathways between the two. In addition to environmental issues, the CSM should also highlight geotechnical issues.

A pCSM is prepared after consideration of all available "desk study" data, and before design of the ground investigation. Data reviewed should include historical plans (with superimposition on a current-day plan), previous SI reports, geological maps etc. The pCSM, in conjunction with knowledge of site constraints (buildings, services, slopes etc) is used to design the ground investigation.

The revised CSM takes account of data obtained during the ground investigation, including the distribution of made ground, the nature and distribution of contamination etc.

02 - Ground investigation fieldwork
Generic notes – geoenvironmental investigations

General

Lithos Ground Investigations are undertaken in accordance with current UK guidance including:

- BS5930:2015 "Code of practice for site investigation"
- Eurocode 7: BS EN 1997-1:2004. Geotechnical design - Part 1: General rules
- Eurocode 7: BS EN 1997-2:2007. Geotechnical design - Part 2: Ground investigation and testing
- BS10175:2013 "Code of practice for the identification of potentially contaminated sites"
- "Technical Aspects of Site Investigation" – EA R&D Technical Report P5-065/TR (2000)
- "Development of appropriate soil sampling strategies for land contamination" – EA R&D Technical Report P5-066/TR (2001)
- Contaminated Land Reports 1 to 6, most notably CLR Report No. 4 "Sampling strategies for contaminated land"
- "Guidance on the protection of housing on contaminated land" – NHBC & EA R&D Publication 66 (2000)
- AGS: 1996 "Guide to the selection of Geotechnical Soil Laboratory Testing"

Exploratory hole locations

Exploratory hole locations are selected by Lithos, prior to commencement of fieldwork, to provide a representative view of the strata beneath the site and to target potential contaminant sources identified during the preliminary investigation (desk study). Additional exploratory locations are often determined by the site engineer in light of the ground conditions actually encountered; this enables better delineation of the depth and lateral extent of organic contamination, poor ground, relict structures etc.

Investigation techniques

Ground conditions can be investigated by a number of techniques; the procedures used are in general accordance with BS5930: 2015 and BS1377: 1990. Techniques most commonly used by Lithos include:

- Machine excavated **trial pits**, usually equipped with a backactor and a 0.6m wide bucket. Allows a thorough inspection of the ground; especially the uppermost 1m or so (but able to reach depths of up to c. 4m), with the recovery of representative, disturbed samples. Also used to conduct soakaway testing.
- **Window or windowless** sampling boreholes (**dynamic sampling**). Constraints associated with existing buildings, operations and underground service runs can render some sites partly or wholly inaccessible to a mechanical excavator. In such circumstances, window sampling is often the most appropriate technique. A window sampling drilling rig can be manoeuvred in areas of restricted access and results in minimal disturbance of the ground (a 150mm diameter tarmac/concrete core can be lifted and put to one side). However, it should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material).
- **Cable percussive** (Shell & Auger) boreholes, typically using 150mm diameter tools and casing. Enables the recovery of soil samples and data from greater depth than is possible via trial pitting or a mini-percussive drill rig. Also enables the installation of better/deeper monitoring wells (cf use of a mini-percussive drill rig) due to the utilisation of temporary steel casing during drilling.
- **Rotary percussive** open-hole probeholes are typically drilled using a tri-cone rock roller or polycrystalline diamond compact (PDC) bit with air as the flushing medium. Probeholes are generally lined through made ground with temporary steel casing to prevent hole collapse. Often used to penetrate bedrock to investigate abandoned shallow mineworkings
- **Rotary cored** boreholes. A rock core is cut by a bit, passes up into the inner barrel and, at the end of the coring run, the core barrel assembly is lifted to the surface. Core drilling is relatively expensive, but essential if quality data is required to assess issues associated with deep excavation, rock slope stability etc.

Where installed, gas\groundwater monitoring **wells** typically comprise a lower slotted section, surrounded by a filter pack of 10 mm non-calcareous gravel and an upper plain section surrounded in part by a bentonite seal and in part by gravel or arisings. The top of the plain pipe is cut off below ground level and the monitoring well protected by a square, stopcock type manhole cover set in concrete, or the plain pipe is cut off just above ground level and the well protected by 100mm diameter steel borehole helmet set in concrete. Monitoring well details, including the location of the response zone and bentonite seal are presented on the relevant exploratory hole logs.

In-situ testing

Relative densities of granular materials given on the trial pit logs are based on visual inspection only, they do not relate to any specific bearing capacities.

The relative densities of granular materials encountered in cable percussive boreholes are based on Standard Penetration Test (SPT) results. SPTs are carried out boreholes, in accordance with BS 1377 1990, Part 9 Section 3.3. Where full penetration (600mm) is not possible, N values are calculated by linear extrapolation and are shown on the logs as N* = x. The strength of cohesive deposits is determined using a hand shear vane.

Shear strength test results (hand vane readings) reported on trial pit logs are considered to be more reliable than those reported on window sample logs. Significant sample disturbance occurs during window sampling and consequently shear strength results on disturbed window samples are generally lower than results obtained during trial pitting, in-situ or in large excavated blocks.

Sampling

Typically Lithos collect at least three soil samples from each exploratory hole, although in practice a greater number are often taken. The collection of a sufficient number of samples provides a sound basis upon which to schedule laboratory analysis, ensuring:

- A sufficient number of samples from each (common) site material are tested
- Horizontal and vertical coverage of the site is adequate, thereby providing a robust data set for use in the conceptual ground model
- Any localised, significant, but non-pervasive conditions are considered

Made ground and natural soils encountered in the field during a ground investigation often contain a significant proportion of coarse grained material (e.g. brick etc). Soil samples obtained during most investigations are often only truly representative of the in-situ soil mass where there is an absence of particles coarser than medium gravel; i.e the entire soil mass would pass a 20mm sieve.

Representative bulk samples of the **soil mass** are retrieved from coarse soils for specific geotechnical tests (most notably grading and compaction); this typically requires the collection of at least 10kg of soil, and occasionally >50kg. However, in the context of assessing land contamination, it is generally accepted that samples should be representative of the **soil matrix** of the stratum from which they are taken. Consequently, truly representative samples of coarse soils for subsequent contaminant analysis are not obtained - only the finer fraction is placed in sample containers. Coarse constituents not sampled would typically comprise any 'particles' with an average diameter greater than about 20mm (i.e. coarse gravel, cobble and boulder).

At present, neither ISO/IEC 17025 nor MCERTS specify sample pre-treatment with respect to stone removal. Unsurprisingly therefore UKAS accredited testing laboratories do not adopt the same approach to stones[1] – some crush and test the "as received" soil, whilst others sieve out stones and analyse only the residual soil (the sieve size used varies depending on the laboratory).

In essence, samples taken from coarser soils for contaminant analysis are "screened" by the geoenvironmental engineer in the field, and often sieved again by the laboratory during sample preparation. Geoenvironmental engineers do not typically re-calculate soil mass contaminant concentrations by taking account of the unsampled coarse fraction. Likewise, laboratories that remove stones typically report contaminant concentrations based on the dry weight of soil passing the sieve. In the context of land contamination and human health risk assessment, this is considered reasonable, because it is the soil matrix which is of greatest concern. Stones are unlikely to:

- Provide a significant source for plant uptake (consumption of vegetables)
- Remain on vegetables after washing (consumption of vegetables)
- Be eaten (accidentally by an adult, or deliberately by a child)
- Be whipped-up by the wind for dust generation (inhalation)
- Stick to the skin for any length of time (dermal contact)
- Yield toxic vapour (inhalation)

Consequently, Lithos instruct labs to remove all stones >10mm, and to report the results as dry-weight based on the mass of matrix tested. However, the laboratory are given site-specific instruction where coarse stones are coated in say oil, or impregnated with mobile contaminants such as diesel. Where the stones are predominantly natural, or inert (e.g. brick, concrete etc), removal will clearly result in higher reported concentrations, than if the stones were crushed and added to the matrix.

Where the stones include a significant proportion of contaminant-rich material (e.g. slag, fragments of galvanised metal etc) an argument could be made for crushing and analysing. However, provided the stones are stable (i.e. unlikely to disintegrate or degrade) they should not pose a significant risk to human health for the reasons stated above.

Sometimes it is necessary to obtain samples that are not representative of the wider soil matrix, for example when investigating localised, significant, but non-pervasive conditions. Any such unrepresentative samples are annotated with the suffix '*' (eg 2D*, or 4G*). Lithos' site engineer describes both the unrepresentative sample, and the soil mass from which it was been taken.

Sample Containers (for contaminant analysis). Samples of soil for contaminant testing are placed into appropriate containers (see below). Soil samples for organic analysis are stored in cool boxes, at a temperature of approximately 4ºC, until delivery to the selected laboratory.

Anticipated testing	Container(s)
Asbestos identification	1000ml plastic tub
pH & metals	1000ml plastic tub or 250ml glass jars
non-volatile organics	250ml glass jars
Speciated TPH	250ml & 50ml glass jars
VOCs (incl. naphthalene and\or GRO)	50ml glass jar

Sample Containers (for geotechnical analysis). The majority of samples are only scheduled for PI and sulphate testing, for which 500g of sample is required (a full 0.5-litre plastic tub). However, bulk bags are taken where scheduling of compaction or grading tests is proposed.

Groundwater

Where encountered during fieldwork, groundwater is recorded on exploratory hole logs. If monitoring wells are installed, groundwater levels are also recorded on one or more occasions after completion of the fieldwork. Long-term monitoring of standpipes or piezometers is always recommended if water levels are likely to have a significant effect on earthworks or foundation design.

It should be borne in mind that the rapid excavation rates used during a ground investigation may not allow the establishment of equilibrium water levels. Water levels are likely to fluctuate with season/rainfall and could be substantially higher at wetter times of the year than those found during this investigation.

Description of strata

Soils encountered during a Lithos investigation are described (logged) in general accordance with BS 5930:2015. The descriptions and depth of strata encountered are presented on the exploratory hole logs and summarised in the Ground Conditions section within the main body of text. The materials encountered in the trial pits are logged, samples taken, and tests performed on the in-situ materials in the excavation faces, to depths of up to 1.2m; below this depth these operations are conducted at the surface on disturbed samples recovered from the excavation.

[1] *Mark Perrin. Stoned – Sample Preparation for Soils Analysis. Ground Engineering, April 2007.*

03 – Geotechnical laboratory testing
Generic notes – geoenvironmental investigations

General

Soil samples are delivered to the laboratory for testing along with a schedule of testing drawn up by Lithos. All tests are carried out in accordance with BS 1377:1990. The following laboratory testing is routinely carried out on a selection of samples:

- Atterberg limits & moisture contents
- Soluble sulphate & pH

Where soft, cohesive soils are encountered, one-dimensional consolidation tests are scheduled in order to assess settlement characteristics, and unconsolidated undrained triaxial compression tests to assess shear strength.

The additional tests are typically only scheduled where significant earthworks regrade is anticipated:

- Grading
- Compaction tests
- Particle density

Test results are presented as received in an Appendix to the Geoenvironmental Report.

Atterberg limits & moisture content

The Liquid and Plastic Limits of samples of natural in-situ clay are determined using the cone penetrometer method and the rolling thread test. These tests enable determination of an average Plasticity Index (PI) for each "type" of clay, although judgement is applied where variable results are reported.

PI can be related to shrinkability (low, medium or high) and then to minimum founding depth. Lithos typically only consider a soil to be shrinkable if the proportion finer than 63µm is >35%. PI results are compared against guidance given in the NHBC Standards, Chapter 4.2 (revised April 2003), which advocates the use of modified Plasticity Index (I'p), defined as:

I'p = Ip * (%< 425µm/100)

i.e. if PI is 30%, but the soil contains 80% < 425µm, then: I'p = 30 * 80/100 = 24%.

It should be noted that in accordance with the requirements of BS 1377, the % passing the 425µm sieve is routinely reported by testing labs. Lithos apply engineering judgment where PI results are spread over a range of classifications. Consideration is given to:

- The average values for each particular soil type (ie differentiate between residual soil and alluvium)
- The number of results in each class and
- The actual values

Unless the judgment strongly indicates otherwise, Lithos typically adopts a conservative approach and recommends assumption of the higher classification.

Soluble sulphate and pH

Sulphates in soil and groundwater are the chemical agents most likely to attack sub-surface concrete, resulting in expansion and softening of the concrete to a mush. Another common cause of concrete deterioration is groundwater acidity.

The rate of chemical attack depends on the concentration of aggressive ions and their replenishment at the reaction surface. The rate of replenishment is related to the presence and mobility of groundwater.

Lithos refer to BRE Special Digest 1 (SD1) "Concrete in aggressive ground. Part 1: Assessing the aggressive chemical environment" (2005). SD 1 provides definitions of:

- The nature of the site (greenfield, brownfield or pyritic)
- The groundwater regime (static, mobile or highly mobile)
- The design sulphate class (DS class) and
- The aggressive chemical environment for concrete (ACEC class)

Lithos reports clearly state each of the above for the site being considered.

The concentrations of sulphate in aqueous soil/fill extracts are determined in the laboratory using the gravimetric method. The results are expressed in terms of SO_4 for direct comparison with BS 5328:1997. The pH value of each sample was determined by the electrometric method.

SD1 also discusses determination of "representative" sulphate concentration from a number of tests. Essentially if <10 samples of a given soil-type have been tested, the highest measured sulphate concentration should be taken. If >10 samples have been tested, the mean of the highest 20% of the sulphate test results can be taken. With respect to groundwater, the highest sulphate concentration should always be taken.

With respect to pH (soil & groundwater) the value used is the lowest value if <10 samples have been tested and the mean of the lowest 20% if >10 samples have been tested.

Oedometer (Consolidation) tests

Oedometer tests measure a soil's consolidation properties, and are performed by applying different loads to a soil sample and measuring the deformation response. Typically the sample is subject to 5 incremental pressures (4 loading & 1 unloading), and the convention is for each subsequent pressure to be double the previous pressure. BS1377 suggests the **initial** pressure should be:

a) For stiff soils the effective overburden pressure*
b) For firm soils "somewhat less" than the effective overburden pressure
c) For soft soils "appreciably less" than the effective overburden pressure, usually 25 kPa or less
d) For very soft soils very low, typically 5 kPa or 10 kPa

* Effective **overburden pressure** (kNm^{-2}) = depth (m) x soil bulk unit weight (kNm^{-3})

Results from these tests are used to predict how a soil in the field will deform in response to a change in effective stress.

Triaxial tests

This test measures the mechanical properties of a soil by placing the sample between two parallel platens which apply stress in one (usually vertical) direction, with fluid used to apply a confining pressure in the perpendicular directions. During the test, the surrounding fluid is pressurized, and then stress on the platens is increased until the material in the cylinder fails.

From triaxial test data, it is possible to extract fundamental material parameters, including its angle of shearing resistance, apparent cohesion, and dilatancy angle. These parameters are then used in computer models to predict how the material will behave in a larger-scale engineering application.

Quick (single stage, Unconsolidated, Undrained tests) are most appropriate for foundation design. This is because load is applied relatively quickly, and shear strength of the clay will be lowest initially; after the applied load causes some consolidation of the ground (after drainage results in dissipation of short-term excess pore water pressure), the in-situ clays will become progressively stronger and hence the factor of safety will increase. Confining pressure is specified as equivalent to overburden pressure (kNm^{-2}).

Foundations on granular soils would use effective shear strength parameters (c' and phi') to assess safe bearing capacity, as the soil would fully drain quickly. These effective shear strength parameters could be determined from Consolidated Undrained (or sometimes the more expensive Consolidated Drained) triaxial tests, but often correlations to the SPT are used.

Unconsolidated Undrained triaxial tests are most appropriate for assessment of the stability of fill slopes on clays. Similar to foundations, the application of load gradually increases the strength of the clays and hence the critical case is the short term undrained condition.

Consolidated Undrained (or sometimes **Consolidated Drained**) triaxial tests are most appropriate for assessment of the stability of cut slopes in clays. This is because unloading of the ground leads to short term reduction in pore pressures that approximately balance the unloading, hence the soil strength is largely unchanged. Over time the reduced pore pressures suck water in, which leads in to the progressive increase in pore pressure and loss of strength. The fully drained state is critical, which must be modelled using effective strength parameters and a reasonable estimate of the long term water table conditions.

Slopes formed in granular soils would use effective shear strength parameters (c' and phi') to assess safe bearing capacity, as the soil would fully drain quickly. These effective shear strength parameters could be determined from Consolidated Undrained (or sometimes the more expensive Consolidated Drained) triaxial tests, but often correlations to the SPT are used.

Determination of analytical suite

An assessment of potential contaminants associated with the former usages of the site is undertaken with reference to CLR 8 "Potential contaminants for the assessment of land" and the relevant DETR Industry Profile(s).

Common contaminants

Common **Inorganic** Contaminants include:

- Metals, most notably cadmium, copper, chromium, mercury, lead, nickel, and zinc
- Semi-metals, most notably arsenic, selenium, and (water soluble) boron
- Non-metals, most notably sulphur
- Inorganic anions, most notably cyanides (free & complex), sulphates, sulphides, and nitrates

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

Total cyanide (CN) is determined by acid extraction; whereas free cyanide is the water soluble fraction. Complex cyanide is "bound" in compounds and is hard to breakdown. Laboratory determination of complex CN involves subjecting the sample to UV digestion for determination of both free and total CN.

Thiocyanate (SCN) is a different species combined with sulphur.

Elemental sulphur (S) and free sulphur are the same. Total sulphur is all forms, including that present in sulphates (SO_4), sulphides etc.

There are 2 forms of chromium (Cr), chromium VI and chromium III. Chromium VI is the more toxic of these. In soils, total chromium is determined by a strong aqua regia acid digestion. Chromium VI is an empirical method based on a water extract test.

Common **Organic** Contaminants include hydrocarbons, phenols, and polychlorinated biphenyls.

Petroleum is a mixture of hydrocarbons produced from the distillation of crude oil, and includes aliphatics (alkanes, alkenes and cycloalkanes), aromatics (benzene and derivatives) and hydrocarbon-like compounds containing minor amounts of oxygen, sulphur or nitrogen. Petroleum hydrocarbons can be grouped based on the carbon number range:

- GRO – Gasoline Range Organics (typically C_6 to C_{10}). Also referred to as PRO – Petroleum Range Organics
- DRO – Diesel Range Organics (typically C_{10} to C_{28})
- LRO - Lubricating Oil Range Organics (typically C_{28} to C_{40})
- MRO – Mineral Oil Range Organics (typically C_{18} to C_{44})

However, it should be borne in mind that the terms "GRO" and "DRO" analysis are purely descriptive terms, the exact definition of which varies. Total Petroleum Hydrocarbons (TPH) is also a poorly defined term; some testing laboratories regard TPH as hydrocarbons ranging from C_5-C_{40}, whereas others define TPH as C_{10}-C_{30}.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictated by the nature of the source (e.g. petrol, diesel, engine oil etc). Furthermore, different hydrocarbons are affected differently by weathering processes, and this can result in further variation in the chemical composition of the TPH.

Gasoline contains light aliphatic hydrocarbons (especially within the C_4 to C_5 range) that are volatile. The aromatic hydrocarbons in gasoline are primarily benzene, toluene, ethylbenzene and xylenes, referred to as BTEX. Small amounts of polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene may also be present. Diesel and light fuel oils have higher molecular weights than gasoline. Consequently, they are less volatile and less water soluble. About 25 to 35% is composed of aromatic hydrocarbons. BTEX concentrations are generally low.

Heavy Fuel Oils are typically dark in colour and considerably more viscous than water. They contain 15 to 40% aromatic hydrocarbons. Polar nitrogen, sulphur and oxygen-containing compounds (NSO) compounds are also present. Lubricating Oils are relatively viscous and insoluble in groundwater. They may contain 10 to 30% aromatics, including the heavier PAHs. NSO compounds are also common.

Polycyclic Aromatic Hydrocarbons (PAHs) have two or more fused benzene rings as a structural characteristic. PAH compounds are present in both petrol and diesel, although in significantly lower concentrations than in coal tars. Certain PAH compounds are carcinogenic (benzo(a)pyrene) and\or mobile in the environment (naphthalene).

Volatile Organic Compounds (VOCs) are organic chemicals, and most are liquids that readily evaporate on exposure to air. Examples include benzene, toluene, xylene, chloroform etc. Semi-Volatile Organic Compounds (sVOCs) include phenol and benzo(a)pyrene, and have relatively low boiling points. Both groups of chemicals are readily absorbed through skin and some, such as benzene, are believed to be linked to tumour growth.

Phenols are compounds that have a hydroxyl group (-OH) attached to an aromatic ring (ie include a benzene ring and an –OH group). Most are colourless solids. A solution of phenol in water is known as carbolic acid, and is a powerful antiseptic. However, phenol vapour is toxic, and skin contact can result in burns.

Polychlorinated Biphenyls (PCBs) were used in pre-1974 transformers as dielectric fluids. PCB's are of increasing toxicity relative to the degree of chlorination. Acute symptoms of PCB poisoning are irritation of the respiratory tract leading to coughing and shortness of breath. Nausea, vomiting and abdominal pain are caused by ingestion of PCB's.

Dioxins and furans (polychlorinated dibenzodioxins and polychlorinated dibenzofurans) are some of the most toxic chemicals known; in the environment, they tend to bio-accumulate in the food chain. Dioxin is a general term that describes a group of hundreds of chemicals that are highly persistent in the environment. The most toxic compound is 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD.

Dioxin is formed by burning chlorine-based chemical compounds with hydrocarbons. The major source of dioxin in the environment comes from waste-burning incinerators and also from backyard burn-barrels. Dioxin pollution is also affiliated with paper mills which use chlorine bleaching in their process and with the production of Polyvinyl Chloride (PVC) plastics and with the production of certain chlorinated chemicals (like many pesticides).

Methods of analysis (organic compounds)

TPH by GC-FID is an analytical technique which only detects hydrocarbons (aliphatic and aromatic) in the range C_{10} to C_{40} (volatiles, heavy tars, humic material and sulphur are not detected). The laboratory can provide a broad, 'banded' breakdown of the TPH results into gasoline range organics (GRO), diesel range organics (DRO) and heavier lubricating oil range organics (LRO), or fully speciated results with the reporting of hydrocarbon concentrations in 14 specific carbon bandings based upon behavioural characteristics, e.g. aliphatic C_6 to C_8, aromatic C_{10} to C_{12} etc.

Speciated VOC (by GC-MS) analysis quantifies the concentrations of 30 USA-EPA priority compounds. These include chlorinated alkanes and alkenes (in the molecular weight range chloroethane to tetrachloroethane); trimethylbenzenes; dichlorobenzenes; and the 4 BTEX compounds (benzene, ethyl-benzene, toluene & xylene).

Speciated sVOC by (GC-MS) analysis quantifies the concentrations of a variety of organic compounds, including the 16 USA-EPA priority PAHs, phenols, 7 USA EPA priority PCB congeners, herbicides & pesticides.

Note: PAHs are hydrocarbons and consequently (where present) will be picked-up when scheduling TPH by GC-FID.

Note: Risk assessment models require physiochemical properties (solubilities, toxicities etc) of compounds in order to model their behaviour in the environment. These physiochemical properties cannot be derived from a single "TPH", "GRO" or "DRO" value. However, the carbon banded fractions can be used in risk assessment models.

Current UK guidance

The UK approach to contaminated land is set out in Land Contamination Risk Management (2020). The approach is based upon risk assessment, where risk is defined as the combination of the probability of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

In the context of land contamination, there are three essential elements to any risk: (1) a contaminant source; (2) a receptor (eg controlled water or people); and (3) a pathway linking (1) and (2). Risk can only exist where all three elements combine to create a pollutant linkage. Risk assessment requires the formulation of a conceptual model which supports the identification and assessment of pollutant linkages.

Lithos adopt a tiered approach to risk assessment, consistent with UK guidance and best practice. The initial step of such a risk assessment (or Tier 1) is the comparison of site data with appropriate UK guidance levels, Lithos risk-derived screening values, or remedial targets. It should be noted that exceedance of Tier 1 does not necessarily mean that remedial action will be required.

Soil screening values used by Lithos

In March 2002 DEFRA and the Environment Agency published a series of technical papers (R&D Publications CLR 7, 8, 9 & 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 & 10 and all corresponding SGV and Tox reports were withdrawn and superseded by new guidance including:

- Guidance on Comparing Soil Contamination Data with a Critical Concentration - CL:AIRE and CIEH, May 2008
- Evaluation of models for predicting plant uptake of chemicals from soil - Science Report – SC050021/SR
- Human health toxicological assessment of contaminants in soil - Science Report: SC050021/SR2
- Updated technical background to the CLEA model - Science Report: SC050021/SR3
- CLEA Software Handbook, Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

In December 2013 Defra published the results of research project SP1010 – Development of Category 4 Screening Levels (C4SLs) for Assessment of Land Affected by Contamination. The objective of this project was to provide technical guidance in support of Defra's revised Statutory Guidance for Part 2A of the Environmental Protection Act 1990 (Part 2A). The revised Statutory Guidance, published in April 2012, introduced a new four-category system for classifying land under Part 2A, where Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is acceptably low. Project SP1010 aimed to deliver:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- Demonstration of the methodology, via derivation of C4SLs for 6 substances – arsenic, cadmium, chromium IV, lead, benzene & benzo(a)pyrene.

The methodology for deriving both the previous Soil Guideline Values and the Category 4 Screening Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology. Development of C4SLs has been achieved by modifying the toxicological and\or exposure parameters used within CLEA (while maintaining current exposure parameters).

Part 2A Statutory Guidance was developed on the basis that C4SLs could be used under the planning regime. Defra anticipate that, where they exist, C4SLs will be used as generic screening criteria, and Lithos consider C4SLs to be suitable for use as Tier 1 Screening Values. Lithos have discussed this matter with both NHBC and YALPAG (collection of Yorkshire & Lincolnshire local authorities) and received confirmation that they are satisfied with this approach.

The CLEA conceptual site model assumes a source located in a sandy loam, with 6% soil organic matter (SOM) - equivalent to 3.5% total organic carbon (TOC). However, many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with revised, lower screening values may be required. Other CLEA default characteristics adopted by Lithos are:

Sandy Loam characteristics (source)	Default values adopted
Total porosity (fraction)	0.53
Water filled porosity (fraction)	0.33
Air filled porosity (fraction)	0.2

Lithos have derived Screening Values for five different CSMs (scenarios); these are:

A - Residential with gardens, but no cover (or only up to 300mm)

B - Residential with gardens and 600mm 'clean' cover

C - Residential apartments with landscaping (i.e. no home grown produce)

D - Commercial/industrial with landscaping

E – Importation of soil cover

The **exposure** pathways considered for each scenario are detailed in the table below.

Scenario	Land use	Pathways	Justification
A	Residential with garden, but no cover (or only up to 300mm)	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	Minimal cover – insufficient to break any pathways therefore all exposure pathways are relevant.
B	Residential with garden minimum 600mm cover	• Inhalation of indoor vapours • Inhalation of outdoor vapours	The 600mm cover removes the risk from all pathways other than inhalation.
C	Residential apartments with landscaped areas and minimum 300mm cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. However consumption of home grown produce not included as unlikely to be grown in landscaped areas. Where vegetables are to be grown site specific QRA may be required.

Scenario	Land use	Pathways	Justification
D	Commercial/ industrial with landscaped areas no cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. Assumed the commercial development consists of offices to provide a conservative assessment.
E	Importation of soil for cover in garden and landscaped areas	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of outdoor vapours and dust	Material used as cover to break existing pathways therefore all direct and indirect pathways relevant; however cover is **not** placed below plots therefore indoor inhalation is not relevant.

Lithos have assumed the source of contamination is directly below the building foundation; i.e. a depth to source of 0.15m as opposed to the CLEA default of 0.65m. This assumption provides for a more conservative approach than the UK default.

Lithos have derived Tier 1 values for a number of inorganic and organic determinands in the context of the five Scenarios A to E. The Tier 1 values are **not** intended to be used when considering potential risks associated with:

- Existing land uses in the context of Part 2A of the Environment Protection Act 1990;
- End uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; or
- Groundwater and surface water

Inorganic Tier 1 values for scenarios A to E

Inorganic contaminant	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
As	32	37	37	Use (A) in SI Report for initial "screen" If >5 x A, then consider increase of cover to 1,000mm	40	640	37	C4SL adopted
Cd	10	26	26		149	410	26	C4SL adopted
Cr			4,000		4,000	28,767	4,000	Assumes Cr is CrIII
Pb	450	200	200		314	2,330	200	C4SL adopted
Ni	130		109		123	892	109	Assessment of health risk only
Se	350		434		596	13,018	434	
Hg	170		199		244	3,603	199	Assumes in an inorganic compound
Vn			584		586	4,994	584	
B			5		5	5	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Cu			100		100	100	100	
Zn			200		200	200	200	

Organic Tier 1 values for scenarios A to E

Organic contaminant (all sourced via CLEA)	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
Benzene	0.33	0.87	0.7	<1^	<1^	63	<1	<1 based on professional judgement and lower than calculated value.
Toluene	610		836	2,048	1,912	5,000	<1	Scenario D based on professional judgement and lower than calculated value.
Ethyl Benzene	350		379	592	566	5,000	<10	
Xylenes	240		535	590	585	5,000	<10	Scenario E based on professional judgement and lower than calculated value.
Phenol	420		1,434	3,360	2,264	5,000	<10	
PCBs			2	8	2	38	N/A	Based on toxicity of EC7
Benzo(a)pyrene		5	5	25	5	76	5	C4SL adopted. Scenario B 5 times scenario A
Naphthalene			6	6	6	619	<10	Scenario E based on professional judgement and lower than calculated value
Gasoline Range Organics			22	23	23	2178	626	See 3-step assessment of TPH below ^Based on professional judgement and lower than calculated value
Diesel Range Organics			215	218	215	^5,000	1,429	
Lubricating Range Org			3,299	5,000	3,829	^5,000	3,299	

* *For a residential end use*

The significance of PAHs can be determined by considering indicator compounds. In most cases benzo(a)pyrene (BaP) is adopted as an indicator due to the amount of toxicological data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. A surrogate marker approach can be used to estimate the toxicity of a mixture of PAHs in soil using toxicity data for individual indicator compounds within that mixture. Exposure to the surrogate marker is assumed to represent exposure to all PAHs in that matrix. The surrogate marker approach relies on a number of assumptions:

- Surrogate marker (BaP) must be present in all soil samples
- Profile of the different PAH relative to BaP should be similar in all samples
- PAH profile in the soil samples should be similar to that used in the pivotal toxicity study[1]

To assess the PAH profile in a soil sample, the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated. The ratio relative to BaP should lie within an order of magnitude above and below the mean ratio to BaP.

[1] SP1010 Appendix E, Provisional C4SIs for benzo(a)pyrene as a surrogate marker for PAHs, CL:AIRE 2013

Naphthalene should also be considered separately against its generic screen. Whilst classed as a PAH, naphthalene is more volatile and mobile in the environment than most other PAHs. As such the significance of naphthalene cannot be considered within the surrogate marker approach.

Similarly, **TPH** cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "The UK approach for evaluating human health risks from petroleum hydrocarbons in soils". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG). The TPHCWG have broken down "TPH" into representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the bandings.

The significance of speciated TPH results can be assessed by following the 3 steps outlined in the tables below.

Step	Result	Action
1. Consider indicator compounds: Are BTEX, naphthalene, benzo(a)pyrene above their respective Tier 1 values?	Yes	Remediation or dQRA required
	No	Proceed to Step 2
2. Consider individual TPH fractions: are they above respective screening values?	Yes	Remediation or dQRA required
	No	Proceed to Step 3
3. Assess Cumulative effects: Is the calculated Hazard Index for each source >1	Yes	Remediation or dQRA required
	No	TPH compounds pose no significant risk

The equation used to assess cumulative effects in step 3 is shown below.

$$HI = \sum_{F_i=1}^{16} HQ\ F_i = \frac{Measured\ concentration\ F_i\ (mg\,kg^{-1})}{SGV\ F_i\ (mg\,kg^{-1})}$$

where HI = Hazard Index
HQ = Hazard Quotient
F_i = Fraction $_i$
SGV = Soil Guideline Value

Statistical Assessment

Current UK guidance is provided by CL:AIRE[2], and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

However, in the context of site investigation to assess the significance of contamination on brownfield sites which are typically underlain by **heterogenous made ground**, some remediation is almost always required (placement of soil cover, excavation of gross contamination etc). Consequently, in such circumstances, it is not necessary to demonstrate that made ground soils are "clean" and therefore there is no need to test large numbers of samples and undertake statistical analysis. Sample results can simply be compared directly with appropriate screening values (e.g. Lithos Tier 1 values).

The CL:AIRE (2020) guidance replaces the withdrawn "Guidance on Comparing Soil Contamination Data with a Critical Concentration" (2008).

The old approach to statistical analysis was based on a definitive yes/no answer which required limited consideration of the dataset and Conceptual Site Model. It was widely accepted that this did not allow sites or risk to be adequately assessed. The updated approach requires a comprehensive understanding of the datasets within the context of the Conceptual Site Model.

Current guidance requires that:

- A robust CSM is in place which identifies source areas, averaging areas and averaging zones
- Sampling locations are relatively evenly spread across the site and were selected using simple or stratified random sampling with no targeting being undertaken
- The field data and CSM do not suggest the presence of a hotspot of contamination which should be treated as a separate zone
- The samples are all taken from a similar same depth and within the same material type across the zone being assessed
- A minimum of 10 samples have been taken. It should be appreciated that confidence in a dataset increases as the number of samples obtained and tested from a zone increases.

The statistical analysis assumes a homogenous distribution of strata and contamination and therefore the dataset will be normally distributed (symmetric, log symmetric or fat tailed).

A normally distributed dataset is assessed using a number of statistical tools to generate a Dot and Box Plot which includes summary statistics and confidence intervals. The review of statistical data enables the assessor to make a decision, with an associated level of confidence, where the true mean of the sample population lies in relation to the critical concentration.

It is essential when using statistics to assess sample data that all decisions relate back to the conceptual site model. Statistics cannot indicate if contamination on a site is likely to present a risk to the end user, this is the role of the 'competent person' i.e. Lithos.

However, broadly speaking the following applies:

- Mean and UCL below the critical concentration – no further assessment required.
- Mean below the critical concentration, but UCL above – consider the CSM and likely sources.
- Mean and UCL above the critical concentration – further assessment required, remediation likely depending on the CSM.
- LCL, Mean & UCL above the critical concentration – further assessment required, remediation likely.

[2] *CL:AIRE, 2020.Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.*

Other screening values used by Lithos

Tier 1 risk assessment of **hazardous gas** is undertaken through reference to the following documents (and further information is presented in Generic Note No. 5 – Hazardous Gas):

- Approved Document C, Building Regulations 2000
- Boyle & Witherington (2007) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC
- CIRIA C665 (2007) – Assessing risks posed by hazardous ground gases to buildings
- BS 8485:2015 – Code of Practice for the characterisation & remediation from ground gas in affected developments

With respect to the assessment of potential **phytotoxic effects** of contaminants, Lithos refer to The Sewage Sludge in Agriculture: Code of Practice 2018 for copper and zinc (at pH 5.5 to 6.0). The CLEA derived Tier 1 value is adopted for nickel due to its human health effects.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, 'Concrete in aggressive ground', 2005.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that: "*In general … it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn*".

Tier 1 **groundwater risk assessments** are always site specific and compare leachate or groundwater concentrations with the appropriate water quality standard based on the CSM and consideration of relevant water quality impacts and assessments.

Waste classification & WAC

In the context of waste soils generated by remediation and\or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated 'natural' soil, bricks, concrete, tiles & ceramics)
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds)
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds)

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

Landfill operators require Waste Acceptance Criteria (WAC) laboratory data, if soil waste is classified as **hazardous**. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Lithos typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated, for example where redevelopment proposals include basement construction etc. If off-site disposal of soils classified as hazardous waste during redevelopment is anticipated, then WAC analysis should be scheduled at an early stage in the remediation programme. However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous, and these contaminants can often be dealt with by alternative technologies (e.g. by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required.

Possible action in event of Tier 1 exceedance

Should any of the Tier 1 criteria detailed above be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

1. Undertake further statistical analysis following the approach set out in Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration, 2020 (see above) in order to determine whether contaminant concentrations of inorganic contaminants within soil\fill actually present a risk (only applicable to assessing the risk to human health).
2. Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
3. Based on a qualitative risk assessment, advocate an appropriate level of remediation to "break" the pollutant linkage - for example the removal of the contaminated materials or the provision of a clean cover.

Prior to undertaking any statistical analysis the issue of the **averaging area** requires further consideration. Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration, 2020 provides some guidance on averaging areas noting that they are the area within which a receptor may be exposed to contamination but leaving the site assessor to determine the appropriate averaging area for their site.

Lithos consider the entire site needs to be characterised by reference to the Conceptual Site Model. Consequently, Lithos gather and analyse sample results by fill type, and\or by former use in a given sub-area of the site, before undertaking statistical analysis; i.e. the averaging area is associated with the extent of a particular fill type, or an area affected by spillage\leakage.

In terms of brownfield redevelopment, this is considered a more appropriate methodology which provides a more representative sample population for statistical analysis. As such the entire site is considered in terms of the proposed end use, be this residential with, or without gardens.

Analysis by soil\fill type is appropriate for essentially immobile contaminants associated with a particular fill type, for example arsenic in colliery spoil, metals in ash & clinker, sulphate in plaster-rich demolition rubble etc.

Analysis by former use is appropriate where more mobile contaminants have entered the ground, for example diesel associated with leakage from a former fuel tank, downward migration of leachable metals through granular materials, various soluble contaminants present in a wastewater leaking into the ground via a fractured sewer etc. In these circumstances, it may be appropriate to undertake statistical analysis of sample results from a variety of different soil\fill types. However, consideration would have to be given to factors such as porosity which might influence impregnation of a mobile contaminant into the soil mass, i.e. contamination would normally be more pervasive and significant in granular soils than cohesive soils

05 – Hazardous gas
Generic notes – geoenvironmental investigations

General

Hazardous gas is considered to be any mixture of potentially explosive, toxic or asphyxiating gases, most notably methane, carbon dioxide and oxygen (deficiency). In addition, radon, a naturally occurring radioactive gas is also considered. Further information about radon is included in Notes 01 – Environmental Setting.

Assessment of potential risks associated with hazardous gas are based on a review of data obtained from the Landmark Information Group, the Environment Agency and the Local Authority and the British Geological Survey. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Where landfilling has occurred within 250m of the site boundary, the Local Planning Authority may request a landfill gas investigation in accordance with the Town and Country Planning General Development Order, 1988.

Sources

Potential sources of hazardous gas include:

- Landfill sites
- Made ground, especially where significant depths are present
- Shallow mineworkings associated with coal extraction
- Geological strata, including peat, organic silts, coal and limestone (reaction with acidic waters), granite (radon)
- Groundwater can sometimes act as a "carrier" for hazardous gas
- Leakages from pipelines or storage tanks
- Sewers, septic tanks and cess pits

Generation

Wherever biodegradable material is deposited, landfill gas (principally a mixture of methane and carbon dioxide) is likely to be generated by microbial activity. Carbon dioxide is an asphyxiant and toxic; methane is flammable and a mixture containing between 5% and 15% methane by volume in air is explosive. Landfill gas in the ground is unlikely in itself to pose a significant risk, though it may damage vegetation. However, infiltration of landfill gas into confined spaces (e.g. cellars, services, etc) may give rise to considerable risk.

There is no typical figure for the length of time that landfill gas will be evolved, but at many sites significant gas generation continues for at least 15 years after the last deposit of waste.

Migration

Gas migration from a landfill site may occur in several ways. It may migrate through adjacent strata; the distance of migration being dependent on the pressure gradients, volume of gas and permeability of the strata. Where there are faults, cavities and fissures within the strata, gas may move considerable distances. Other migration pathways for gas include man-made features such as mine shafts, roadways and underground services.

Gas migration is influenced by a number of climatic factors, such as atmospheric pressure variations, water table level variations and the influence of a covering of snow or ice over the surface of the site and surrounding area.

Gas monitoring procedure

Lithos adopt a standard gas monitoring procedure, in accordance with CIRIA guidance. This procedure involves the measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration
- Gas emission rate
- Methane, oxygen and carbon dioxide concentrations using an infra-red gas analyser
- Standing water level using a dipmeter.

In addition, ground conditions at each sampling location are recorded together with prevailing weather conditions and any other observations such as any vandalism. Where samples of gas are required for laboratory analysis, Gresham Tubes or multi-layer Tedlar / ALTEF sampling bags are used. Gas concentrations in the well are typically recorded immediately before and after retrieval of a sample.

Current guidance

CIRIA Report 151 (1995)[i] identified that there was inadequate guidance on trigger concentrations for ground gases. CIRIA concluded that the most important aspect of a gas regime below or adjacent to a site was the surface emission rate, i.e. how quickly the gas is coming out of the ground. The lower the surface emission rate the lower the risk. CIRIA Report C665 (2007)[ii] advocates two methodologies for characterising sites:

A – All developments except low rise housing. The advocated methodology is that proposed by Wilson & Card, 1999[iii]

B – Low rise housing. An alternative (traffic light) methodology, derived by Boyle and Witherington, 2006[iv] for NHBC

Both methodologies refer to Gas Screening Values (GSV); previously referred to as limiting borehole gas volume flow.

Other relevant UK guidance includes:

- BS8485:2015+A1:2019 – Code of Practice for the characterisation & remediation from ground gas in affected developments.
- BS8576:2013 Guidance on investigations for ground gas – permanent gases and volatile organic compounds
- Boyle & Witherington (2007) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC
- Wilson, Card & Haines (CIEH, 208) The Local Authority Guide to Ground Gas
- CL:AIRE Research Bulletin RB17 (November 2012) A Pragmatic Approach to Ground Gas Risk Assessment
- CL:AIRE Research Bulletin RB13 (February 2011) The Utility of Continuous Monitoring in Detection & Prediction of 'Worst-Case' Ground Gas Concentration
- BRE\Environment Agency Report BR 414 (2001) – "Protective Measures for housing on gas-contaminated land".
- YALPAG (December 2016) - Verification Requirements for Gas Protection Systems - Technical Guidance for Developers, Landowners and Consultants.
- Environment Agency Report LFTGN 03 - Guidance on the management of landfill gas, June 2014

A – All developments except low rise housing

(Wilson & Card, 1999)[v] revised Table 28 of CIRIA 149[v] in terms of borehole gas volume flow rate (now GSV) in order to achieve a more consistent design of protection measures. This was done to reflect the importance of recognising the gas surface emission rate. Wilson & Card then developed a method for classifying gassing sites (Table 1 below), which took into account the combined gas concentration and GSV.

Characteristic Situation	Gas Screening Value, CH_4 or CO_2 (l/hr)	Additional limiting factors	Typical source of generation
1	<0.07	Methane not to exceed 1% v/v and carbon dioxide not to exceed 5% v/v	Natural soils with low organic content
2	<0.7	Borehole air flow rate not to exceed 70 litre/hr otherwise increase to Characteristic Situation 3	Natural soil, high peat/organic content
3	<3.5		Old landfill, inert waste, mineworkings flooded.
4	<15	Quantitative Risk Assessment required to evaluate scope of protection measures.	Mineworkings – susceptible to flooding, completed landfill, inert waste
5	<70		Mineworkings unflooded, inactive
6	>70		Recent landfill site

Notes: Borehole flow rate = volume of gas (regardless of composition) which is escaping from well (l/hr). Gas Screening Value (litre/hour) = gas concentration (%) / 100 x borehole flow rate (l/hr). To facilitate design implementation, the limiting values for both methane and carbon dioxide are identical.

B – Low rise housing.

NHBC have developed a characterisation system similar to that of Wilson & Card above, but specific to low-rise housing development (Boyle and Witherington) (Table 8.7). This approach compares measured gas emission rates with generic "Traffic Lights". The Traffic Lights include "Typical Maximum Concentrations" for initial screening, and risk-based Gas Screening Values (GSVs) for consideration of situations where the Typical Maximum Concentrations are exceeded. Calculations are carried out for both methane and carbon dioxide and the worst case adopted in order to establish the appropriate protection measures.

Table 8.7 NHBC Traffic light system for 150 mm void

Traffic Light Classification	Methane [1]		Carbon Dioxide [1]	
	Typical Maximum Concentration [5] (%v/v)	Gas Screening Value [2,4,6] (l/hr)	Typical Maximum Concentration [5] (%v/v)	Gas Screening Value [2,3,4,6] (l/hr)
Green	1	0.16	5	0.78
Amber 1	5	0.63	10	1.56
Amber 2	20	1.56	30	3.13
Red				

Notes:

1. The worst gas-regime identified at the site, either methane or carbon dioxide, recorded from monitoring in the worst temporal conditions, will be the decider for which Traffic Light and GSV is allocated.
2. Generic GSVs are based on guidance contained within "The Building Regulations: Approved Document C" (2004) and assume a sub-floor void of 150 mm thickness.
3. A leak of gas from the sub-floor void into a small room (e.g. downstairs toilet with soil pipe potentially passing into sub-floor void) of dimensions 1.50m × 1.50m × 2.50m, with a total room volume of 5.63m^3 has been considered.
4. The GSV, in litres per hour, is as defined in Wilson and Card (1999) as the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered.
5. The Typical Maximum Concentrations can be exceeded in certain circumstances should the conceptual site model indicate it is safe to do so. This is where professional judgment will be required, based on a thorough understanding of the gas regime identified at the site where monitoring in the worst temporal conditions has occurred.
6. The GSV thresholds should not generally be exceeded without completion of a detailed gas risk assessment taking into account site-specific conditions.

---

i *Harries CR, Witherington PJ and McEntee JM (1995). Interpreting measurements of gas in the ground. CIRIA Report 151*

ii *CIRIA (2007) – Assessing risks posed by hazardous ground gases to buildings.*

iii *Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.*

iv *Boyle & Witherington (2006) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC*

v *Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.*

Appendix B

Drawings



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CLIENT	COUNTRYSIDE PROPERTIES
JOB TITLE	BARUGH GREEN
DRAWING TITLE	SITE LOCATION PLAN
DRAWN	LEW
DATE	17 04 19
CHECKED	ASw
DATE	17 04 19
STATUS	FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑
SCALE	1:25,000
SHEET	A4
DRAWING NO.	3407/1
REVISION	



NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM COUNTRYSIDE PROPERTIES DRAWING 'BARUGH GREEN ROAD, BARNSLEY - PLANNING LAYOUT' REF. SKPY-004-A-PL-01, REV. N, DATED 12 JANUARY 2022

REV.	DESCRIPTION	DATE
B	UPDATED WITH NEW PROPOSED DEVELOPMENT LAYOUT	11 02 22
A	UPDATED WITH NEW PROPOSED DEVELOPMENT LAYOUT	19 08 20

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JOB TITLE

BARUGH GREEN

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
LEW	09 03 20	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	09 02 20	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3407/2	B



NOTES

- GRASS & OVERGROWN AREAS
- AREAS OF BOGGY GROUND/STANDING WATER
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE
A	UPDATED SITE FEATURES	11 02 22

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COUNTRYSIDE PROPERTIES

JOB TITLE

BARUGH GREEN

DRAWING TITLE

SITE FEATURES

DRAWN	DATE	STATUS
LEW	09 03 20	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	09 03 20	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1250	A3	3407/3	A



















NOTES

GRASS & OVERGROWN AREAS

APPROXIMATE SITE BOUNDARY

LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE

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JOB TITLE

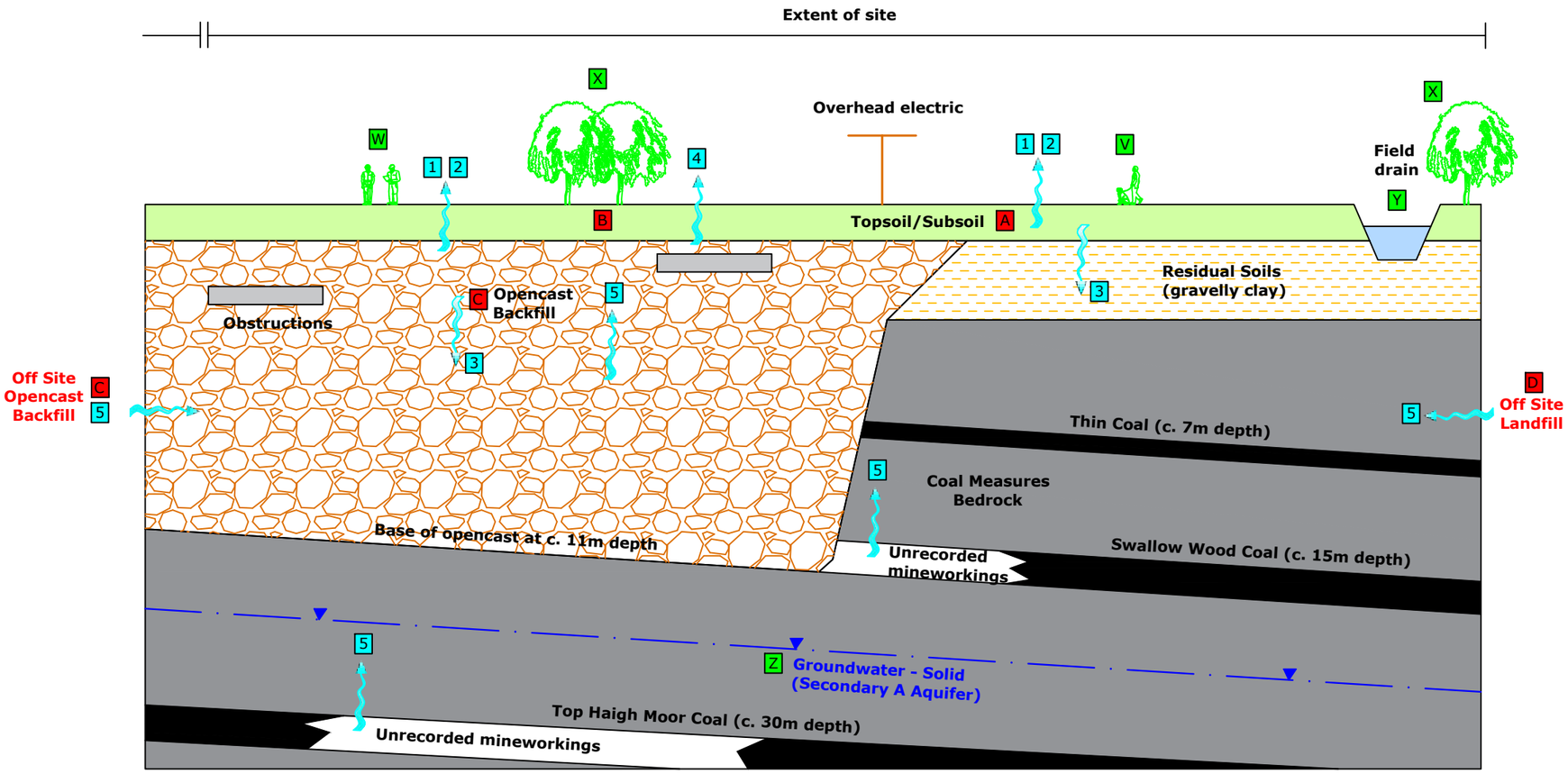
BARUGH GREEN

DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	DATE	STATUS
LEW	09 03 20	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	09 03 20	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
NOT TO SCALE	A3	3407/4	



SOURCES	
A	NATURALLY OCCURRING CONTAMINANTS (INORGANICS)
B	FARMING RELATED ACTIVITIES (INORGANICS & ORGANICS)
C	OPENCAST BACKFILL (INORGANICS & ORGANICS)
D	OFFSITE LANDFILL (HAZARDOUS GAS)

PATHWAYS	
1	DERMAL CONTACT
2	INGESTION/INHALATION
3	LEACHING OF CONTAMINANTS
4	UPTAKE BY PLANTS
5	MIGRATION OF GAS

RECEPTORS	
V	END USERS (RESIDENTS)
W	SITE WORKERS
X	VEGETATION
Y	SURFACE WATERS
Z	GROUNDWATER

NOTES

REV.	DESCRIPTION	DATE

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COUNTRYSIDE PROPERTIES

JOB TITLE

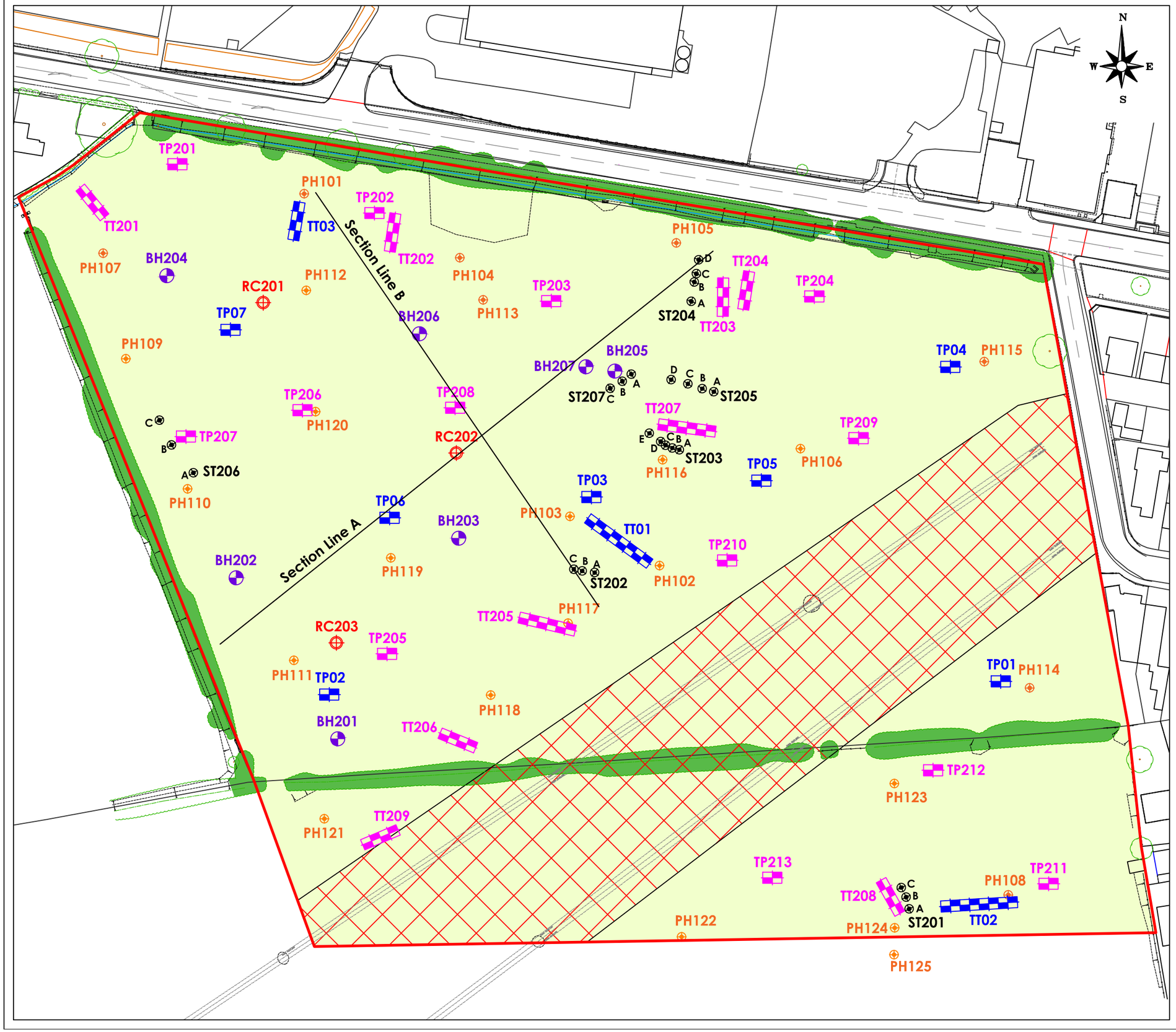
BARUGH GREEN

DRAWING TITLE

PRELIMINARY CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
LEW	23 03 20	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	23 03 20	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	3407/5	



NOTES

- GRASS & OVERGROWN AREAS
- INACCESSIBLE DUE TO LIVE OVERHEAD SERVICES
- TRIAL PIT LOCATION
- TRIAL TRENCH LOCATION
- PROBEHOLE LOCATION
- BOREHOLE LOCATION
- CORED BOREHOLE LOCATION
- LINE OF STITCH DRILLING
- APPROXIMATE SITE BOUNDARY

MAJORITY (c. 95%) OF EXPLORATORY HOLE LOCATIONS HAVE BEEN SURVEYED IN (COORDINATES & GROUND LEVEL) ON COMPLETION

REMAINING HOLE LOCATIONS BASED ON DATA FROM A HAND-HELD GPS (+/- 3M ACCURACY)

REV.	DESCRIPTION	DATE

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JOB TITLE

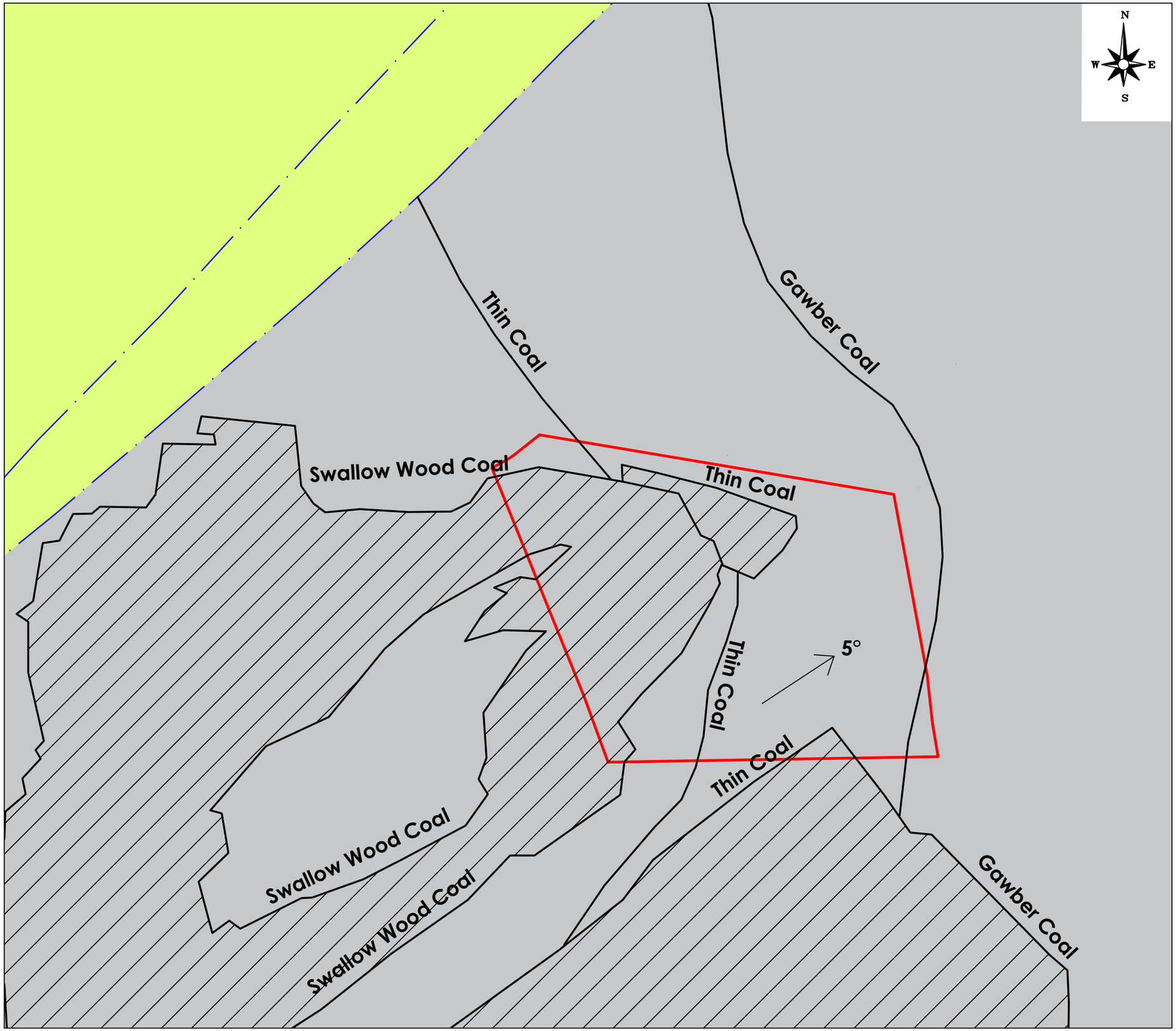
BARUGH GREEN

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS

DRAWN	DATE	STATUS
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CHECKED	DATE	FOR APPROVAL ☐
AG	17 04 19	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3407/6	B



NOTES

- PENNINE MIDDLE COAL MEASURES (MUDSTONE, SILTSTONE & SANDSTONE)
- HIGH MOOR ROCK (SANDSTONE)
- WORKED GROUND (BACKFILLED OPENCAST)
- COAL OUTCROP
- GEOLOGICAL FAULT
- DIP DIRECTION
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

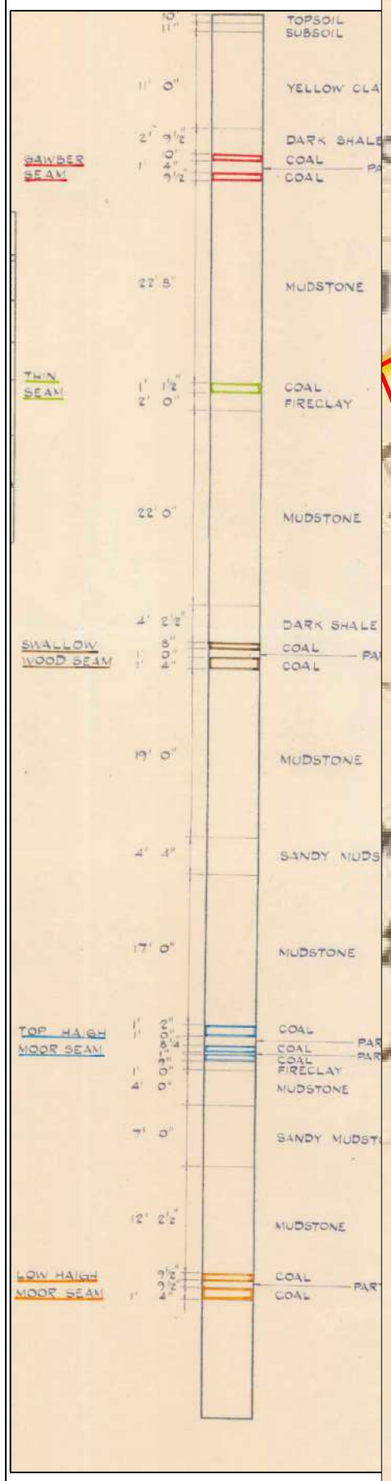
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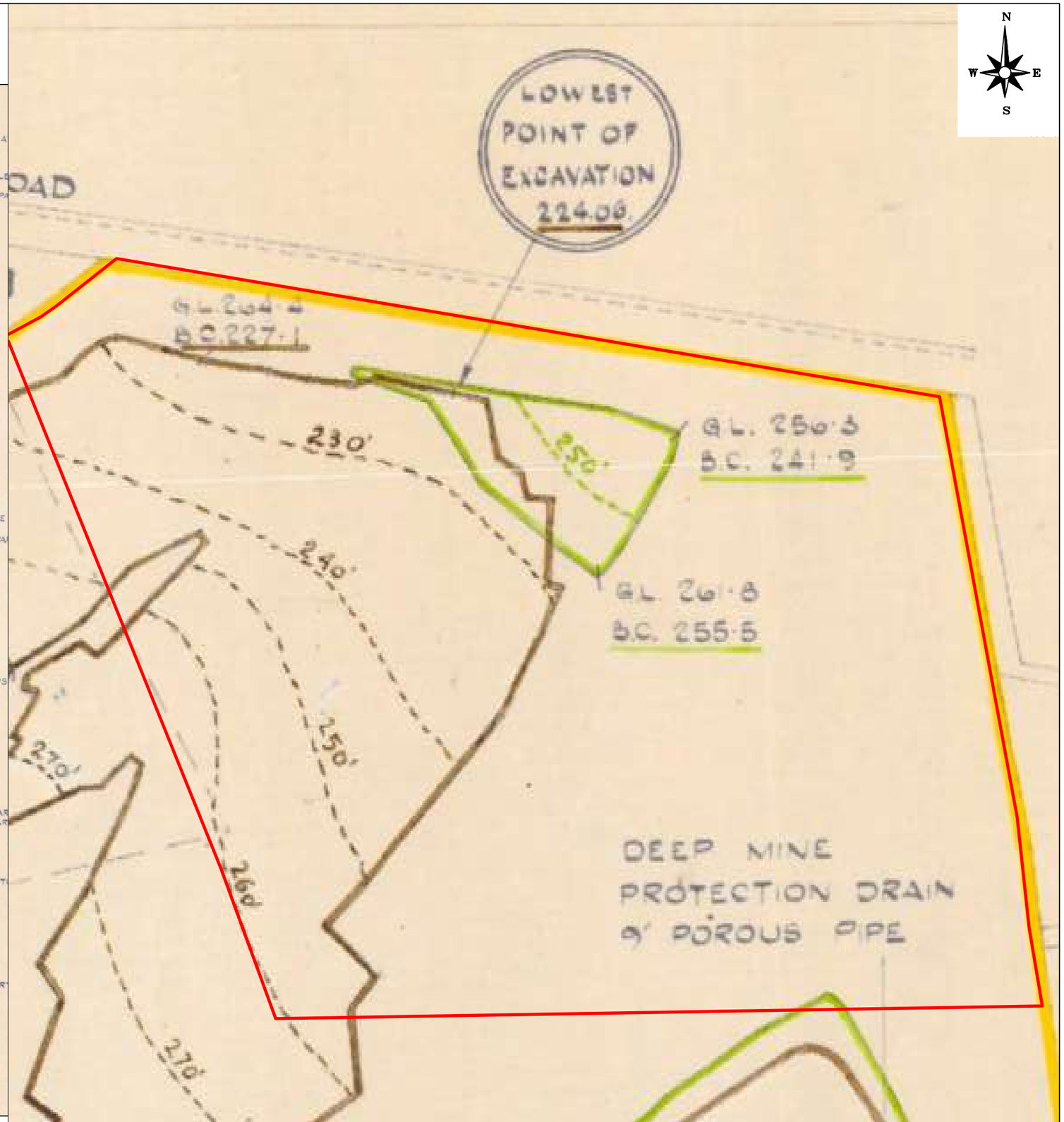
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PUBLISHED GEOLOGY & COAL OUTCROPS

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CHECKED	DATE	FOR APPROVAL ☐
ASw	23 04 19	DRAFT ☐
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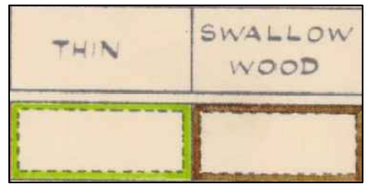
SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3407/7	





N
W E
S

NOTES



APPROXIMATE SITE BOUNDARY

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JOB TITLE

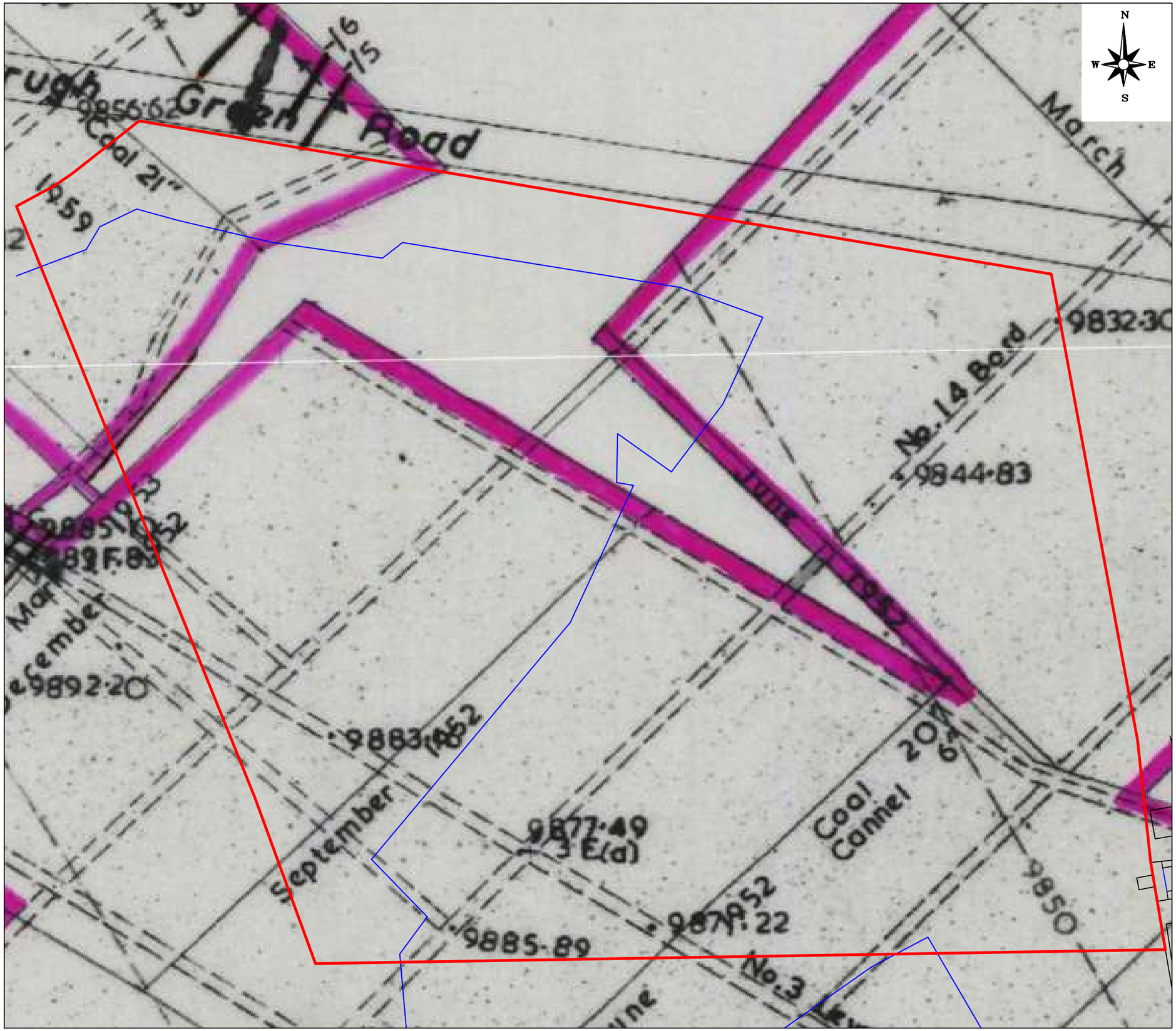
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DRAWING TITLE

CRAVEN I & II OPENCAST ABANDONMENT PLAN

DRAWN	DATE	STATUS
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CHECKED	DATE	FOR APPROVAL ☐
ASw	17 04 19	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1250	A3	3407/8	



NOTES

APPROXIMATE LINE OF HIGHWALL (ABANDONMENT PLAN)

APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

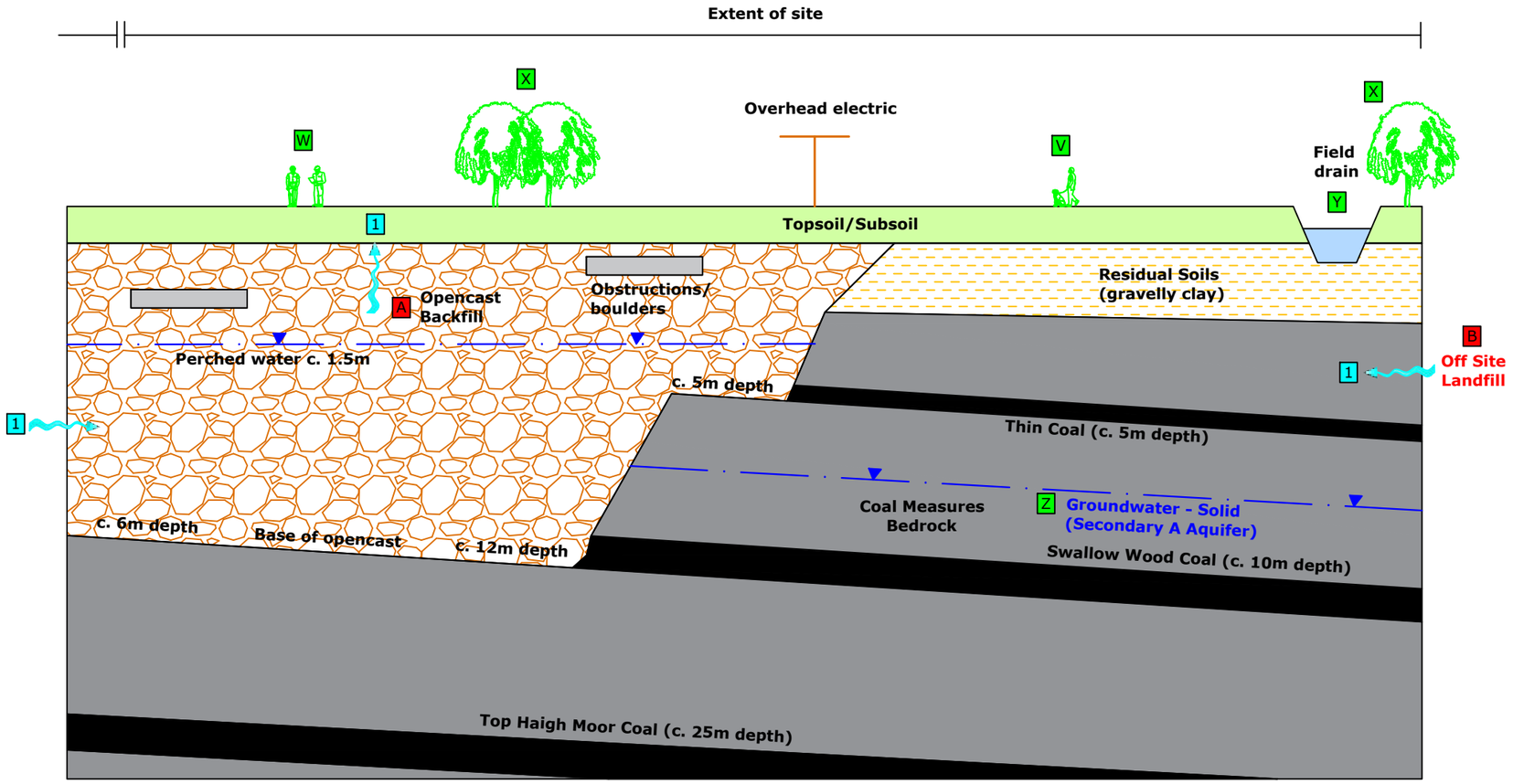
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DRAWING TITLE

FLOCKTON THICK COAL ABANDONMENT PLAN

DRAWN	DATE	STATUS
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CHECKED	DATE	FOR APPROVAL ☐
ASw	17 04 19	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3407/9	



SOURCES	PATHWAYS	RECEPTORS
A OPENCAST BACKFILL	1 MIGRATION OF GAS	V END USERS (RESIDENTS)
B OFF-SITE LANDFILL		W SITE WORKERS
		X VEGETATION
		Y SURFACE WATERS
		Z GROUNDWATER

NOTES

REV.	DESCRIPTION	DATE

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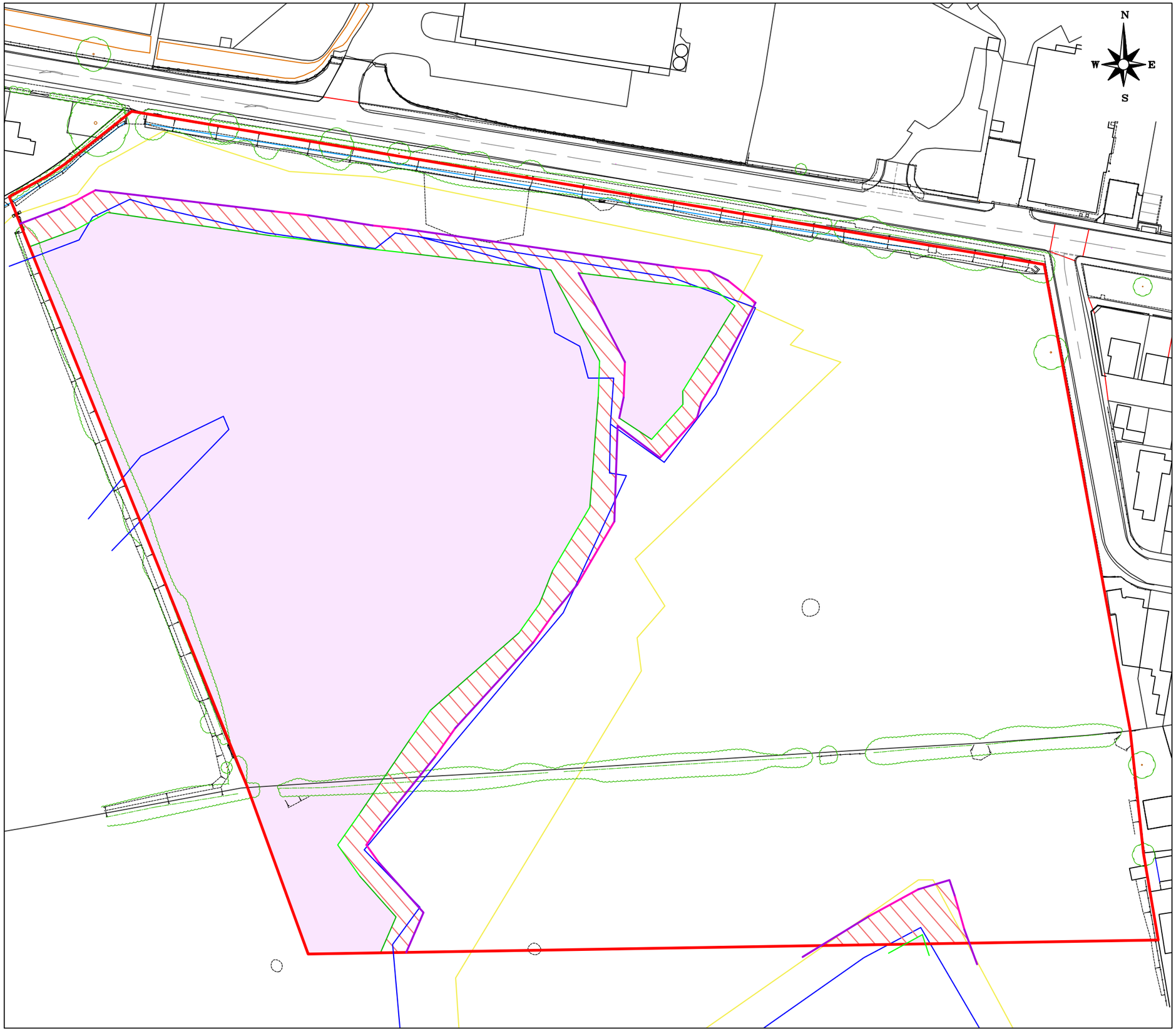
CLIENT: COUNTRYSIDE PROPERTIES

JOB TITLE: BARUGH GREEN

DRAWING TITLE: REVISED CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
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CHECKED	DATE	FOR APPROVAL ☐
AG	24 02 22	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	3407/10	



NOTES

- APPROXIMATE HIGHWALL (FROM ABANDONMENT PLAN)
- APPROXIMATE HIGHWALL (FROM COAL AUTHORITY REPORT)
- OPENCAST HIGHWALL (AS SURVEYED)
- OPENCAST HIGHWALL (INFERRED BETWEEN EXPLORATORY HOLES)
- OPENCAST HIGHWALL TOE (CALCULATED FROM OBSERVED HIGHWALL)
- OPENCAST HIGHWALL TOE (INFERRED BETWEEN OBSERVED HIGHWALL)
- AREA OVERLYING BURIED HIGHWALL
- APPROXIMATE FOOTPRINT OF FORMER OPENCAST

NOTES:

- Line of highwall inferred between exploratory holes assumed to be relatively consistent with abandonment plan
- Gradient of highwall observed in trenches assumed to continue to base of opencast at a consistent angle.
- Gradient of highwall assumed to be relatively constant between observed locations.
- Toe of highwall calculated from observed highwall position and gradient, and proven/assumed depth of base of opencast.

- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

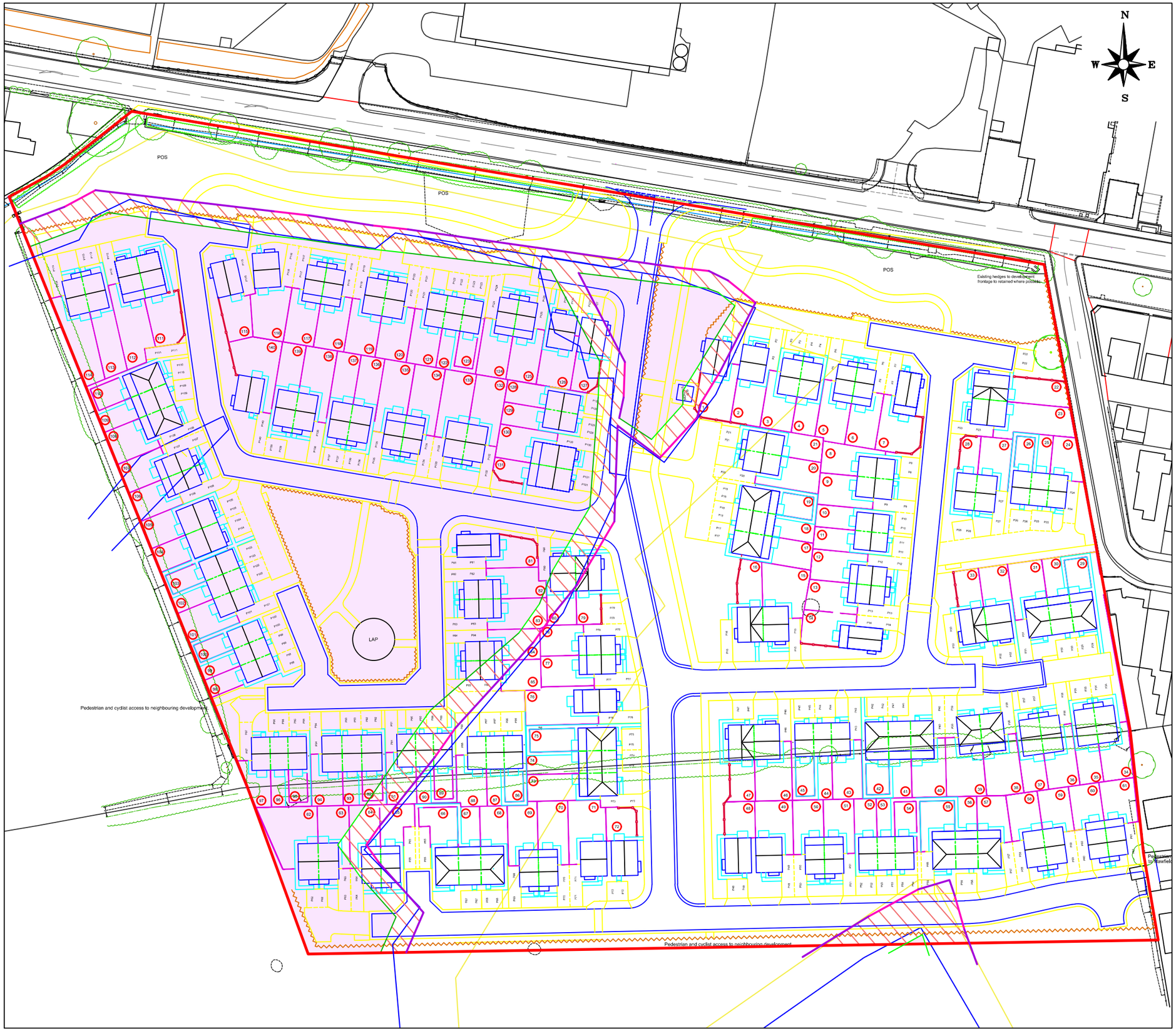
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DRAWING TITLE

LINE OF OPENCAST HIGHWALLS

DRAWN	DATE	STATUS
LEW	11 02 22	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	11 02 22	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3407/11A	



NOTES

REPRODUCED FROM COUNTRYSIDE PROPERTIES DRAWING 'BARUGH GREEN ROAD, BARNSLEY - PLANNING LAYOUT' REF. SKPY-004-A-PL-01, REV. N, DATED 12 JANUARY 2022

- APPROXIMATE HIGHWALL (FROM ABANDONMENT PLAN)
- APPROXIMATE HIGHWALL (FROM COAL AUTHORITY REPORT)
- OPENCAST HIGHWALL (AS SURVEYED)
- OPENCAST HIGHWALL (INFERRED BETWEEN EXPLORATORY HOLES)
- OPENCAST HIGHWALL TOE (CALCULATED FROM OBSERVED HIGHWALL)
- OPENCAST HIGHWALL TOE (INFERRED BETWEEN OBSERVED HIGHWALL)
- AREA OVERLYING BURIED HIGHWALL
- APPROXIMATE FOOTPRINT OF FORMER OPENCAST

NOTES:

- Line of highwall inferred between exploratory holes assumed to be relatively consistent with abandonment plan
- Gradient of highwall observed in trenches assumed to continue to base of opencast at a consistent angle.
- Gradient of highwall assumed to be relatively constant between observed locations.
- Toe of highwall calculated from observed highwall position and gradient, and proven/assumed depth of base of opencast.

- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

BARUGH GREEN

DRAWING TITLE

LINE OF OPENCAST HIGHWALLS AND PROPOSED LAYOUT

DRAWN	DATE	STATUS
LEW	11 02 22	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	11 02 22	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3407/11B	



NOTES

OPENCAST HIGHWALL (AS SURVEYED)

OPENCAST HIGHWALL (INFERRED BETWEEN EXPLORATORY HOLES)

NOTES:

- Thickness of made ground shown from existing ground level at the time of investigation.
- Thickness of made ground extrapolated between available exploratory holes.
- Depth to rockhead taken primarily from cable percussion boreholes and supplemented with rotary open probeholes due to level of detail obtained during drilling/logging.
- No thickness of made ground shown in Craven II opencast (far southeast) due to extremely variable findings.

APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

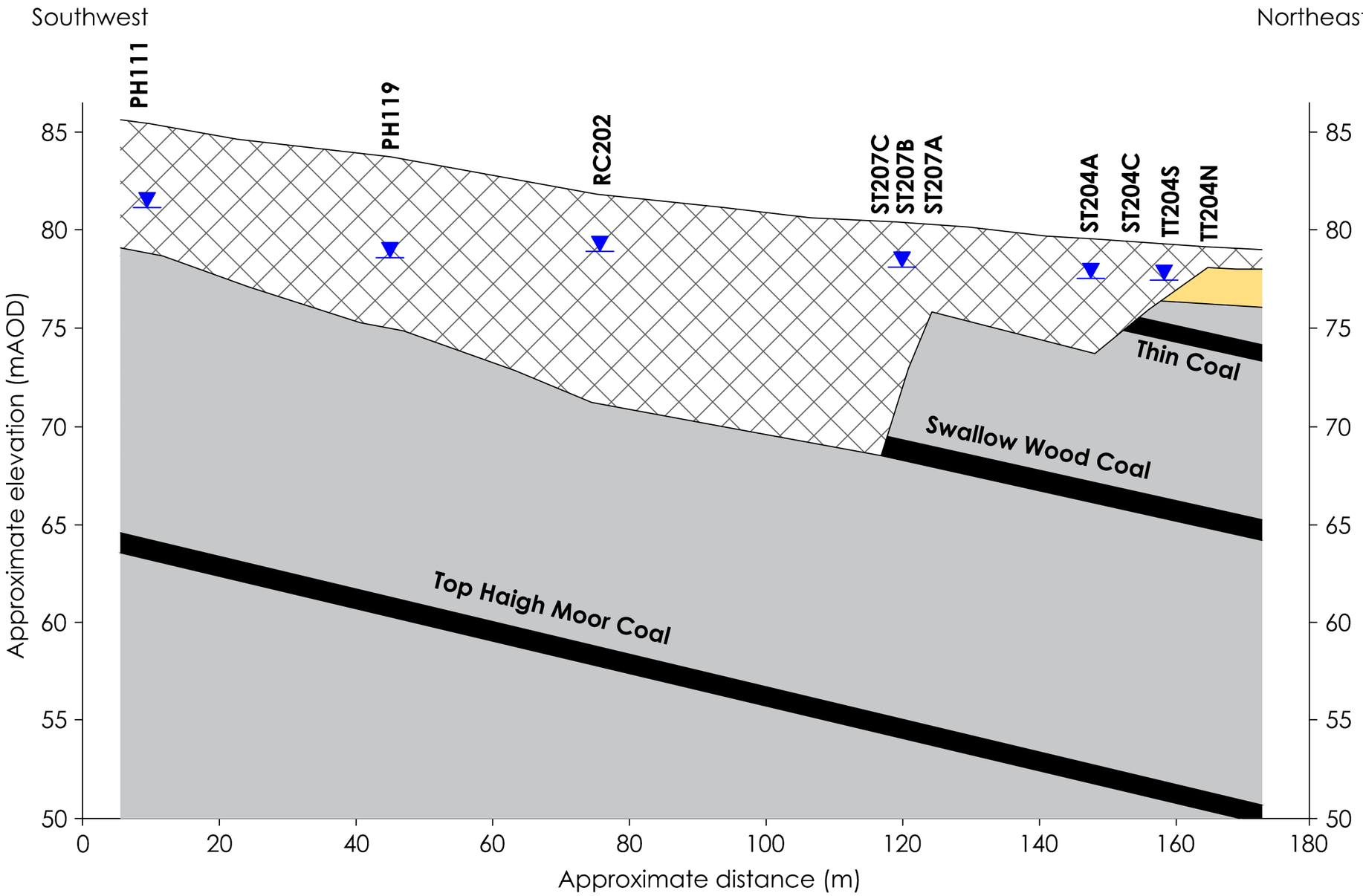
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DRAWING TITLE

APPROXIMATE THICKNESS OF MADE GROUND WITHIN OPENCAST

DRAWN	DATE	STATUS
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		FOR APPROVAL ☐
CHECKED	DATE	DRAFT ☐
AG	23 02 22	FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3407/12	



NOTES

- OPENCAST BACKFILL
- RESIDUAL SOILS
- COAL MEASURES BEDROCK
- COAL
- APPROXIMATE DEPTH OF GROUNDWATER

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

COUNTRYSIDE PROPERTIES

JOB TITLE

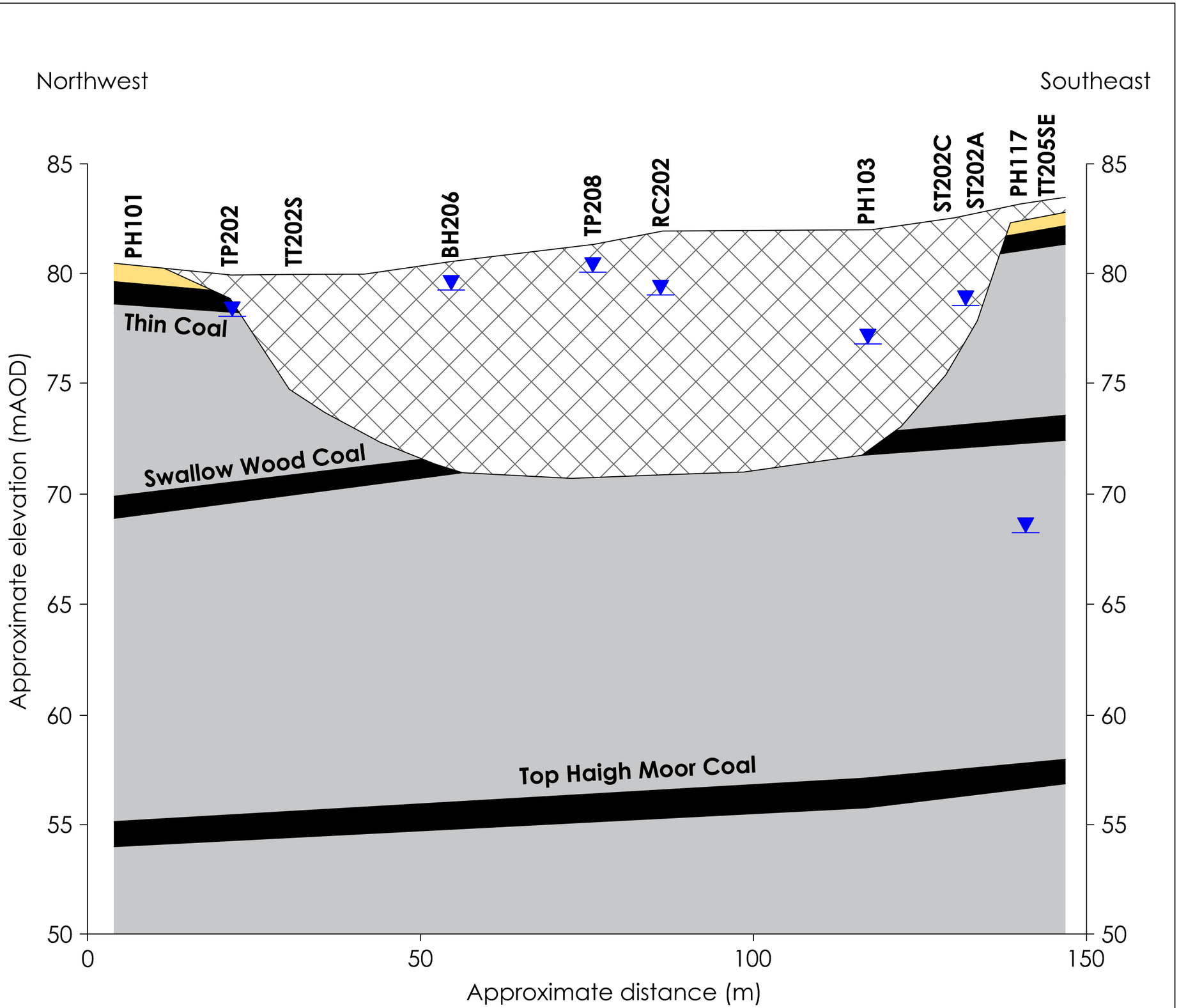
BARUGH GREEN

DRAWING TITLE

GEOLOGICAL CROSS SECTION - LINE A

DRAWN	DATE	STATUS
LEW	24 02 22	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	24 02 22	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	3407/13A	



NOTES

- OPENCAST BACKFILL
- RESIDUAL SOILS
- COAL MEASURES BEDROCK
- COAL
- APPROXIMATE DEPTH OF GROUNDWATER

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

COUNTRYSIDE PROPERTIES

JOB TITLE

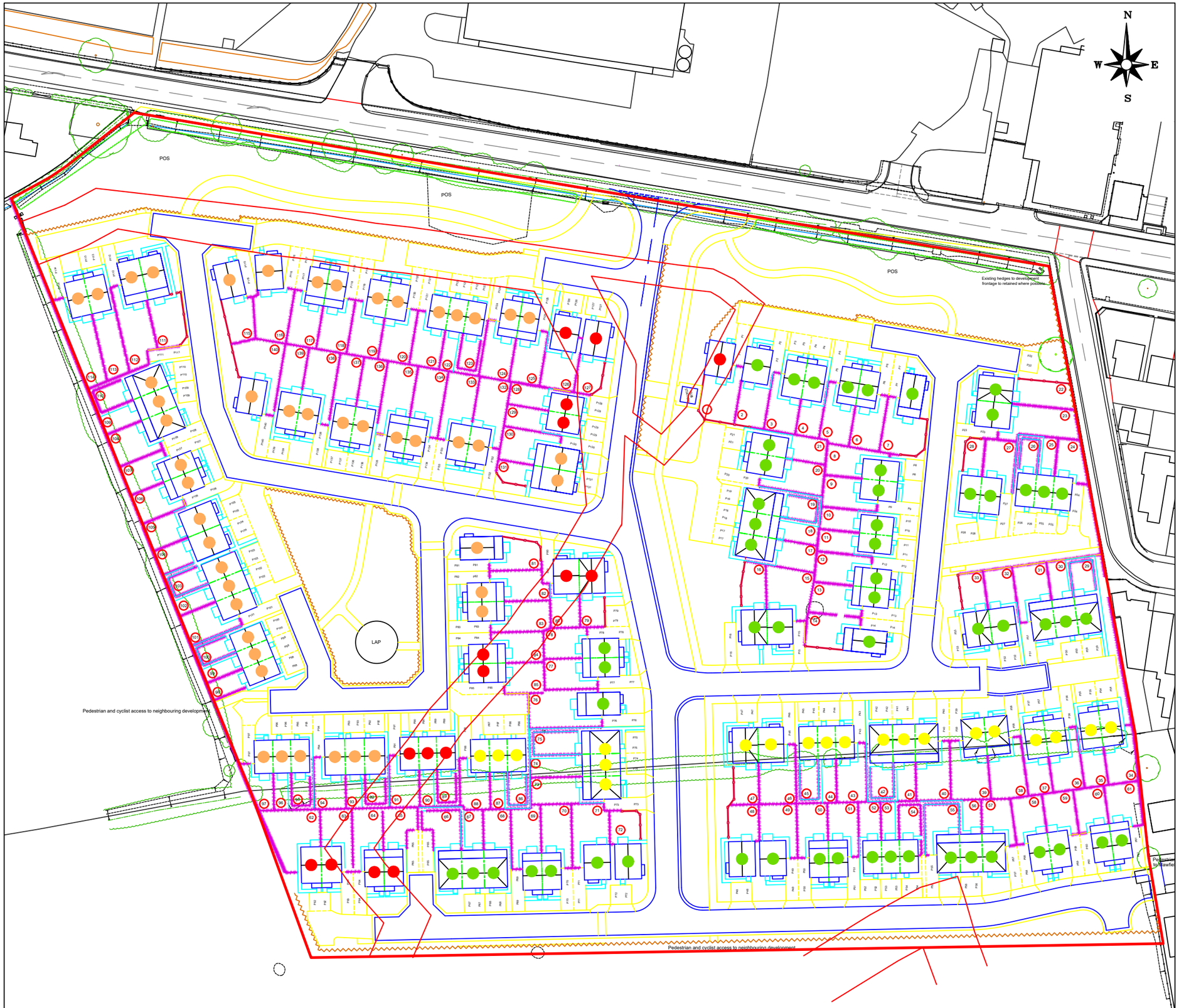
BARUGH GREEN

DRAWING TITLE

GEOLOGICAL CROSS SECTION - LINE B

DRAWN	DATE	STATUS
LEW	24 02 22	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	24 02 22	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	3407/13B	



NOTES

- Strip/trench-filll foundations at minimum depths of 0.9m in cohesive soils and 0.6m in granular soils or bedrock.
- Foundation depth is greater than 2.5m due to tree influence. Foundation excavations may encounter granular soil/bedrock at shallower depth. A site specific assessment by an engineer is required.
- Piles in competent bedrock, or reinforced strips/rafts in made ground.
- Pre-bored piles in socketed in competent bedrock.
- Zone of influence of buried highwalls

NOTES:

- Strip/trench-fill foundations to be deepened where necessary due to tree influence.
- It should be assumed pre-boring of piles will be required for plots over buried highwalls to ensure piles are socketed in competent bedrock.
- Further advice should be sought from a specialist piling contractor.

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

COUNTRYSIDE PROPERTIES

JOB TITLE

BARUGH GREEN

DRAWING TITLE

INDICATIVE FOUNDATION ZONING PLAN

DRAWN	DATE	STATUS
LEW	09 03 22	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	09 03 22	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3407/14	

Appendix C

Commission

002/3407/REG

1st April 2019

Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

T 01937 545 330

www.lithos.co.uk

Mr M Bray
Countryside Properties
3200 Thorpe Park
Century Way
Leeds
LS15 8ZB

Dear Mark

Barugh Green

Further to our discussions on Friday, please find attached our proposal for undertaking an exploratory ("quick look/see") investigation on the above land.

Review of the information supplied suggests that the site consists of a single parcel of land of approximately 5 hectares, immediately south of the A635. Review of Google Maps suggests the land is currently grazing pasture.

Brief review of Old Maps and Environment Agency data suggests the site:

- Appears to have remained undeveloped throughout its history (although partially subject to coal opencast);
- Is located within 250m of a known landfill site; and,
- Is not within a groundwater source protection zone.

Brief examination of the relevant geological map suggests the site is directly underlain by Coal Measures bedrock. This site is located within a Coal Mining Development High Risk Area, therefore a Consultant's mining report and opencast abandonment plans will be obtained.

We will need a Promap or topo survey in CAD format, to provide a base plan for technical drawings etc. If you do not have one, we could obtain at cost plus £ .

This proposal allows for the following works:

Desk study: Environmental search data and historical maps (obtained from Landmark or Groundsure), will be reviewed in order to determine whether past land uses have had any effect on the proposed development. In addition, published geological plans of the area will be examined.

Fieldwork: We have allowed for a day's trial pitting with all pits to be supervised and logged by an experienced geoenvironmental engineer.

Representative soil samples of natural and man-made ground, including any contaminated samples, will be taken during the works. In-situ shear strengths of any cohesive soils encountered will be determined by the use of a hand-held shear vane.

We will make every effort to compact arisings and 'sweep' them over each pit. However, you should be aware that on completion of the investigation, "graves" of spoil (each about 3m long by 1m wide) unsuitable for trafficking, will be left up to 400mm proud at each trial pit location. At this stage, no allowance has been made for any further reinstatement such as removal of excess arisings, replacement of turf.

This proposal has been put together without a recent site visit. If ground conditions are found to be significantly wet/boggy at the time of the investigation, it may be necessary to hire additional resources (bog mats, tracked excavators, tractors, stone etc) in order for works to continue. We will discuss the requirement for any such items and associated costs with you prior to ordering.

Testing: Not allowed for at this stage.

Reporting & timescales: On completion of the desk study & fieldwork, a simple factual and interpretative letter report will be issued. This will contain detailed engineering records, copies of all relevant search data and drawings of the site.

Fieldwork could be commenced within 3 weeks of receipt of your written instruction to proceed. Our letter report will be issued within a week of fieldwork completion.

Invoicing: The attached proposal provides a breakdown of the costs associated with this project. This breakdown is for information only and the proposal can be regarded as a lump sum price of £ plus VAT.

We will submit our invoice for this project with the letter report.

Health, safety & welfare: The works outlined above will be carried out in accordance with Lithos' task- and site- specific Risk Assessments and Method Statements.

Details of welfare will be included within the Method Statements, however, this investigation is expected to be completed within a working day and therefore it is not considered reasonably practicable to provide formal welfare facilities, and our proposal makes no allowance for so doing.

Utility plans are required in order to protect operatives from the hazards associated with striking buried services and avoid potentially substantial disruption\repair costs. We will make every effort not to damage any services (including review of utility plans and use of a CAT detector). However, Lithos cannot accept liability for damage to any underground services that are not accurately marked on plans made available to us prior to commencement of our field investigation, or have not been accurately marked on the ground by a responsible third party (e.g. utility company, site owner).

Most developers have copies of the necessary utility plans (including electricity, gas, water, drainage & telecom), and it would be appreciated if you could forward these prior to the proposed fieldworks. However, if you do not have the necessary plans, Lithos will obtain them direct from each of the utility companies.

Under the CDM Regulations 2015, Lithos must be provided with pre-construction information already in your possession, or information that can reasonably be obtained through sensible enquiry. This information must be relevant to the project, have an appropriate level of detail, and be proportionate to the nature of the risks.

Further work: Will be required and is likely to include:

- Rotary probeholes to: confirm the depth of opencast backfill; highwall gradient; and determine whether extractable coal and/or old mineworkings are present is present (beyond the opencast).
- Further trial pitting (c. 20 no.) to 'tighten' the grid
- Installation of shallow (c. 3m) wells, with subsequent gas monitoring and risk assessment
- Cable percussion boreholes to determine geotechnical properties of the opencast backfill.

And possibly also (if settlement f deep opencast backfill requires rigorous assessment):

- Extensometers. Access tubing is installed in a borehole, and anchored in bedrock at the base of the backfill. Magnetic targets are installed along the tubing, and subsequent measurements of the distance from the top of the access pipe to each magnetic target are taken by lowering a suspended probe on a graduated tape. Any displacement of the ground is assessed by taking

repeated measurements of each target over a period of time. Changes in this distance relative to the datum magnet near the base of the pipe will reflect the fill movements along the axis of the access casing.

- Installation of a grid of survey stations (e.g. Berntsen Sleeved Rod Monuments), and subsequent surveying to determine whether ground levels are changing.
- Zone tests to assist determination of the settlement characteristics associated with lightly loaded foundations via construction of a shallow test pad which is subjected to a fixed load (e.g. large concrete blocks, or stone filled skips), for a prolonged period of time (typically 3 to 12 months).

Terms & conditions: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely



Mark Perrin
Director
for and on behalf of
LITHOS CONSULTING LIMITED

Terms and Conditions for the Appointment of Lithos Consulting Limited

V006.18

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" shall mean these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording the Client's unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing:

"Client" shall mean the party for whom the Services are being provided by Lithos;

"Documents" shall mean all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of Lithos, and whether in paper form or stored electronically or on disk, or otherwise;

"Lithos" shall mean Lithos Consulting Limited whose registered office is at Parkhill, Walton Road, Wetherby, West Yorkshire, LS22 5DZ.

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Parties" shall mean the Client and Lithos

"Project" shall mean the project described in the Proposal and any enquiry from the Client on which Lithos has based its Proposal;

"Proposal" means the offer document prepared by Lithos in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by Lithos pursuant to the Agreement and as set out in the Proposal and shall include any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment".

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

2 APPOINTMENT

2.1 The Client agrees to engage Lithos and Lithos agrees to provide the Services in accordance with the provisions of the Agreement.

3 OBLIGATIONS OF LITHOS

3.1 Lithos shall perform the Services using the reasonable standard of skill and care normally exercised by similar professional Environmental firms in performing similar services under similar conditions.

3.2 Lithos shall use all reasonable endeavours to perform the Services in accordance with all relevant environmental and safety legislation.

4 OBLIGATIONS OF THE CLIENT

4.1 Throughout the period of this Agreement the Client shall afford to Lithos or procure the affording to Lithos of access to any site where access is required for the performance of the Services.

4.2 The Client accepts responsibility for ensuring that Lithos is notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards known or suspected by the Client, which the Client shall clearly mark on the ground or identify on accurate location plans supplied to Lithos prior to the commencement of the Services. The Client shall also inform Lithos in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. The Client shall indemnify Lithos against all costs, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If the Client discovers any conflict, defect or other fault in the information or designs provided by Lithos pursuant to the Agreement, he will advise Lithos in writing of such defect, conflict or other fault and Lithos shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

5 INTELLECTUAL PROPERTY

5.1 The copyright in all Intellectual Property prepared by or on behalf of Lithos in connection with the Project for delivery to the Client shall remain vested in Lithos.

5.2 The Client shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable the Client to copy and use the Intellectual Property but solely for its own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by Lithos.

5.3 Should the Client wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, it must obtain the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and shall be upon such terms as may be required by Lithos. Lithos shall not be liable for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on behalf of Lithos.

5.4 Ownership of any proposals submitted to the Client that are not subsequently confirmed as part of the Services to be provided for the Client remain with Lithos and such proposals must not be used as the basis for any future work undertaken by the Client or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of the Client being in default of payment of any fees or other amounts due, Lithos may suspend further use of the licence on giving 2 days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

6 TITLE

6.1 Lithos shall transfer only such title or rights in respect of the Documents as it has, and if any part is purchased from a third party Lithos shall transfer only such title or rights as that party had and has transferred to Lithos.

6.2 Title in the Documents shall remain with and shall not pass to the Client until the amount due under the invoice(s) (including interest and costs) has been paid in full.

6.3 Until title passes, the Client shall hold the Documents as bailee for Lithos and shall store or mark them so that they can at all times be identified as the property of Lithos.

6.4 At any time before title passes (save and except where payment is not due), but only after prior consultation with the Client, Lithos may without any liability to the Client repossess and use or sell all or any of part of the Documents and by doing so terminate the right of the Client to use, sell or otherwise deal in the Documents.

6.5 Lithos may maintain an action for the price of the Documents notwithstanding that title in them has not passed to the Client.

7 CONFIDENTIALITY AND DATA PROTECTION

7.1 Lithos undertakes not to divulge or disclose to any third party without the written consent of the Client information which is designated confidential by the Client or which can reasonably be considered to be confidential and arises during the performance of the Services unless required to do so by law or necessary in the proper performance of its duties in relation to the Project, or in order to make full frank and proper disclosure to its insurers or intended insurers, or to obtain legal or accounting advice.

7.2 Subject to the above and Lithos' Privacy Policy which can be found on www.lithos.co.uk, Lithos shall be permitted to use information related to the Services it provides in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

8 THIRD PARTIES

8.1 The Agreement or any part thereof or any benefit or interest thereunder may not be assigned by the Client without the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and Lithos will only agree to an assignment on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any assignment.

8.2 The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

8.3 Lithos will consider and may consent to any request from the Client for Lithos to enter a collateral warranty with a third party with regard to the Services provided under the Agreement. The giving of such consent shall be at the discretion of Lithos and Lithos will only enter a collateral warranty on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any collateral warranty.

9 INSURANCE

9.1 Lithos warrants to the Client that there is in force a policy of Professional Indemnity insurance covering its liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, Lithos agrees to use reasonable endeavours to maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under the Agreement, provided such insurance is available at commercially reasonable rates having regard, inter alia, to premiums required and policy terms obtainable.

9.2 If for any period such insurance is not available at commercially reasonable rates, Lithos shall forthwith inform the Client and shall obtain in respect of such period such reduced level of Professional Indemnity insurance as is available and as would be fair and reasonable in the circumstances for Lithos to obtain.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, Lithos' liability under or in connection with the Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either five million pounds in the aggregate (unless it is a pollution, contamination or asbestos claim in which case it is two million pounds in the aggregate) or 10 times the total value of invoices issued to the Client for consultancy work instructed under the Agreement.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against Lithos after the expiry of a period of six years from the date of the completion (or termination) of the Services under the Agreement.

10.3 Whilst Lithos will scan all potential exploratory locations with a Cable Avoidance Tool, Lithos shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 Lithos shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by Lithos or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless Lithos has been advised in writing of the same by the Client and has been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

11 PAYMENT

11.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

11.2 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

11.3 If the Client disputes the amount included for payment in an invoice a written notice must be served on Lithos by the Client not later than 14 days before the final date for payment. If no notice is given the amount due shall be the amount stated in the invoice.

11.4 In the event of failure on the part of the Client to pay any monies in accordance with the foregoing payment provisions, Lithos will be entitled to charge interest on any monies owed to it by the Client, such interest to be at a rate of 8% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis.

12 DELAY

12.1 Lithos will comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond its reasonable control and in the event of any such circumstances arising Lithos undertakes to complete the Services within a reasonable period, but will not be liable to the Client for any delay as a result.

13 TERMINATION

13.1 The Agreement may be terminated by either party in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of termination must be given to the party which is insolvent by the other party.

13.2 If for any reason the performance of the Services by Lithos is suspended for a period in excess of three calendar months then Lithos shall be entitled to terminate its appointment in respect of the Services by seven days written notice to the Client.

13.3 If the Client shall fail to pay in full any sum due under the terms of the Agreement by the final date for payment for that sum and no effective notice of intention to withhold payment has been issued, Lithos may serve written notice on the Client demanding payment within 14 days of such notice. If the Client shall fail to comply with such notice, Lithos shall be entitled to terminate its employment under the Agreement forthwith.

13.4 Any termination of the appointment of Lithos howsoever caused shall be without prejudice to the right of Lithos to require payment for all services performed up to the date of such termination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

14 NOTICES

14.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to the address of Lithos set out above or to the registered address of the Client.

14.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by first class post.

15 ENTIRE AGREEMENT

15.1 The Agreement constitutes the complete and entire agreement between the Client and Lithos with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against Lithos in respect of the Services can only be made in contract under the provisions of the Agreement and not otherwise under the law or tort or otherwise.

15.2 No amendments, modifications or variation of the Agreement shall be valid unless made in writing and agreed to by both the Client and Lithos; such agreement must be recorded in writing by at least one of the Parties.

15.3 Lithos will not be bound by any standard or printed terms or conditions furnished by the Client in any of its documents unless Lithos specifically states in writing separately from such documents that it intends such terms and conditions to apply.

16 DISPUTES AND GOVERNING LAW

16.1 The Agreement shall be governed by and construed in accordance with English law and the Parties irrevocably and unconditionally submit to the jurisdiction of the English Courts.

16.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between the Parties may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

Lewis Whiteley

From: Reg
Sent: 01 April 2019 15:40
To: Adam Clarke
Cc: David Bridges; Alan Swales
Subject: 3207 - Barugh Green

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: New Instruction

Wil do.

Mark Perrin
Director
Lithos Consulting Ltd
M 07703 396 635
DD 01937 545 331

www.lithos.co.uk

From: Adam Clarke <AdamC@cpplc.com>
Sent: 01 April 2019 15:24
To: Reg <Reg@lithos.co.uk>
Cc: David Bridges <David.Bridges@cpplc.com>
Subject: FW: Barugh Green

Afternoon Reg

Please take this email as instruction to proceed with this work.

Either myself or Dave will send through an appointment letter this week.

Could you let us know when you anticipate carrying out the trial pitting as we may pop down to site

Thanks

Adam

Adam Clarke
Development Engineer
Partnerships Yorkshire
Countryside Properties (UK) Ltd
3200 Century Way
Thorpe Park
Leeds
LS15 8ZB

M: 07468 702603 I countryside-properties.com

From: Reg <Reg@lithos.co.uk>
Sent: 01 April 2019 15:19
To: Mark Bray <Mark.Bray@cpplc.com>
Subject: [EXTERNAL] Barugh Green

OK, here's the formal quote. Should be able to squeeze in next week, if I can take your earlier e-mail as formal instruction.

ta

Mark Perrin
Director
Lithos Consulting Ltd
M 07703 396 635
DD 01937 545 331

www.lithos.co.uk

From: Mark Bray <Mark.Bray@cpplc.com>
Sent: 01 April 2019 12:50
To: Reg <Reg@lithos.co.uk>
Subject: RE: Barugh Green

Hi Reg,

Lets go for the 1 day event!

Cheers.

Mark

Mark Bray
Development Director
Partnerships Yorkshire
3200 Century Way
Thorpe Park
Leeds
LS15 8ZB

M: 07468 702711 I countrysideproperties.com

From: Reg <Reg@lithos.co.uk>
Sent: 29 March 2019 16:30
To: Mark Bray <Mark.Bray@cpplc.com>
Subject: [EXTERNAL] RE: Barugh Green

Mark

Breakdown for "quick look/see" exploratory SI - **£** . It allows for searches (incl. opencast abandonment plan) & 1 days' pitting. No testing; just a simple letter report. If you wanted to do a bit more, we could go for a 2nd days' pitting (add £).

Let me know, and I'll sort formal letter on Monday.

Regards

Mark Perrin
Director
Lithos Consulting Ltd
M 07703 396 635
DD 01937 545 331

www.lithos.co.uk

008/3407/Reg

19th February 2020

Registered in England 07068066

Parkhill
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LS22 5DZ

T 01937 545 330

www.lithos.co.uk

Mr A Clarke
Countryside Properties
3200 Thorpe Park
Century Way
Leeds
LS15 8ZB

Dear Adam

Barugh Green

Further to your recent invitation, please find attached our proposal for undertaking a site investigation on the above land. We understand that your proposed development will include traditional 2 storey domestic dwellings with associated gardens, POS and adoptable roads and sewers; a feasibility layout showing 121 units has been provided.

As you know we have already completed some initial research and an exploratory days' pitting; key findings of which are summarised below:

- The shallowest recorded mineworkings beneath this site are in the Flockton Thick seam (c. 0.7m thick at c. 125m bgl). However, the possibility of unrecorded shallow workings cannot be discounted, and if present would have significant implications for the proposed development.
- The western half and far southeast of the site are located within Coal Mining Development High Risk Areas due to previous opencast operations. Opencast backfill within the area of current interest is only expected to be around 5m to 10m deep.
- Trial trenching suggests the highwall locations roughly correspond to those shown on CA abandonment plans.
- The presence of deep opencast backfill has implications for foundations, drainage, new utilities & highways.

Given the depth of the fill and its age, and following discussion with Surepath (our specialist geotechnical sub-consultant), we do not expect settlement to be critical except over high walls (and internal walls if present – none are indicated). This assumes though that the fill is not atypical in composition or density. We need to establish the nature of the fill, as even if piles are used the surrounding development will settle relative to the houses.

Consequently, the ground investigation proposed here includes cable percussion boreholes with some with some classification testing and SPTs. Rotary probeholes are also proposed in order to check for the presence of shallow mineworkings, both beneath & beyond areas of known opencast.

This proposal also allows for a brief independent site appraisal by **Surepath**, to supplement Lithos' desk study, including:

- A review of our GI report and site photographs / plans
- Appraisal of the geometry of the quarry based on the available data
- Appraisal of the nature of the backfill and its properties
- Assessment of the likely sources of backfill movement and the likely range of settlements that the backfilled area could be subject to
- Discussion of the findings and the main development implications

Preliminary assessment will enable us to provide an order of magnitude of likely movements for your consideration and discussion with the NHBC etc.

If indications are that settlements could be important (this is not anticipated) then additional testing / monitoring could be required.

Our site investigation will be undertaken in accordance with UK good practice (as outlined in BS5930, BS10175, CLR11 etc). Our Report may not be fully compliant with Eurocode 7 (EC7) and will not purport to be a Ground Investigation Report, nor a Geotechnical Design Report as defined by EC7. Our ground appraisal is intended to assist others as they proceed with design of the proposed development.

This proposal allows for the following works:

Desk study: We already have environmental search data and historical maps (obtained from Landmark or Groundsure), and a Consultant's mining report from the Coal Authority.

We will complete a more detailed review of this data in order to draft a "traditional desk study" (to date only a letter report has been issued).

Fieldwork: We have allowed for a further 2 day's trial pitting (to 'tighten' the existing grid), the drilling of 5 cable percussion boreholes, and the drilling of c. 25 rotary probeholes. All trial pits and boreholes will be supervised and logged by an experienced geoenvironmental engineer.

Given nature of the land and the time of year, we have allowed for pits to be dug using a tracked 360° excavator.

We will make every effort to compact arisings and 'sweep' them over each **trial pit**. However, you should be aware that on completion of the investigation, "graves" of spoil (each about 3m long by 1m wide) unsuitable for trafficking, will be left up to 400mm proud at each trial pit location. At this stage, no allowance has been made for any further reinstatement such as removal of excess arisings, replacement of turf.

Based on anticipated ground, **soakaways** will not provide a satisfactory solution for surface water drainage, and no allowance has been made for soakaway testing.

Representative soil samples of natural and man-made ground, including any contaminated samples, will be taken during the works. In-situ shear strengths of any cohesive soils encountered will be determined by the use of a hand-held shear vane.

The cable percussion **boreholes** will be advanced to depths of c. 10m or refusal in bedrock, whichever is the deeper, and are primarily intended to enable the retrieval of geotechnical data from depth within the opencast backfill where piled foundations are anticipated.

However, boreholes will also allow the installation of gas wells (50mm ID, HDPE pipework with bentonite seals and a gravel filter pack). Well headworks will comprise a 100mm diameter steel security helmet which will extend about 300mm above ground level (if required, the position of each helmet could be "marked" with a 1.5m high fence post to reduce the likelihood of damage by farm machinery).

SPTs will be undertaken at approximate 1m intervals as the boreholes are advanced. SPTs allow assessment of the in-situ density of granular soils, enabling determination of allowable bearing capacity and thereby definitive foundation advice.

The borehole will be cased-off during drilling to at least rock head, in order to reduce the possibility of groundwater ingress, mis-sampling etc.

This investigation should yield sufficient data to enable a foundation zoning plan, and possibly a detailed Foundation Schedule. However, if ground conditions are found to be more variable than anticipated, a 'tighter' grid of pits will be necessary prior to preparation of a detailed Foundation

Schedule. This proposal does not allow for the preparation of a detailed Foundation Schedule, but we will provide a quote on completion of the site investigation if requested.

The site is underlain by several coal seams, and therefore we have allowed for the drilling of c. 25 **rotary probeholes** to check for the presence of mineworkings. This drilling should be sufficient to determine whether old mineworkings are present and pose a significant risk to surface stability of the site. However, if a potential risk is perceived to exist, further probeholes may be required to delineate the extent of workings in order to obtain fixed price quotations for the necessary consolidation works.

It will be necessary to submit an application (with the associated fee) to the Coal Authority (CA) for 'Permission to enter CA mining interests'; and we have allowed for this. Given the proximity of surrounding housing (within 50m of some of the general site area), and in accordance with CA requirements we have had to assume that the probeholes will need to be advanced using water as the flushing medium (as reinforced by recent CA guidance on managing the risk of hazardous gas). Our drilling sub-contractor will need to locate the wash outs close to the site, and procure a standpipe and licence from Yorkshire Water.

With reference to the control, management and disposal of surplus water and flush arising from the works, (and in order to avoid additional costs associated with the provision of a telehandler to transfer a weir tank between boreholes, and the provision of a pump to transfer surplus water from the weir tank to an approved disposal point), we have made provision for a sand bag bund at the foot of the drilling mast, at each borehole to contain the majority of the drill cuttings. However, we have assumed that potentially discoloured surplus water will be allowed to flow and settle into the field.

We have also assumed that it will be possible to park plant overnight within the farmyard, where it will be more secure.

We have allowed for all exploratory holes to be picked-up by a **surveyor** (co-ordinates/ground levels will be included on the logs).

Given the presence of deep opencast backfill, we have allowed for the installation of wells in c. 15 boreholes and monitoring for hazardous **gas** (and any shallow groundwater).

The generation potential of this gas source is considered likely to be Low. Therefore, in accordance with CIRIA Report C665, we have initially allowed for 9 visits over a 6-month period. A hazardous gas risk assessment will be issued on completion of monitoring.

Testing: This will comprise routine **geotechnical** soils analysis, including 40 moisture content & Atterberg limits, and 40 pH & water-soluble sulphate. We will also schedule 12 compaction tests on samples of made ground to assess suitability for use in earthworks ground improvement.

This site is underlain by opencast backfill which is likely to be subject to re-engineering prior to the construction of new estate roads. Consequently, there is no merit in obtaining CBR values at this stage.

Appropriate **chemical analyses**, based on our knowledge of the site's history, have been allowed for; this will comprise 30 samples for a suite including heavy metals, speciated PAH, and banded TPH (with supplementary speciation as/where appropriate). In the event that ground contamination is more significant or different to that anticipated, it might be necessary to carry out additional chemical testing.

Within in our proposal we have allowed for the screening (ID) of 30 samples for asbestos. In the event that positive IDs are reported, it is likely that we will need to schedule further analysis (asbestos quantification), in order to determine the significance of the results. Asbestos quantification is currently a relatively expensive test and consequently we have not allowed for it at this stage. We will inform you immediately after receipt of results if we consider asbestos quantification is required.

Reporting & timescales: In order to provide you with sufficient information to enable assessment of abnormal costs at the earliest opportunity we will issue a concise overview report within 3 days of fieldwork completion.

On completion of the desk study, fieldwork and laboratory testing a comprehensive, factual and interpretative report will be issued. This will contain detailed engineering records, laboratory test results, copies of all relevant correspondence and drawings of the site. The report will include qualitative risk assessment with respect to both controlled waters and human health. The report will also include consideration of foundation types.

Fieldwork could be commenced within 4 weeks of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report will be issued within 4 weeks of fieldwork completion. This report will comment on issues associated with hazardous gas, but the gas risk assessment will not be issued until monitoring is completed.

A completed copy of the **YW** Contaminated Land Assessment Form will be included in an Appendix to our Report.

A copy of the final report will be issued to the relevant regulatory authorities on receipt of written instruction from yourselves.

Invoicing: The attached proposal provides a breakdown of the costs associated with this project. This breakdown is for information only and the proposal can be regarded as a lump sum price of **£** plus VAT. Variation will only occur in the event that a given item is not undertaken or that substantial additional works are recommended, in which case we will inform you immediately, provide costs for the required works, and seek your prior consent.

Our proposal allows for submission of the report to the Local Authority and NHBC, and for submission of a single piece of subsequent correspondence with each regulator to address any queries they may have. Any further meetings, correspondence etc, would be chargeable.

We will submit invoices for this project at the milestones defined below:

- 1st milestone invoice (Items A) on issue of the Desk Study report
- 2nd milestone invoice (Items B to E) within 5 days of fieldwork completion, with exploratory hole logs and an interim letter report outlining our initial findings
- 3rd milestone invoice (Item F to I) on issue of the final SI report
- 4th and final invoice (Item J) after completion of the gas monitoring/issue of the supplementary letter report

Health, safety & welfare: The works outlined above will be carried out in accordance with Lithos' task- and site- specific Risk Assessments and Method Statements.

Details of welfare will be included within the Method Statements, however, this investigation is expected to be completed within 5 working days and therefore it is not considered reasonably practicable to provide formal welfare facilities, and our proposal makes no allowance for so doing. However, we have allowed for mobilisation and use of a welfare van.

Utility plans are required in order to protect operatives from the hazards associated with striking buried services and avoid potentially substantial disruption\repair costs. We will make every effort not to damage any services (including review of utility plans and use of a CAT detector). However, Lithos cannot accept liability for damage to any underground services that are not accurately marked on plans made available to us prior to commencement of our field investigation, or have not been accurately marked on the ground by a responsible third party (e.g. utility company, site owner).

Most developers have copies of the necessary utility plans (including electricity, gas, water, drainage & telecom), and it would be appreciated if you could forward these prior to the proposed fieldworks.

However, if you do not have the necessary plans, Lithos will obtain them direct from each of the utility companies.

Under the **CDM** Regulations 2015, Lithos must be provided with pre-construction information already in your possession, or information that can reasonably be obtained through sensible enquiry. This information must be relevant to the project, have an appropriate level of detail, and be proportionate to the nature of the risks.

Further work: In addition to the investigation outlined above, further work that might be required, in light of initial findings and EA feedback, could include:

- Further cable percussion boreholes within the opencast backfill.
- In accordance with BS 8004:2015 and EC7, if piled foundations are anticipated, piling contractors may request that boreholes be extended a minimum 5m into competent bedrock using rotary coring techniques.
- Preparation of a Remediation Statement.
- Installation of extensometers.
- Installation of a grid of survey stations, and subsequent surveying to determine whether ground levels are changing.
- Zone tests via construction of a shallow test pad.

Terms & conditions: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely



Mark Perrin
Director
for and on behalf of
LITHOS CONSULTING LIMITED

Terms and Conditions for the Appointment of Lithos Consulting Limited

V006.18

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" shall mean these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording the Client's unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing:

"Client" shall mean the party for whom the Services are being provided by Lithos;

"Documents" shall mean all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of Lithos, and whether in paper form or stored electronically or on disk, or otherwise;

"Lithos" shall mean Lithos Consulting Limited whose registered office is at Parkhill, Walton Road, Wetherby, West Yorkshire, LS22 5DZ.

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Parties" shall mean the Client and Lithos

"Project" shall mean the project described in the Proposal and any enquiry from the Client on which Lithos has based its Proposal;

"Proposal" means the offer document prepared by Lithos in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by Lithos pursuant to the Agreement and as set out in the Proposal and shall include any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment".

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

2 APPOINTMENT

2.1 The Client agrees to engage Lithos and Lithos agrees to provide the Services in accordance with the provisions of the Agreement.

3 OBLIGATIONS OF LITHOS

3.1 Lithos shall perform the Services using the reasonable standard of skill and care normally exercised by similar professional Environmental firms in performing similar services under similar conditions.

3.2 Lithos shall use all reasonable endeavours to perform the Services in accordance with all relevant environmental and safety legislation.

4 OBLIGATIONS OF THE CLIENT

4.1 Throughout the period of this Agreement the Client shall afford to Lithos or procure the affording to Lithos of access to any site where access is required for the performance of the Services.

4.2 The Client accepts responsibility for ensuring that Lithos is notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards known or suspected by the Client, which the Client shall clearly mark on the ground or identify on accurate location plans supplied to Lithos prior to the commencement of the Services. The Client shall also inform Lithos in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. The Client shall indemnify Lithos against all costs, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If the Client discovers any conflict, defect or other fault in the information or designs provided by Lithos pursuant to the Agreement, he will advise Lithos in writing of such defect, conflict or other fault and Lithos shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

5 INTELLECTUAL PROPERTY

5.1 The copyright in all Intellectual Property prepared by or on behalf of Lithos in connection with the Project for delivery to the Client shall remain vested in Lithos.

5.2 The Client shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable the Client to copy and use the Intellectual Property but solely for its own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by Lithos.

5.3 Should the Client wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, it must obtain the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and shall be upon such terms as may be required by Lithos. Lithos shall not be liable for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on behalf of Lithos.

5.4 Ownership of any proposals submitted to the Client that are not subsequently confirmed as part of the Services to be provided for the Client remain with Lithos and such proposals must not be used as the basis for any future work undertaken by the Client or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of the Client being in default of payment of any fees or other amounts due, Lithos may suspend further use of the licence on giving 2 days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

6 TITLE

6.1 Lithos shall transfer only such title or rights in respect of the Documents as it has, and if any part is purchased from a third party Lithos shall transfer only such title or rights as that party had and has transferred to Lithos.

6.2 Title in the Documents shall remain with and shall not pass to the Client until the amount due under the invoice(s) (including interest and costs) has been paid in full.

6.3 Until title passes, the Client shall hold the Documents as bailee for Lithos and shall store or mark them so that they can at all times be identified as the property of Lithos.

6.4 At any time before title passes (save and except where payment is not due), but only after prior consultation with the Client, Lithos may without any liability to the Client repossess and use or sell all or any of part of the Documents and by doing so terminate the right of the Client to use, sell or otherwise deal in the Documents.

6.5 Lithos may maintain an action for the price of the Documents notwithstanding that title in them has not passed to the Client.

7 CONFIDENTIALITY AND DATA PROTECTION

7.1 Lithos undertakes not to divulge or disclose to any third party without the written consent of the Client information which is designated confidential by the Client or which can reasonably be considered to be confidential and arises during the performance of the Services unless required to do so by law or necessary in the proper performance of its duties in relation to the Project, or in order to make full frank and proper disclosure to its insurers or intended insurers, or to obtain legal or accounting advice.

7.2 Subject to the above and Lithos' Privacy Policy which can be found on www.lithos.co.uk, Lithos shall be permitted to use information related to the Services it provides in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

8 THIRD PARTIES

8.1 The Agreement or any part thereof or any benefit or interest thereunder may not be assigned by the Client without the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and Lithos will only agree to an assignment on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any assignment.

8.2 The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

8.3 Lithos will consider and may consent to any request from the Client for Lithos to enter a collateral warranty with a third party with regard to the Services provided under the Agreement. The giving of such consent shall be at the discretion of Lithos and Lithos will only enter a collateral warranty on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any collateral warranty.

9 INSURANCE

9.1 Lithos warrants to the Client that there is in force a policy of Professional Indemnity insurance covering its liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, Lithos agrees to use reasonable endeavours to maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under the Agreement, provided such insurance is available at commercially reasonable rates having regard, inter alia, to premiums required and policy terms obtainable.

9.2 If for any period such insurance is not available at commercially reasonable rates, Lithos shall forthwith inform the Client and shall obtain in respect of such period such reduced level of Professional Indemnity insurance as is available and as would be fair and reasonable in the circumstances for Lithos to obtain.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, Lithos' liability under or in connection with the Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either five million pounds in the aggregate (unless it is a pollution, contamination or asbestos claim in which case it is two million pounds in the aggregate) or 10 times the total value of invoices issued to the Client for consultancy work instructed under the Agreement.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against Lithos after the expiry of a period of six years from the date of the completion (or termination) of the Services under the Agreement.

10.3 Whilst Lithos will scan all potential exploratory locations with a Cable Avoidance Tool, Lithos shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 Lithos shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by Lithos or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless Lithos has been advised in writing of the same by the Client and has been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

11 PAYMENT

11.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

11.2 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

11.3 If the Client disputes the amount included for payment in an invoice a written notice must be served on Lithos by the Client not later than 14 days before the final date for payment. If no notice is given the amount due shall be the amount stated in the invoice.

11.4 In the event of failure on the part of the Client to pay any monies in accordance with the foregoing payment provisions, Lithos will be entitled to charge interest on any monies owed to it by the Client, such interest to be at a rate of 8% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis.

12 DELAY

12.1 Lithos will comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond its reasonable control and in the event of any such circumstances arising Lithos undertakes to complete the Services within a reasonable period, but will not be liable to the Client for any delay as a result.

13 TERMINATION

13.1 The Agreement may be terminated by either party in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of termination must be given to the party which is insolvent by the other party.

13.2 If for any reason the performance of the Services by Lithos is suspended for a period in excess of three calendar months then Lithos shall be entitled to terminate its appointment in respect of the Services by seven days written notice to the Client.

13.3 If the Client shall fail to pay in full any sum due under the terms of the Agreement by the final date for payment for that sum and no effective notice of intention to withhold payment has been issued, Lithos may serve written notice on the Client demanding payment within 14 days of such notice. If the Client shall fail to comply with such notice, Lithos shall be entitled to terminate its employment under the Agreement forthwith.

13.4 Any termination of the appointment of Lithos howsoever caused shall be without prejudice to the right of Lithos to require payment for all services performed up to the date of such termination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

14 NOTICES

14.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to the address of Lithos set out above or to the registered address of the Client.

14.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by first class post.

15 ENTIRE AGREEMENT

15.1 The Agreement constitutes the complete and entire agreement between the Client and Lithos with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against Lithos in respect of the Services can only be made in contract under the provisions of the Agreement and not otherwise under the law or tort or otherwise.

15.2 No amendments, modifications or variation of the Agreement shall be valid unless made in writing and agreed to by both the Client and Lithos; such agreement must be recorded in writing by at least one of the Parties.

15.3 Lithos will not be bound by any standard or printed terms or conditions furnished by the Client in any of its documents unless Lithos specifically states in writing separately from such documents that it intends such terms and conditions to apply.

16 DISPUTES AND GOVERNING LAW

16.1 The Agreement shall be governed by and construed in accordance with English law and the Parties irrevocably and unconditionally submit to the jurisdiction of the English Courts.

16.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between the Parties may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

Lewis Whiteley

From: Mark Bray <Mark.Bray@cpplc.com>
Sent: 13 July 2020 12:31
To: Reg
Subject: Barugh Green

Hi Reg,

Further to our telephone conversation please accept this e-mail as confirmation to proceed with the rotary hole exploration as per item E quote number 3407/2 dated 19th February 2020.

Cheers.

Mark

Mark Bray
Development Director

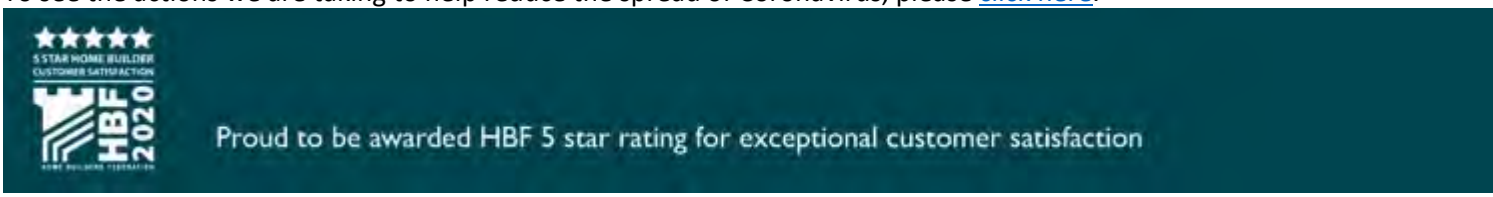
Division: Yorkshire

Aeris, 3200 Century Way, Thorpe Park, Leeds, LS15 8ZB

T: 01135 324482 I M: 07468 702711 I countrysideproperties.com

COUNTRYSIDE
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To see the actions we are taking to help reduce the spread of Coronavirus, please click here.



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026/3407/AG

27th October 2021

Mr A Clarke
Countryside Properties
3200 Thorpe Park
Century Way
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Parkhill
Wetherby
West Yorkshire
LS22 5DZ

T 01937 545 330

www.lithos.co.uk

Dear Adam

Barugh Green Road, Barnsley

Further to your recent invitation, please find attached our updated proposal (additions in blue text) which now also allows for an additional days' trial trenching (3 days in total) to locate the buried highwall, and an additional cable percussive borehole (6 in total) within the footprint of the former Craven 1 opencast.

The rotary probeholes were completed in August 2020 (016/3407/GLM), with additional rotary drilling not deemed necessary at this stage. The requirement to utilise Surepath as specialist geotechnical sub-consultant is not required, as this work can now be done inhouse.

We understand that your proposed development will include traditional 2 storey domestic dwellings with associated gardens, POS and adoptable roads and sewers; a feasibility layout showing 121 units has been provided.

As you know we have already completed a Desk Study, an exploratory days' pitting and the drilling of 25 rotary probeholes; key findings of which are summarised below:

- The shallowest recorded mineworking's beneath this site are in the Flockton Thick seam (c. 0.7m thick at c. 125m bgl).
- No evidence of underground mineworking's has been encountered in any shallow coal seams, including the Thin and Swallow Wood coals that underlie the site at shallow depth in the north and east (beyond the area of opencast), and the Top Haigh Moor and Low Haigh Moor coals that underlie the opencast.
- The western half and far southeast of the site are located within Coal Mining Development High Risk Areas due to previous opencast operations. Opencast backfill within the area of current interest is only expected to be around 6m to 11m deep.
- Preliminary trial trenching suggests the highwall locations roughly correspond to those shown on CA abandonment plans.
- The presence of deep opencast backfill has implications for foundations, drainage, new utilities & highways.

We have assumed that all plots within the former opencast will be piled. Given the depth of the fill and its age, we do not expect settlement to be critical, assuming that the fill is not atypical in composition or density. However, we still need to establish the nature of the fill, as even if piles are used, the surrounding development will settle relative to the houses, which will be a concern that NHBC will want to be resolved / quantified prior to construction.

Consequently, the ground investigation proposed here includes 6 cable percussion boreholes with some with some classification testing, SPTs, laboratory consolidation and strength tests. The cable

percussive boreholes will also be used to assess the risk associated with below ground obstructions (boulders), which will be key to determining the pile type and installation method.

This proposal also allows for a detailed review of the ground investigation findings (boreholes, trial pits and laboratory testing) and preliminary settlement assessment including:

- A detailed review of the GI findings, site photographs and plans
- Appraisal of the geometry of the quarry based on the available data
- Appraisal of the nature of the backfill and its properties
- Assessment of the likely sources of backfill movement and the likely range of settlements that the backfilled area could be subject to
- Discussion of the findings and the main development implications

Preliminary assessment will enable us to provide an order of magnitude of likely movements for your consideration and discussion with the NHBC etc. If indications are that settlements could be important (this is not anticipated) then additional testing / monitoring could be required.

Our site investigation will be undertaken in accordance with UK good practice (as outlined in BS5930, BS10175, CLR11 etc). Our Report may not be fully compliant with Eurocode 7 (EC7) and will not purport to be a Ground Investigation Report, nor a Geotechnical Design Report as defined by EC7. Our ground appraisal is intended to assist others as they proceed with design of the proposed development.

This proposal allows for the following works:

Desk study: We already have completed a Desk Study for the site (3407/1B, dated August 2020). We will incorporate this information into our GI report.

Fieldwork: We have allowed for a further 2 day's trial pitting (to 'tighten' the existing grid), 1 day trial trenching to locate the buried highwall and the drilling of 6 cable percussion boreholes. All trial pits and boreholes will be supervised and logged by an experienced geoenvironmental engineer.

Trial pitting / trenching will enable us to determine the:

- Nature of the opencast backfill, including:
  - visual/olfactory evidence of potential contamination and the proportion of undesirable elements e.g. biodegradable matter, etc
  - the proportion of "oversize", boulder-sized material
  - the location and extent of the opencast, with trenching to locate the opencast high wall
- Nature, distribution and thickness of shallow soils beyond the former opencast
- Suitability of the ground for founding structures and highways

Given nature of the land and the time of year, we have allowed for pits and trenches to be dug using a tracked 360° excavator. We have also allowed for the hire of ground guards to facilitate plant / rig movement around the site during wet weather.

Representative soil samples of natural and man-made ground, including any contaminated samples, will be taken during the works. In-situ shear strengths of any cohesive soils encountered will be determined by the use of a hand-held shear vane.

We will make every effort to compact arisings and 'sweep' them over each **trial pit / trial trench**. However, you should be aware that on completion of the investigation, "graves" of spoil (each about 3m long by 1m wide) unsuitable for trafficking, will be left up to 400mm proud at each trial pit location. At this stage, no allowance has been made for any further reinstatement such as removal of excess arisings, replacement of turf.

Based on anticipated ground, **soakaways** will not provide a satisfactory solution for surface water drainage, and no allowance has been made for soakaway testing.

Representative soil samples of natural and man-made ground, including any contaminated samples, will be taken during the works. In-situ shear strengths of any cohesive soils encountered will be determined by the use of a hand-held shear vane.

The cable percussion **boreholes** will be advanced to depths of c. 10m to 12m or refusal in bedrock, whichever is the deeper, and are primarily intended to enable the retrieval of geotechnical data and representative samples from depth within the opencast backfill where piled foundations are anticipated.

Boreholes will also allow the installation of gas wells (50mm ID, HDPE pipework with bentonite seals and a gravel filter pack). Well headworks will comprise a 100mm diameter steel security helmet which will extend about 300mm above ground level (if required, the position of each helmet could be "marked" with a 1.5m high fence post to reduce the likelihood of damage by farm machinery).

SPTs will be undertaken at approximate 1m intervals as the boreholes are advanced. SPTs allow assessment of the in-situ density of granular soils, enabling determination of allowable bearing capacity and thereby definitive foundation advice.

The boreholes will be cased-off during drilling to at least rock head, in order to reduce the possibility of groundwater ingress, mis-sampling etc.

This investigation should yield sufficient data to enable a foundation zoning plan, and possibly a detailed Foundation Schedule. However, if ground conditions are found to be more variable than anticipated, a 'tighter' grid of pits will be necessary prior to preparation of a detailed Foundation Schedule. This proposal does not allow for the preparation of a detailed Foundation Schedule, but we will provide a quote on completion of the site investigation if requested.

At this stage, we have assumed that overnight security will not be required, but this will be reviewed following a site visit. If required, security would be an E\O of £ per night.

We have allowed for all exploratory holes to be picked-up by a **surveyor** (co-ordinates/ground levels will be included on the logs).

Given the presence of deep opencast backfill, we have allowed for the installation of wells in c. 6 additional boreholes (8 wells were installed as part of the rotary drilling, which should still be serviceable) and monitoring for hazardous **gas** (and any shallow groundwater).

The generation potential of this gas source is considered likely to be Low. Therefore, in accordance with CIRIA Report C665, we have initially allowed for 9 visits over a 6-month period. A hazardous gas risk assessment will be issued on completion of monitoring.

Testing: This will comprise routine **geotechnical** soils analysis, including 40 moisture content & Atterberg limits, and 40 pH & water-soluble sulphate. We will also schedule 12 compaction tests on samples of made ground to assess suitability for use in earthworks ground improvement.

Given the anticipated deep opencast backfill, we have allowed for single stage, undrained unconsolidated triaxial tests on 8 undisturbed samples to assess shear strength, and one-dimensional analysis on 8 undisturbed samples to enable assessment of the potential for settlement and thereby the effects of down-drag (negative skin friction).

This site is underlain by opencast backfill which is likely to be subject to re-engineering prior to the construction of new estate roads. Consequently, there is no merit in obtaining CBR values at this stage.

Appropriate **chemical analyses**, based on our knowledge of the site's history, have been allowed for; this will comprise 30 samples for a suite including heavy metals, speciated PAH, and banded TPH (with supplementary speciation as/where appropriate). In the event that ground contamination is more significant or different to that anticipated, it might be necessary to carry out additional chemical testing.

Within in our proposal we have allowed for the screening (ID) of 30 samples for asbestos. In the event that positive IDs are reported, it is likely that we will need to schedule further analysis (asbestos quantification), in order to determine the significance of the results. Asbestos quantification is currently a relatively expensive test and consequently we have not allowed for it at this stage. We will inform you immediately after receipt of results if we consider asbestos quantification is required.

Decommissioning of monitoring wells removes the potential for groundwater pollution caused by accidental spillages during the construction phase and prevents gas migration into sub-floor voids. Subject to your instruction, we will decommission accessible wells after the last monitoring visit for an E\O price of £ +VAT. We will contact you to seek instruction following issue of our gas risk assessment / groundwater dip results.

Reporting & timescales: In order to provide you with sufficient information to enable assessment of abnormal costs at the earliest opportunity we will issue a concise overview report within 3 days of fieldwork completion.

On completion of the fieldwork and laboratory testing a comprehensive, factual and interpretative report will be issued. This will contain exploratory hole logs, cross sections, laboratory test results, copies of all relevant correspondence and drawings of the site. The report will include qualitative risk assessment with respect to both controlled waters and human health. The report will also include a settlement assessment and consideration of foundation types.

At the time of writing, fieldwork could be commenced within 4 to 6 weeks of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report will be issued within 4 to 6 weeks of fieldwork completion. This report will comment on issues associated with hazardous gas, but the gas risk assessment will not be issued until monitoring is completed.

A completed copy of the **YW** Contaminated Land Assessment Form will be included in an Appendix to our Report. However, the proposed route(s), and total length, of water supply pipes are not currently known and no allowance has been made for laboratory testing of soil samples in line with UKWIR guidance.

Our proposal allows for submission of the report to the Local Authority and NHBC, and for submission of a single piece of subsequent correspondence with each regulator to address any queries they may have. Any further meetings, correspondence etc, would be chargeable.

Invoicing: The attached proposal provides a breakdown of the costs associated with this project. This breakdown is for information only and the proposal can be regarded as a lump sum price of **£** plus VAT. Variation will only occur in the event that a given item is not undertaken or that substantial additional works are recommended, in which case we will inform you immediately, provide costs for the required works, and seek your prior consent.

We will submit invoices for this project on completion of each Item(s) instructed.

Please note if following instruction of the works outlined in this proposal, it is necessary to subsequently **postpone or cancel**, this should be done at least 3 working days before Lithos are due to commence intrusive investigation on site. We reserve the right to charge a cancellation fee in the event of later notification to cover plant / drill rig costs and abortive consultancy time. The cancellation fee will not exceed £ plus VAT.

Health, safety & welfare: The works outlined above will be carried out in accordance with Lithos' task- and site- specific Risk Assessments and Method Statements.

Details of welfare will be included within the Method Statements, however, this investigation is expected to be completed within 10 working days and therefore it is not considered reasonably practicable to provide formal welfare facilities, and our proposal makes no allowance for so doing. However, we have allowed for mobilisation and use of a welfare van. Immediately prior to commencement of fieldwork, a site compound will be established in a location to be agreed, secured with Heras fencing; equipment and plant will be stored here overnight.

Utility plans are required in order to protect operatives from the hazards associated with striking buried services and avoid potentially substantial disruption\repair costs. We will make every effort not to damage any services (including review of utility plans and use of a CAT detector). However, Lithos cannot accept liability for damage to any underground services that are not accurately marked on plans made available to us prior to commencement of our field investigation, or have not been accurately marked on the ground by a responsible third party (e.g. utility company, site owner).

Most developers have copies of the necessary utility plans (including electricity, gas, water, drainage & telecom), and it would be appreciated if you could forward these prior to the proposed fieldworks. However, if you do not have the necessary plans, Lithos will obtain them direct from each of the utility companies.

Under the **CDM** Regulations 2015, Lithos must be provided with pre-construction information already in your possession, or information that can reasonably be obtained through sensible enquiry. This information must be relevant to the project, have an appropriate level of detail, and be proportionate to the nature of the risks.

If no other designers or contractors have been appointed, Lithos could perform the role of Principal Contractor but only for the duration of the site investigation outlined in this proposal. If you require us to perform the role of Principal Contractor, please make this clear in your instruction. It should be noted that we are not suitably qualified to perform either role where other designers or contractors are also appointed.

It is anticipated that the site investigation outlined in this proposal will be undertaken several months before any construction is commenced on site. Consequently, our works can be considered in isolation and, given the anticipated number of person days on site, this site investigation is not notifiable to the HSE.

Further work: In addition to the investigation outlined above, further work that might be required, in light of initial findings and EA feedback, could include:

- Further cable percussion boreholes within the opencast backfill.
- In accordance with BS 8004:2015 and EC7, if piled foundations are anticipated, piling contractors may request that boreholes be extended a minimum 5m into competent bedrock using rotary coring techniques.
- Preparation of a Remediation Statement.
- Installation of a grid of survey stations, and subsequent surveying to determine whether ground levels are changing.
- Zone tests via construction of a shallow test pad (only if ground bearing foundation were to be considered in the backfilled opencast).

Terms & conditions: Countryside and Lithos have an agreed Appointment document, and this work will be undertaken in accordance with that. However, if the Appointment term expires or remains unsigned, works will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely



Adam Gombocz
Associate Director
for and on behalf of
LITHOS CONSULTING LIMITED

Terms and Conditions for the Appointment of Lithos Consulting Limited

V007.20

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" shall mean these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording the Client's unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing:

"Client" shall mean the party for whom the Services are being provided by Lithos;

"Documents" shall mean all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of Lithos, and whether in paper form or stored electronically or on disk, or otherwise;

"Lithos" shall mean Lithos Consulting Limited whose registered office is at Parkhill, Walton Road, Wetherby, West Yorkshire, LS22 5DZ.

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Parties" shall mean the Client and Lithos

"Project" shall mean the project described in the Proposal and any enquiry from the Client on which Lithos has based its Proposal;

"Proposal" means the offer document prepared by Lithos in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by Lithos pursuant to the Agreement and as set out in the Proposal and shall include any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment".

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

2 APPOINTMENT

2.1 The Client agrees to engage Lithos and Lithos agrees to provide the Services in accordance with the provisions of the Agreement.

3 OBLIGATIONS OF LITHOS

3.1 Lithos shall perform the Services using the reasonable standard of skill and care normally exercised by similar professional Environmental firms in performing similar services under similar conditions.

3.2 Lithos shall use all reasonable endeavours to perform the Services in accordance with all relevant environmental and safety legislation.

4 OBLIGATIONS OF THE CLIENT

4.1 Throughout the period of this Agreement the Client shall afford to Lithos or procure the affording to Lithos of access to any site where access is required for the performance of the Services.

4.2 The Client accepts responsibility for ensuring that Lithos is notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards known or suspected by the Client, which the Client shall clearly mark on the ground or identify on accurate location plans supplied to Lithos prior to the commencement of the Services. The Client shall also inform Lithos in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. The Client shall indemnify Lithos against all costs, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If the Client discovers any conflict, defect or other fault in the information or designs provided by Lithos pursuant to the Agreement, he will advise Lithos in writing of such defect, conflict or other fault and Lithos shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

5 INTELLECTUAL PROPERTY

5.1 The copyright in all Intellectual Property prepared by or on behalf of Lithos in connection with the Project for delivery to the Client shall remain vested in Lithos.

5.2 The Client shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable the Client to copy and use the Intellectual Property but solely for its own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by Lithos.

5.3 Should the Client wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, it must obtain the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and shall be upon such terms as may be required by Lithos. Lithos shall not be liable for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on behalf of Lithos.

5.4 Ownership of any proposals submitted to the Client that are not subsequently confirmed as part of the Services to be provided for the Client remain with Lithos and such proposals must not be used as the basis for any future work undertaken by the Client or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of the Client being in default of payment of any fees or other amounts due, Lithos may suspend further use of the licence on giving 2 days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

6 TITLE

6.1 Lithos shall transfer only such title or rights in respect of the Documents as it has, and if any part is purchased from a third party Lithos shall transfer only such title or rights as that party had and has transferred to Lithos.

6.2 Title in the Documents shall remain with and shall not pass to the Client until the amount due under the invoice(s) (including interest and costs) has been paid in full.

6.3 Until title passes, the Client shall hold the Documents as bailee for Lithos and shall store or mark them so that they can at all times be identified as the property of Lithos.

6.4 At any time before title passes (save and except where payment is not due), but only after prior consultation with the Client, Lithos may without any liability to the Client repossess and use or sell all or any of part of the Documents and by doing so terminate the right of the Client to use, sell or otherwise deal in the Documents.

6.5 Lithos may maintain an action for the price of the Documents notwithstanding that title in them has not passed to the Client.

7 CONFIDENTIALITY AND DATA PROTECTION

7.1 Lithos undertakes not to divulge or disclose to any third party without the written consent of the Client information which is designated confidential by the Client or which can reasonably be considered to be confidential and arises during the performance of the Services unless required to do so by law or necessary in the proper performance of its duties in relation to the Project, or in order to make full frank and proper disclosure to its insurers or intended insurers, or to obtain legal or accounting advice.

7.2 Subject to the above and Lithos' Privacy Policy which can be found on www.lithos.co.uk, Lithos shall be permitted to use information related to the Services it provides in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

8 THIRD PARTIES

8.1 The Agreement or any part thereof or any benefit or interest thereunder may not be assigned by the Client without the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and Lithos will only agree to an assignment on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any assignment.

8.2 The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

8.3 Lithos will consider and may consent to any request from the Client for Lithos to enter a collateral warranty with a third party with regard to the Services provided under the Agreement. The giving of such consent shall be at the discretion of Lithos and Lithos will only enter a collateral warranty on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any collateral warranty.

9 INSURANCE

9.1 Lithos warrants to the Client that there is in force a policy of Professional Indemnity insurance covering its liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, Lithos agrees to use reasonable endeavours to maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under the Agreement, provided such insurance is available at commercially reasonable rates having regard, inter alia, to premiums required and policy terms obtainable.

9.2 If for any period such insurance is not available at commercially reasonable rates, Lithos shall forthwith inform the Client and shall obtain in respect of such period such reduced level of Professional Indemnity insurance as is available and as would be fair and reasonable in the circumstances for Lithos to obtain.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, Lithos' liability under or in connection with the Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either the level of insurance cover referred to within clause 9.1 above, or 20 times the total value of invoices issued to the Client for consultancy work instructed under the Agreement.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against Lithos after the expiry of a period of six years from the date of the completion (or termination) of the Services under the Agreement.

10.3 Whilst Lithos will scan all potential exploratory locations with a Cable Avoidance Tool, Lithos shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 Lithos shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by Lithos or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless Lithos has been advised in writing of the same by the Client and has been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

11 PAYMENT

11.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

11.2 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

11.3 If the Client disputes the amount included for payment in an invoice a written notice must be served on Lithos by the Client not later than 14 days before the final date for payment. If no notice is given the amount due shall be the amount stated in the invoice.

11.4 In the event of failure on the part of the Client to pay any monies in accordance with the foregoing payment provisions, Lithos will be entitled to charge interest on any monies owed to it by the Client, such interest to be at a rate of 8% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis.

12 DELAY

12.1 Lithos will comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond its reasonable control and in the event of any such circumstances arising Lithos undertakes to complete the Services within a reasonable period, but will not be liable to the Client for any delay as a result.

13 TERMINATION

13.1 The Agreement may be terminated by either party in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of termination must be given to the party which is insolvent by the other party.

13.2 If for any reason the performance of the Services by Lithos is suspended for a period in excess of three calendar months then Lithos shall be entitled to terminate its appointment in respect of the Services by seven days written notice to the Client.

13.3 If the Client shall fail to pay in full any sum due under the terms of the Agreement by the final date for payment for that sum and no effective notice of intention to withhold payment has been issued, Lithos may serve written notice on the Client demanding payment within 14 days of such notice. If the Client shall fail to comply with such notice, Lithos shall be entitled to terminate its employment under the Agreement forthwith.

13.4 Any termination of the appointment of Lithos howsoever caused shall be without prejudice to the right of Lithos to require payment for all services performed up to the date of such termination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

14 NOTICES

14.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to the address of Lithos set out above or to the registered address of the Client.

14.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by first class post.

15 ENTIRE AGREEMENT

15.1 The Agreement constitutes the complete and entire agreement between the Client and Lithos with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against Lithos in respect of the Services can only be made in contract under the provisions of the Agreement and not otherwise under the law or tort or otherwise.

15.2 No amendments, modifications or variation of the Agreement shall be valid unless made in writing and agreed to by both the Client and Lithos; such agreement must be recorded in writing by at least one of the Parties.

15.3 Lithos will not be bound by any standard or printed terms or conditions furnished by the Client in any of its documents unless Lithos specifically states in writing separately from such documents that it intends such terms and conditions to apply.

16 DISPUTES AND GOVERNING LAW

16.1 The Agreement shall be governed by and construed in accordance with English law and the Parties irrevocably and unconditionally submit to the jurisdiction of the English Courts.

16.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between the Parties may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

Lewis Whiteley

From: Adam Gombocz
Sent: 10 March 2022 11:33
To: Lewis Whiteley
Subject: FW: 3407, Site Investigation Quote - Barugh Green, Barnsley

Adam Gombocz
Associate Director
Lithos Consulting Ltd
M 07951 497021
DD 01937 543 353

www.lithos.co.uk



From: Adam Clarke <AdamC@cpplc.com>
Sent: 28 October 2021 14:00
To: Adam Gombocz <Adam.Gombocz@lithos.co.uk>
Cc: Reg <Reg@lithos.co.uk>
Subject: RE: 3407, Site Investigation Quote - Barugh Green, Barnsley

Hi Adam

Thanks for the revised quote

Please take this email as acceptance of the quote and book the works in. Please could you let me know when dates are arranged so I can inform the landowner. Also, we may invite our prospective remediation and groundworks contractor up to site to witness some of the trial trenching so they can get a feel for the ground conditions unless you have any objections

Thanks

Adam

Adam Clarke
Development Engineer
Yorkshire
Aeris, 3200 Century Way, Thorpe Park, Leeds, LS15 8ZB

T: 0113 5324484 I M: 07468 702603 I countrysideproperties.com

COUNTRYSIDE
Places People Love

From: Adam Gombocz <Adam.Gombocz@lithos.co.uk>
Sent: 27 October 2021 15:54
To: Adam Clarke <AdamC@cpplc.com>
Cc: Reg <reg@lithos.co.uk>; David Bridges <David.Bridges@cpplc.com>
Subject: [EXTERNAL] RE: 3407, Site Investigation Quote - Barugh Green, Barnsley

This message originated from outside Countryside Properties

Afternoon Adam,

Further to your email below, please find attached our revised SI quote (£ +VAT). As Reg has previously indicated, this is a complicated site, which is reflected in the cost. We have allowed for two day's trial

pitting, one day's trial trenching, the drilling of 6 cable percussive boreholes, gas and groundwater monitoring plus chemical and geotechnical lab testing.

As you indicate below, we no longer need to sub-contract complicated geotechnical projects (like this one) to Surepath, as we are able to do this in house. The quote attached includes for a detailed SI report, along with an assessment of the likely sources of backfill movement and the likely range of settlements that the backfilled area could be subject to.

Even if piles are used, the surrounding development will settle relative to the houses, which will be a concern that NHBC will want to be resolved / quantified prior to construction.

We would expect to be on site within 4 to 6 weeks of instruction, with a summary of initial findings issued within 2 to 3 days of fieldwork completion. Our final SI Report should be available within c. 10 weeks of instruction (although a quicker turnaround might be possible).

I have a very good working relationship with the NHBC Engineers in this area, who all value my opinion on complicated sites such as this. If required, I am more than happy to discuss our proposals and subsequent SI findings with them as and when needed.

If you have any questions, please drop me a line.

Kind regards,

Adam Gombocz
Associate Director
Lithos Consulting Ltd
M 07951 497021
DD 01937 543 353

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www.lithos.co.uk



From: Adam Clarke <AdamC@cpplc.com>
Sent: 19 October 2021 17:03
To: Reg <Reg@lithos.co.uk>
Cc: David Bridges <David.Bridges@cpplc.com>
Subject: FW: Site Investigation Quote - Barugh Green, Barnsley

Afternoon Reg

Finally been given the go ahead for the SI at Barugh Green now the Strata application is moving forward. We will just be going for basic SI for now, so that costs are based on piled foundations within opencast area. Will potentially then carry out the alternative SI based on achieving a switch to RC strip foundations a little further down the line once the land price is agreed and we would realise the saving rather than landowner. Personally I think the timescales will become too tight given the settlement monitoring / discussion with NHBC that would be needed to get everything approved, as we'll want to get onto site ASAP after planning, but we will see.

Could you review the attached quote and advise if it is still applicable (minus rotary PHs which are complete), as conscious the quote is over 18 months old. Also aware you now have Adam who would likely carry out the Surepath element of work which may affect quote?

Could you also advise timescales for the works & reporting?

Many thanks

Adam

Adam Clarke
Development Engineer
Yorkshire
Aeris, 3200 Century Way, Thorpe Park, Leeds, LS15 8ZB

T: 0113 5324484 I M: 07468 702603 I countrysideproperties.com

COUNTRYSIDE
Places People Love

From: Reg <Reg@lithos.co.uk>
Sent: 19 February 2020 12:29
To: Adam Clarke <AdamC@cpplc.com>
Subject: Site Investigation Quote - Barugh Green, Barnsley

SI quote as promised.

As discussed, this is a relatively costly job (£), largely due to the need for an intrusive mining investigation and gas risk assessment. We have allowed for c. 20 trial pits, 25 deep rotary probeholes (to check for mineworkings), 15 shallow probeholes (monitoring well installation), and 5 cable percussion backfill (to assess the nature of opencast backfill) plus plenty of soils testing (geotechnical & contaminant) and reporting.

We could issue a Desk Study Report in advance of fieldwork if desired.

If required, we could reduce the scope/cost and/or adopt a more staged approach issue. However, this is a potentially difficult site and consequently, there could be need for other supplementary investigation anyway.

We would expect to be on site within 4 weeks of instruction, with a summary of initial findings issued within 2 to 3 days of fieldwork completion. Our final SI Report should be available within c. 9 weeks of instruction (although a quicker turnaround might be possible).

Any queries, please call.

Regards

Mark Perrin
Director
Lithos Consulting Ltd
M 07703 396 635
DD 01937 545 331

www.lithos.co.uk



From: Adam Clarke <AdamC@cpplc.com>
Sent: 11 February 2020 15:17
To: Reg <Reg@lithos.co.uk>
Subject: Site Investigation Quote - Barugh Green, Barnsley

Hi Reg

As discussed, we're now preparing a planning application for the site at Barugh Green, Barnsley where you carried out the trial trenching previously to locate the opencast highwalls.

Please could you provide a quote for a phase 1 and 2 SI – phase 1 to be issued in advance of phase 2 to achieve planning submission date of end of March.

I attach a copy of our layout.

Thanks

Adam

Adam Clarke
Development Engineer, Partnerships Yorkshire

Countryside Properties
Aeris, 3200 Century Way, Thorpe Park, Leeds, LS15 8ZB

T: 0113 5324484 I M: 07468 702603 I countrysideproperties.com
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Lewis Whiteley

From: Lewis Whiteley
Sent: 09 February 2022 09:42
To: Lewis Whiteley
Subject: FW: 3407, Site Investigation Quote - Barugh Green, Barnsley - Rotary Coring

---

From: Adam Clarke <AdamC@cpplc.com>
Sent: 09 November 2021 15:37
To: Adam Gombocz <Adam.Gombocz@lithos.co.uk>
Cc: Reg <Reg@lithos.co.uk>; Lewis Whiteley <Lewis.Whiteley@lithos.co.uk>
Subject: RE: 3407, Site Investigation Quote - Barugh Green, Barnsley - Rotary Coring

Hi Adam

Yes please proceed with the rotary coring also.

I was going through some of the information produced by JPG for the Strata site yesterday and noticed something which may affect our site which doesn't appear to have been picked up on the Lithos plans showing highwall positions but you're probably already aware of – the opencast appears from the attached drawing to have, for want of a better term, an island where no material was extracted. This extends for a short distance into our site from the western boundary, so we will have another highwall position that may need investigation & consideration in foundation / highway designs – just wanted to make sure the proposals allow for enough to cover investigation of this?

Thanks

Adam

Adam Clarke
Development Engineer
Yorkshire
Aeris, 3200 Century Way, Thorpe Park, Leeds, LS15 8ZB

T: 0113 5324484 I M: 07468 702603 I countrysideproperties.com

COUNTRYSIDE
Places People Love

From: Adam Gombocz <Adam.Gombocz@lithos.co.uk>
Sent: 09 November 2021 11:05
To: Adam Clarke <AdamC@cpplc.com>
Cc: Reg <reg@lithos.co.uk>; Lewis Whiteley <Lewis.Whiteley@lithos.co.uk>
Subject: [EXTERNAL] RE: 3407, Site Investigation Quote - Barugh Green, Barnsley - Rotary Coring

This message originated from outside Countryside Properties

Hi Adam,

Just to confirm the TPs will start Monday 29th November, I presume the landowner / tenant is aware of our planned SI works?

Are you able to confirm if you want the rotary coring? I could do with booking this in the with the drillers if you do.

Kind regards,

Adam Gombocz
Associate Director
Lithos Consulting Ltd
M 07951 497021
DD 01937 543 353

www.lithos.co.uk

From: Adam Gombocz
Sent: 04 November 2021 11:16
To: Adam Clarke <AdamC@cpplc.com>
Cc: Reg <Reg@lithos.co.uk>; Lewis Whiteley <Lewis.Whiteley@lithos.co.uk>
Subject: RE: 3407, Site Investigation Quote - Barugh Green, Barnsley - Rotary Coring

Hi Adam,

As discussed this morning, to undertake 3 rotary cored holes 6m beyond the base of the opencast, including full time Engineer supervision would be c. £ .

I have spoken to the drillers (coring), they could probably be on site mid-December, which is roughly when we would expect the cable percussive holes to be complete.

The trial pits are booked in to commence w/c 29th November, with the cable percussive BHs starting either the same week, or w/c 6th December.

I would expect all field work to be complete before the Christmas shutdown.

Let me know if you want to proceed with the coring and I will get the drillers formally booked in.

Kind regards

Adam Gombocz
Associate Director
Lithos Consulting Ltd
M 07951 497021
DD 01937 543 353

www.lithos.co.uk

Lewis Whiteley

From: Adam Gombocz
Sent: 07 January 2022 08:32
To: Adam Clarke
Cc: Lewis Whiteley
Subject: RE: 3407 - Barugh Green Road - Stitch drilling

Morning Adam,

Yes, very nice Christmas thanks, although it is starting to seem like a distant memory now.

We are waiting to hear back from the drillers regarding availability – as soon as we have a date confirmed for the stitch drilling, I will let you know.

Kind regards,

Adam Gombocz
Associate Director
Lithos Consulting Ltd
M 07951 497021
DD 01937 543 353

www.lithos.co.uk



From: Adam Clarke <AdamC@cpplc.com>
Sent: 06 January 2022 15:35
To: Adam Gombocz <Adam.Gombocz@lithos.co.uk>
Cc: Lewis Whiteley <Lewis.Whiteley@lithos.co.uk>
Subject: RE: 3407 - Barugh Green Road - Prelim

Afternoon Adam

Happy New Year! Yes great thanks, hope you did too.

Yes please proceed with the stitch drilling. When will this work be carried out – will it follow on from the coring? Just so I can inform the landowner

Thanks

Adam

Adam Clarke
Development Engineer
Yorkshire
Aeris, 3200 Century Way, Thorpe Park, Leeds, LS15 8ZB

T: 0113 5324484 I M: 07468 702603 I countrysideproperties.com

---

From: Adam Gombocz <Adam.Gombocz@lithos.co.uk>
Sent: 06 January 2022 13:04
To: Adam Clarke <AdamC@cpplc.com>
Cc: Lewis Whiteley <Lewis.Whiteley@lithos.co.uk>
Subject: [EXTERNAL] RE: 3407 - Barugh Green Road - Prelim

This message originated from outside Countryside Properties

Afternoon Adam,

Happy New Year! I hope you had a nice Christmas.

Regarding my email below – would you like to proceed with the rotary stitch drilling to locate the opencast highwall, where we could not physically observe it due to high groundwater.

We are hoping to be back on-site next week to undertake the rotary coring.

Kind regards,

Adam Gombocz
Associate Director
Lithos Consulting Ltd
M 07951 497021
DD 01937 543 353

www.lithos.co.uk



From: Adam Gombocz
Sent: 14 December 2021 17:05
To: Adam Clarke <AdamC@cpplc.com>
Cc: Lewis Whiteley <Lewis.Whiteley@lithos.co.uk>
Subject: 3407 - Barugh Green Road - Prelim

Hi Adam,

Preliminary findings letter attached, which summaries the SI works undertaken to date, which includes the trial pitting, trial trenching and cable percussive boreholes. The SI left to do in the new year are the rotary cored holes (already instructed) through the base of the opencast, with some rotary probehole stich drilling recommended in some key locations where due to shallow groundwater we were unable to observe the geometry of the buried highwall.

The cost to undertake 3 days rotary stich drilling at the locations shown on the attached drawing (3407_ZZ), including full time engineer supervision is £ . Please confirm if you want us to proceed with the drilling and we will get the rig booked in for January.

As I mentioned on the phone, we had hoped to not need stitch drilling by using a 20T excavator, which where shallow groundwater was not encountered was successful, however, the presence of shallow groundwater meant that we could not physically observe the highwall in some locations.

I will send the invoice to invoicesnonmat@cpplc.com as previously advised – if you would like a copy of the invoice for your records let me know.

If you have any questions relating to the above or attached, please drop me a line.

Kind regards,

Adam Gombocz
Associate Director
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby, LS22 5DZ
M 07951 497021
DD 01937 543353

adam.gombocz@lithos.co.uk

www.lithos.co.uk

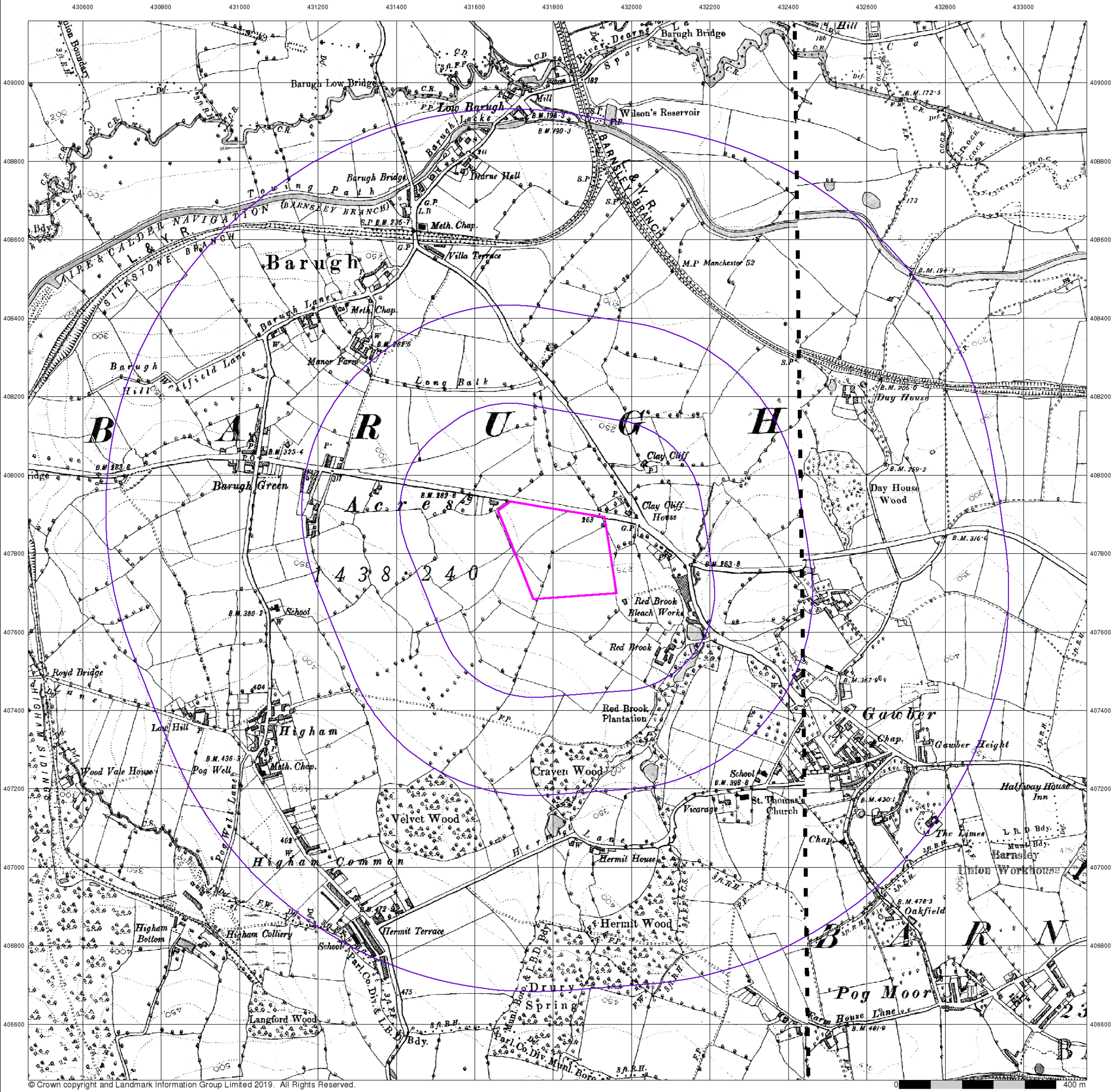


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Appendix D

Historical OS Plans



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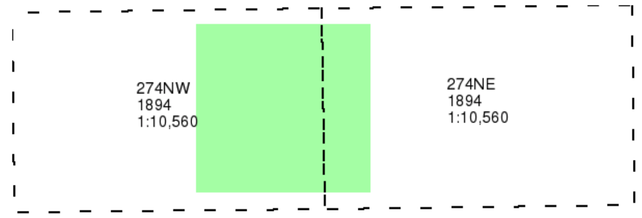
Yorkshire

Published 1894

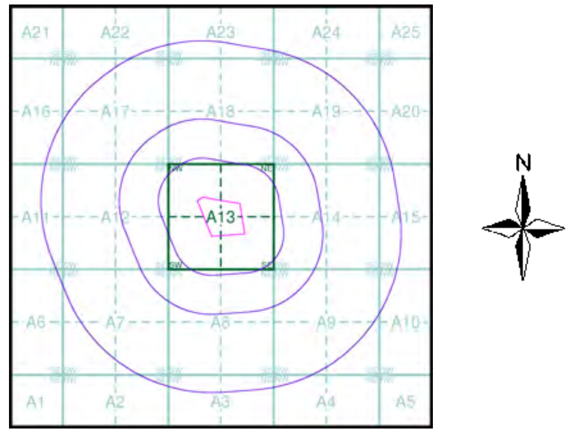
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



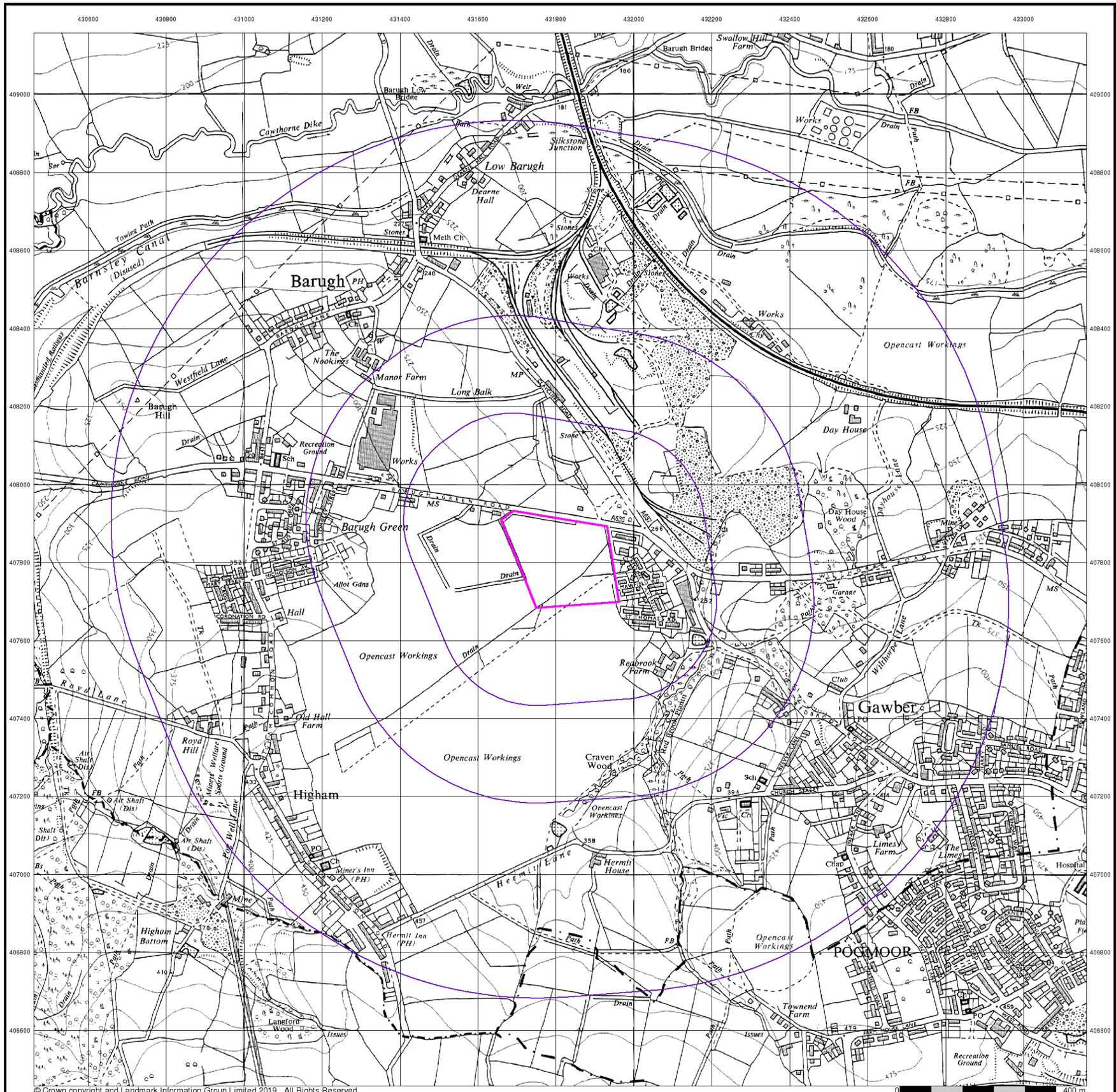
Order Details

Order Number: 199418449_1_1
Customer Ref: PO14383/JW/3407
National Grid Reference: 431820, 407810
Slice: A
Site Area (Ha): 5.43
Search Buffer (m): 1000

Site Details

Barugh Green, S75 1JY

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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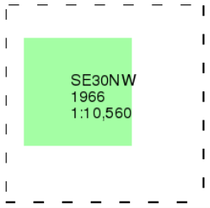
Ordnance Survey Plan

Published 1966

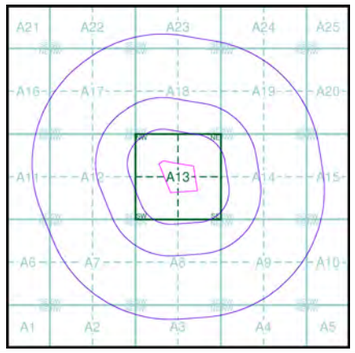
Source map scale - 1:10,000

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Map Name(s) and Date(s)



Historical Map - Slice A



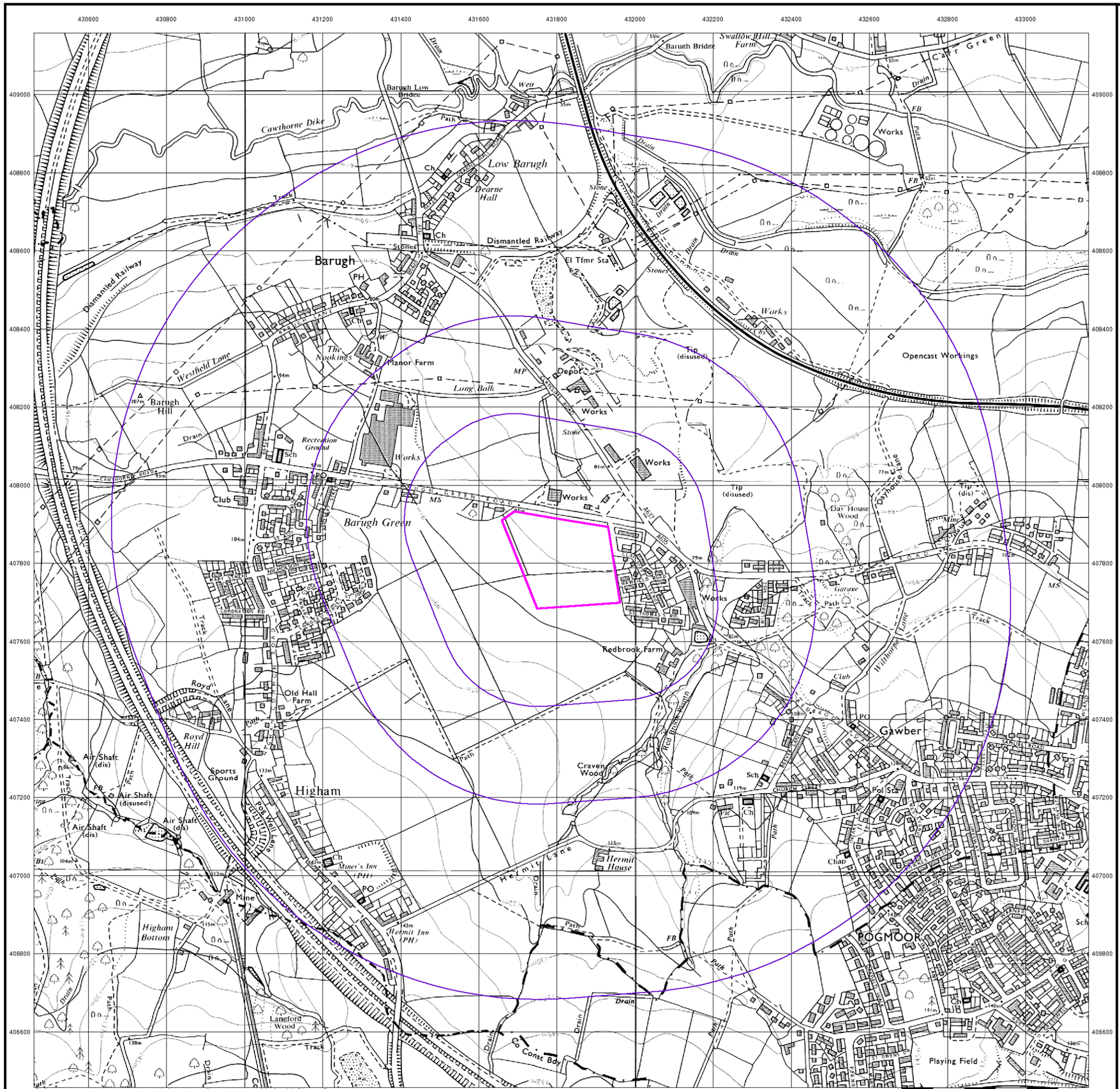
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Customer Ref:	PO14383/JW/3407
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Site Area (Ha):	5.43
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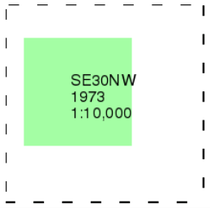
Ordnance Survey Plan

Published 1973

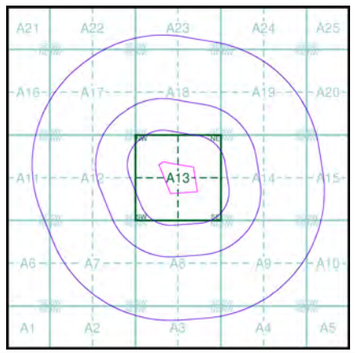
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number:	199418449_1_1
Customer Ref:	PO14383/JW/3407
National Grid Reference:	431820, 407810
Slice:	A
Site Area (Ha):	5.43
Search Buffer (m):	1000

Site Details

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Web: www.envirocheck.co.uk

Appendix E

Search Responses & other Correspondence

Envirocheck® Report:

Datasheet

Order Details:

Order Number:
199418449_1_1

Customer Reference:
PO14383/JW/3407

National Grid Reference:
431820, 407810

Slice:
A

Site Area (Ha):
5.43

Search Buffer (m):
1000

Site Details:

Barugh Green
S75 1JY

Client Details:

Mr M Perrin
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

Contents

Report Section	Page Number
Summary	-
Agency & Hydrological	1
Waste	17
Hazardous Substances	-
Geological	28
Industrial Land Use	35
Sensitive Land Use	54
Data Currency	55
Data Suppliers	60
Useful Contacts	61

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination.
For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.
In this datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

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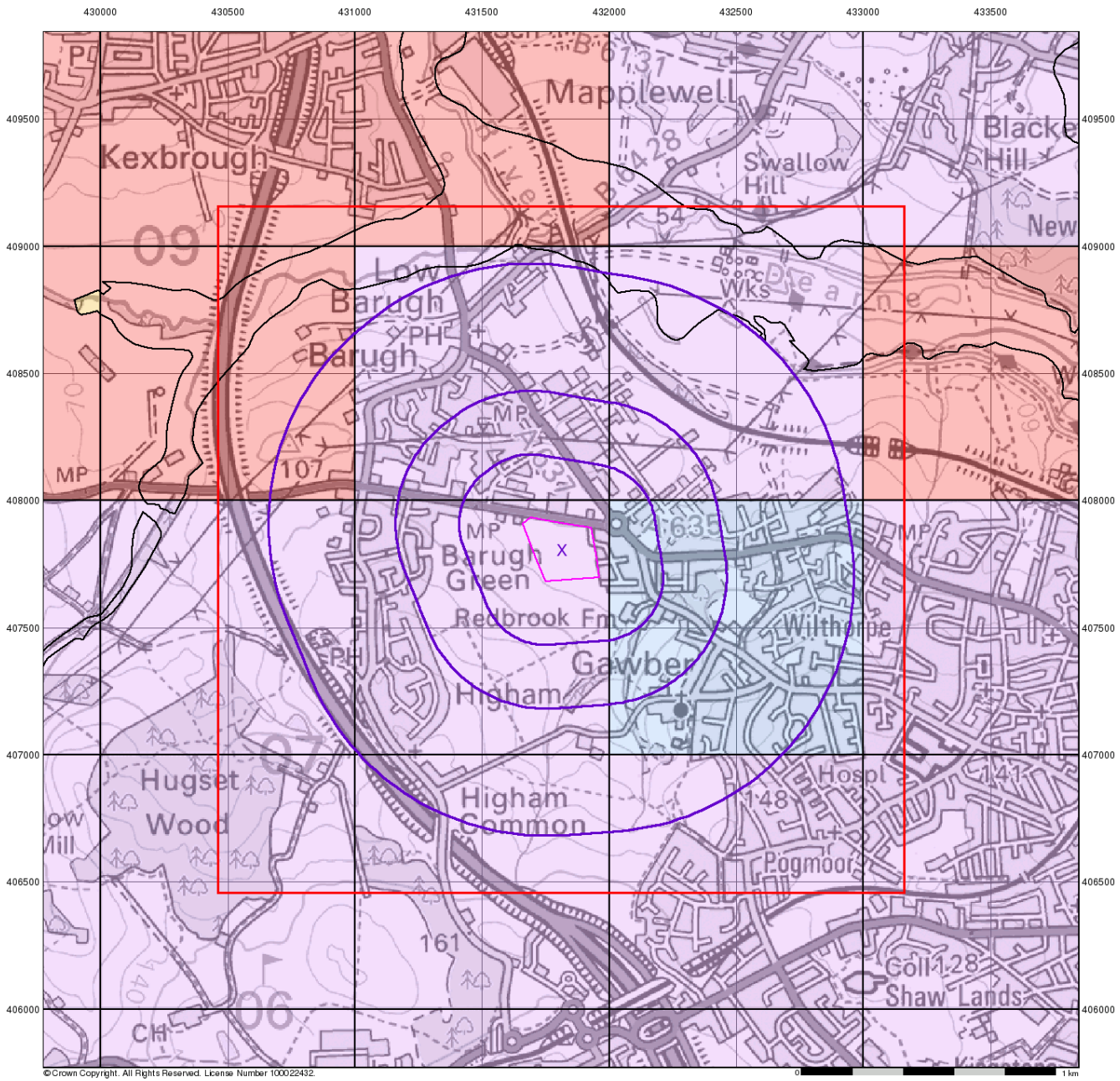
Report Version v53.0

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1	Yes	Yes	Yes	n/a
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 2		3	2	4
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control					
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls	pg 5		4	6	5
Local Authority Pollution Prevention and Control Enforcements	pg 7			1	1
Nearest Surface Water Feature	pg 7	Yes			
Pollution Incidents to Controlled Waters	pg 7			1	12
Prosecutions Relating to Authorised Processes					
Registered Radioactive Substances	pg 9			1	
River Quality					
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register	pg 10				1
Water Abstractions	pg 10				(*1)
Water Industry Act Referrals					
Groundwater Vulnerability Map	pg 10	Yes	n/a	n/a	n/a
Groundwater Vulnerability - Soluble Rock Risk			n/a	n/a	n/a
Groundwater Vulnerability - Local Information			n/a	n/a	n/a
Bedrock Aquifer Designations	pg 10	Yes	n/a	n/a	n/a
Superficial Aquifer Designations			n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
OS Water Network Lines	pg 10	2	10	16	27

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Waste					
BGS Recorded Landfill Sites	pg 17				1
Historical Landfill Sites	pg 17		3	5	8
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)	pg 20			1	
Local Authority Landfill Coverage	pg 20	1	n/a	n/a	n/a
Local Authority Recorded Landfill Sites	pg 20		1	7	6
Potentially Infilled Land (Non-Water)	pg 22		1	3	5
Potentially Infilled Land (Water)	pg 23		3	3	32
Registered Landfill Sites	pg 25			6	1
Registered Waste Transfer Sites					
Registered Waste Treatment or Disposal Sites					
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					



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Groundwater Vulnerability

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

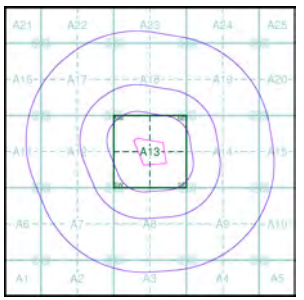
Agency and Hydrological

Bedrock Aquifers	Superficial Aquifers
High Vulnerability, Principal Aquifer	High Vulnerability, Principal Aquifer
High Vulnerability, Secondary Aquifer	High Vulnerability, Secondary Aquifer
Medium Vulnerability, Principal Aquifer	Medium Vulnerability, Principal Aquifer
Medium Vulnerability, Secondary Aquifer	Medium Vulnerability, Secondary Aquifer
Low Vulnerability, Principal Aquifer	Low Vulnerability, Principal Aquifer
Low Vulnerability, Secondary Aquifer	Low Vulnerability, Secondary Aquifer

Unproductive Aquifer

Soluble Rock

Site Sensitivity Context Map - Slice A



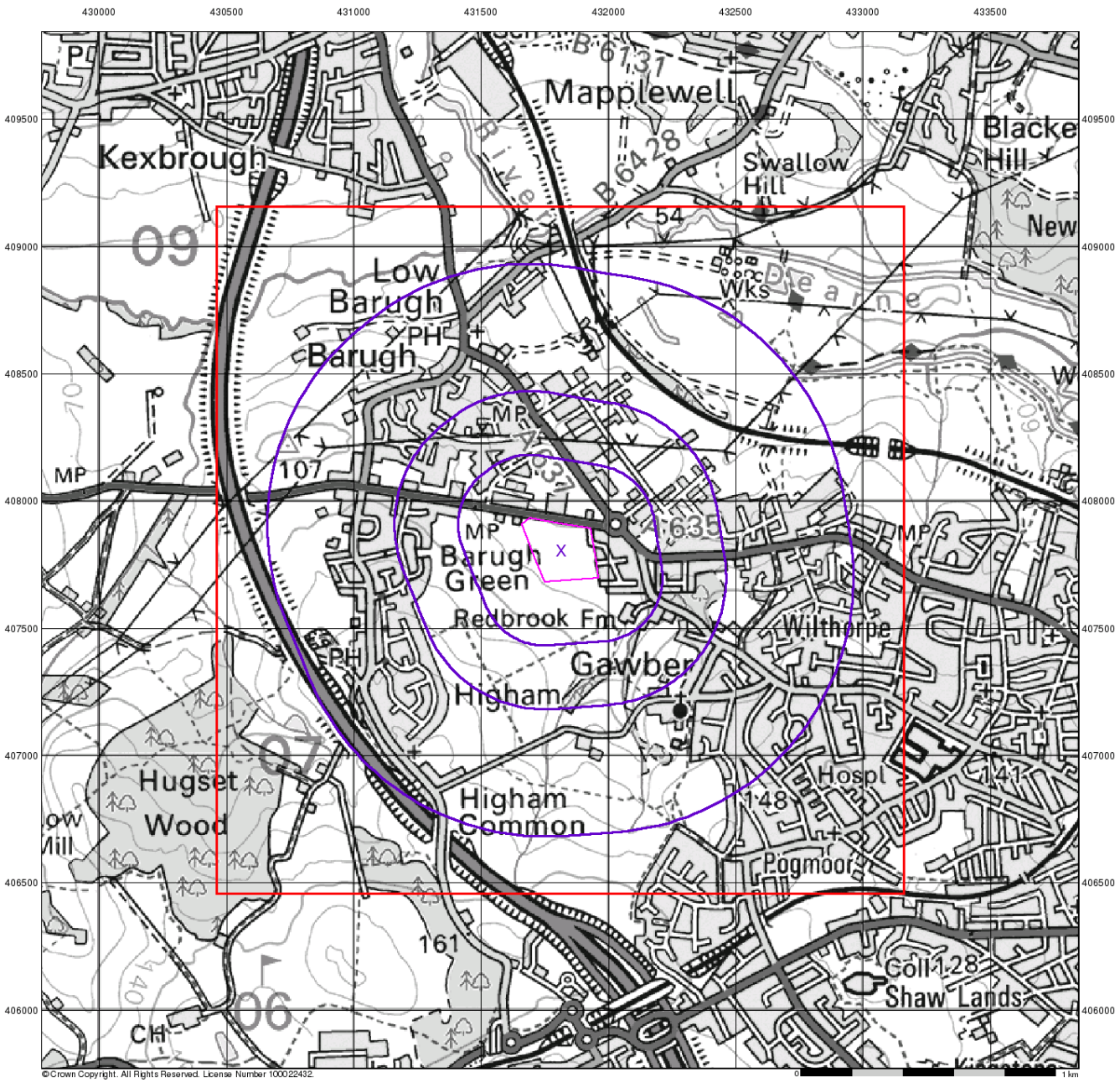
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National Grid Reference:	431820, 407810
Slice:	A
Site Area (Ha):	5.43
Search Buffer (m):	1000

Site Details

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Source Protection Zones

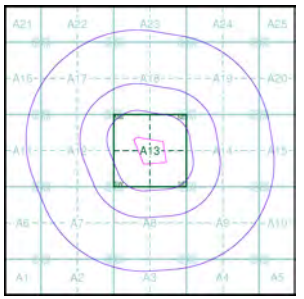
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

Site Sensitivity Context Map - Slice A

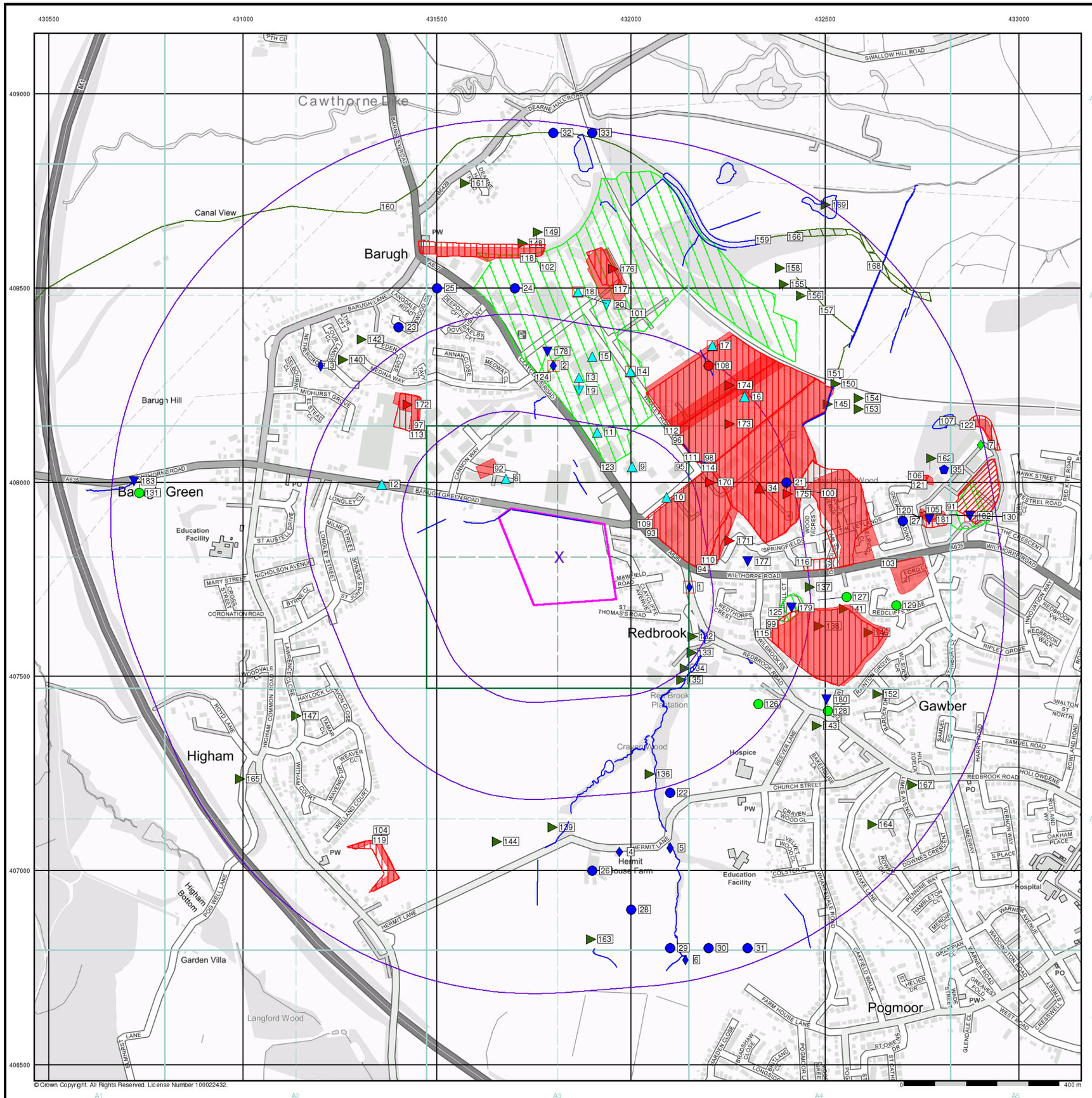


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National Grid Reference:	431820, 407810
Slice:	A
Site Area (Ha):	5.43
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Site Details

Barugh Green, S75 1JY



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General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Map ID

Several of Type at Location

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

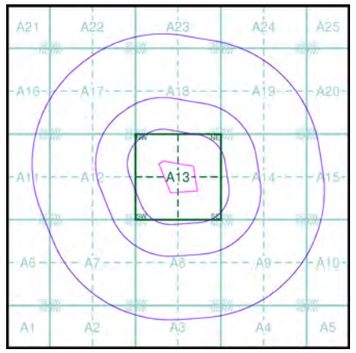
Hazardous Substances

- COMAH Site
- Explosive Site
- NIHHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

Geological

- BGS Recorded Mineral Site

Site Sensitivity Map - Slice A



Order Details

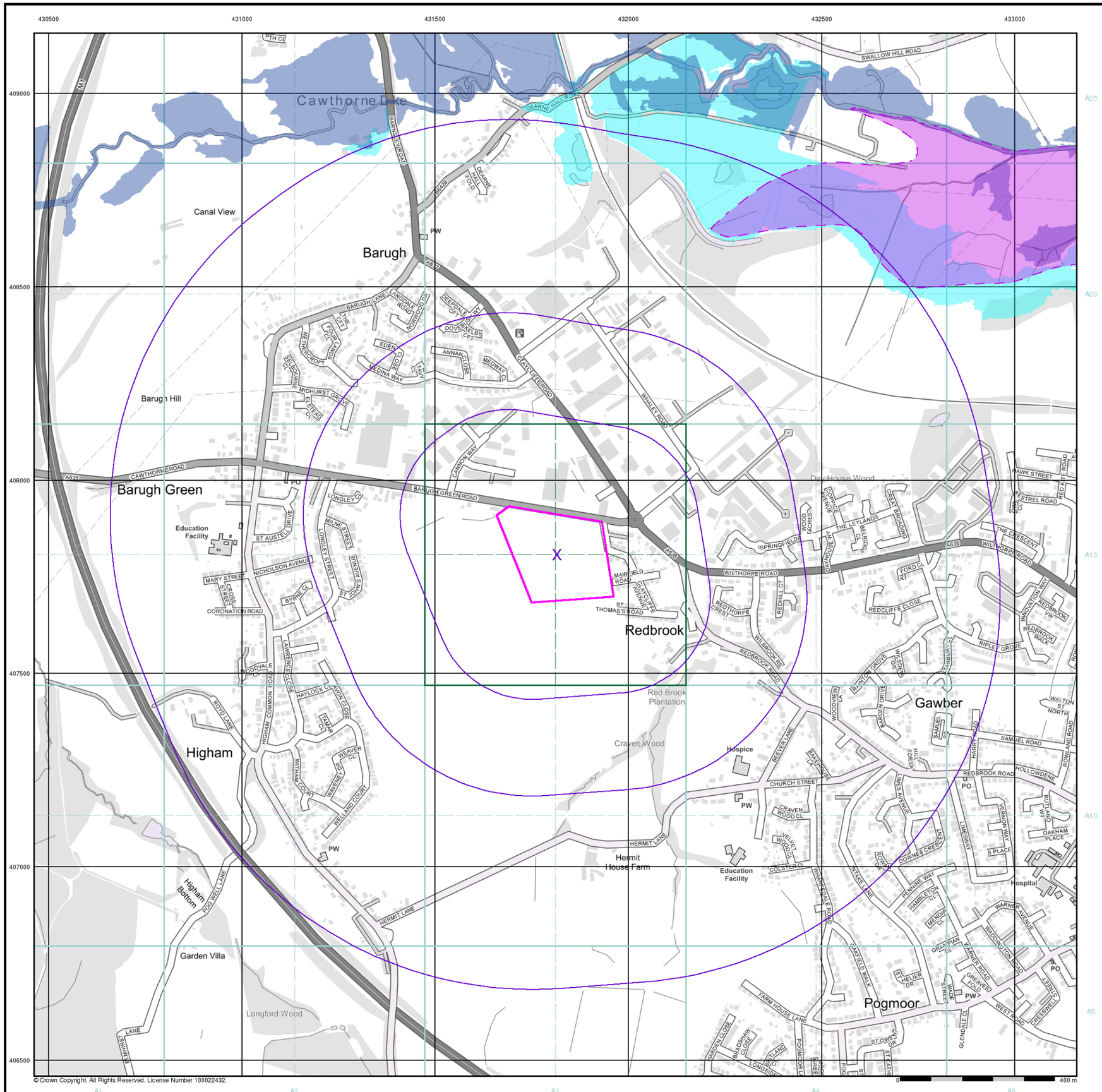
Order Number:	199418449_1_1
Customer Ref:	PO14383/JW/3407
National Grid Reference:	431820, 407810
Slice:	A
Site Area (Ha):	5.43
Search Buffer (m):	1000

Site Details

Barugh Green, S75 1JY

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

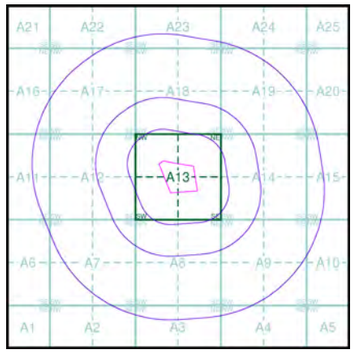
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A



Order Details

Order Number:	199418449_1_1
Customer Ref:	PO14383/JW/3407
National Grid Reference:	431820, 407810
Slice:	A
Site Area (Ha):	5.43
Search Buffer (m):	1000

Site Details

Barugh Green, S75 1JY

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

OS Water Network Data

- Canal
- Reservoir
- Foreshore
- Marsh
- Tidal River
- Inland River
- Drain
- Other
- Lake
- Transfer
- Lock Or Flight Of Locks
- Sea

Contours (height in meters)

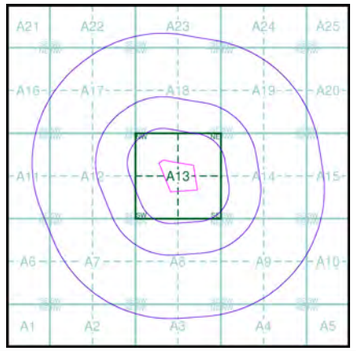
Standard Contour 105 100 95

Master Contour

Spot Height 167.3

- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



Order Details

Order Number:	199418449_1_1
Customer Ref:	PO14383/JW/3407
National Grid Reference:	431820, 407810
Slice:	A
Site Area (Ha):	5.43
Search Buffer (m):	1000

Site Details

Barugh Green, S75 1JY

Landmark INFORMATION GROUP

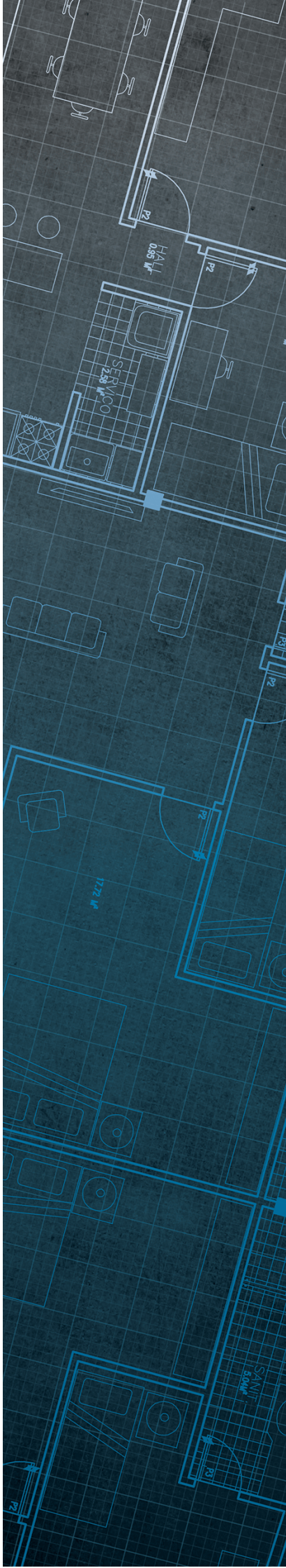
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

The Coal Authority

Consultants

Coal Mining Report

Barugh Green
S75 1JY



Date of enquiry:	**2 April 2019**
Date enquiry received:	**2 April 2019**
Issue date:	**2 April 2019**
Our reference:	**51002073864001**
Your reference:	**PO14384/JW/3407**

Consultants

Coal Mining Report

This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

LITHOS CONSULTING LTD

Enquiry address

Barugh Green
S75 1JY



Approximate position of property

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How to contact us

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200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

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

Section 1 – Mining activity and geology

Past underground mining

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
DODWORTH	FLOCKTON THICK	Coal	6NKR	70	Beneath Property	3.8	North-East	68	1952
DODWORTH	FLOCKTON THICK	Coal	6NJR	127	Beneath Property	3.8	North-East	71	1959
DODWORTH	FLOCKTON THICK	Coal	6NFT	128	North	4.2	North-East	56	1960
DODWORTH	FLOCKTON THICK	Coal	6Z6U	133	East	4.1	North-East	76	1950
DODWORTH	TOP FENTON	Coal	6NCR	153	South-West	2.7	North-East	79	1933
DODWORTH	SILKSTONE	Coal	6NHS	253	Beneath Property	3.9	North-East	105	1977
STANHOPE SILKSTONE	SILKSTONE	Coal	6NDS	254	North-West	4.4	North-East	107	1928
STANHOPE SILKSTONE	SILKSTONE	Coal	6NCV	258	North-West	3.9	North-East	107	1928
unnamed	SILKSTONE	Coal	6NFS	267	Beneath Property	4.7	North-East	107	1928
DODWORTH	SILKSTONE	Coal	6NGS	269	Beneath Property	4.0	North-East	105	1979
DODWORTH	SILKSTONE	Coal	6Z70	273	East	4.3	North-East	105	1976
DODWORTH	SILKSTONE	Coal	6NDW	274	North	3.0	North-East	100	1978
DODWORTH	SILKSTONE	Coal	6YNG	279	North-East	3.9	North-East	90	1978
WOOLLEY	WHINMOOR	Coal	6NLS	306	Beneath Property	4.3	North-East	107	1978
WOOLLEY	WHINMOOR	Coal	6NEV	321	North	4.8	North-East	115	1978
WOOLLEY/REDBROOK	WHINMOOR	Coal	6Z72	322	East	4.8	North-East	107	1977
WOOLLEY	WHINMOOR	Coal	Z89	323	Beneath Property	5.2	North-East	107	1980
WOOLLEY	WHINMOOR	Coal	6NFV	327	North	4.4	North-East	115	1979
WOOLLEY/REDBROOK	WHINMOOR	Coal	6Z74	329	North-East	4.7	North-East	117	1979
WOOLLEY/REDBROOK	WHINMOOR	Coal	6YNH	329	North-East	4.4	East	109	1979

Probable unrecorded shallow workings

None.

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Spine roadways at shallow depth
No spine roadway recorded at shallow depth.

Mine entries
None recorded within 100 metres of the enquiry boundary.

Abandoned mine plan catalogue numbers
The following abandoned mine plan catalogue numbers intersect with some, or all, of the enquiry boundary:

NE3	7196	NE584
NE919	NE1034	NE498
7197	NE762	9534

Our records show we have more plans than those shown above which could affect the enquiry boundary.

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

Outcrops
No outcrops recorded.

Geological faults, fissures and breaklines
No faults, fissures or breaklines recorded.

Opencast mines
Please refer to the “Summary of findings” map (on separate sheet) for details of any opencast areas within 500 metres of the enquiry boundary.

Coal Authority managed tips
None recorded within 500 metres of the enquiry boundary.

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Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations

None recorded within 50 metres of the enquiry boundary.

Remediated sites

None recorded within 50 metres of the enquiry boundary.

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 31 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.

Mine gas

None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes

None recorded within 500 metres of the enquiry boundary.

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Section 3 – Licensing and future mining activity

Future underground mining
None recorded.

Coal mining licensing
None recorded within 200 metres of the enquiry boundary.

Court orders
None recorded.

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

Withdrawal of support notices
The property is in an area where notices to withdraw support were given in 1956, 1977 and 1987.

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.

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.

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Section 4 – Further information

The following potential risks have been identified and as part of your risk assessment should be investigated further.

Development advice

The site is within an area of historical coal mining activity. Should you require advice and/or support on understanding the mining legacy, its risks to your development or what next steps you need to take, please contact us.

For further information on specific site or ground investigations in relation to any issues raised in Section 4, please call us on 0345 762 6848 or email us at groundstability@coal.gov.uk.

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Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk.**

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

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Opencast mines
Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips
Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations
Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites
Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence
Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas
Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

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Mine water treatment schemes
Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining
Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing
Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders
Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices
Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices
Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land
Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

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The Coal Authority

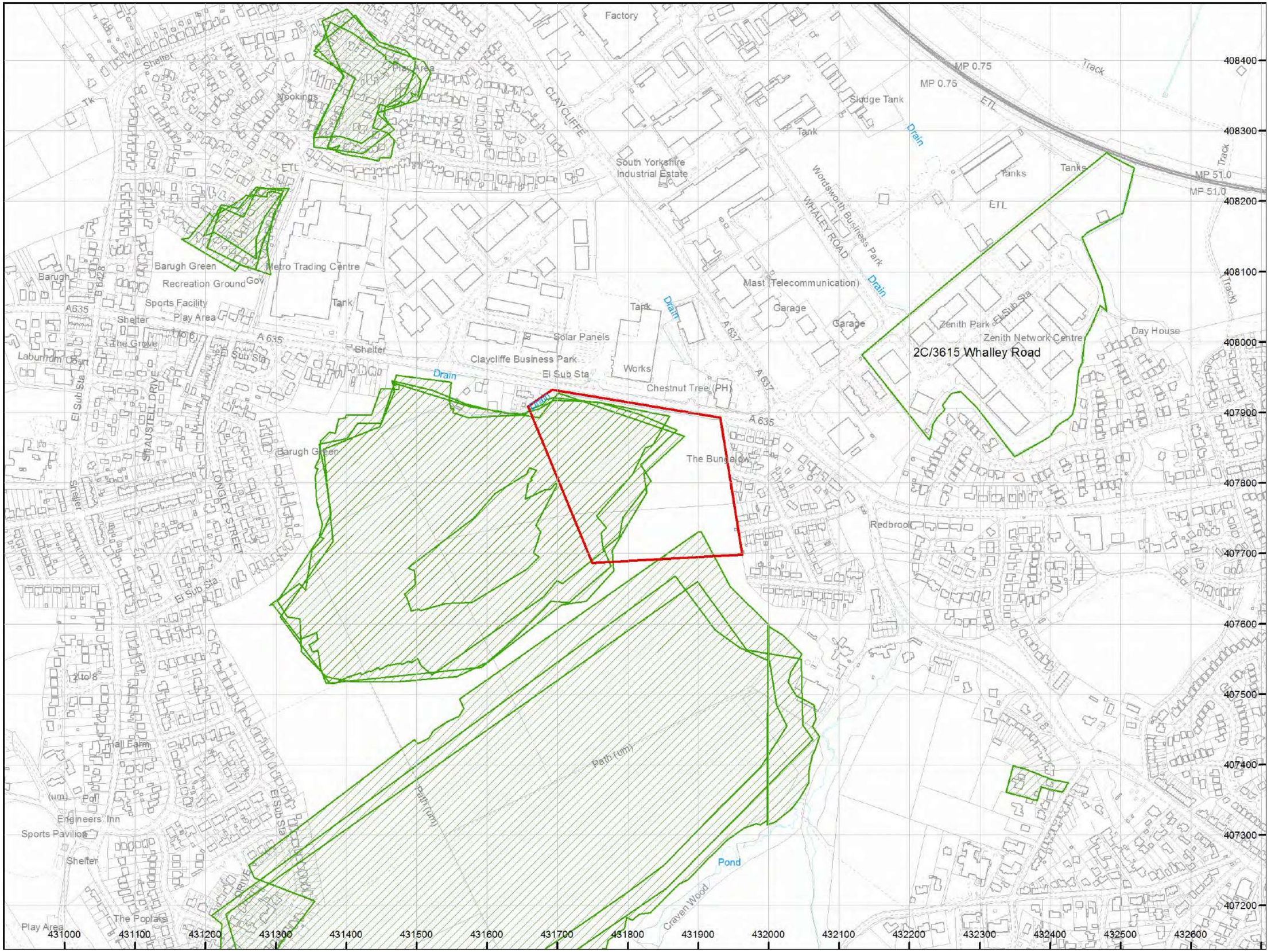
Summary of findings

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The map highlights any specific surface or subsurface features within or near to the boundary of the site.

Key

- Approximate position of the enquiry boundary shown
- Opencast mine licence area
- Unlicensed opencast site



How to contact us
0345 762 6848 (UK)
+44 (0)1623 637 000 (International)
www.groundstability.com

Appendix F

Trial Pit Logs

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP01**

Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords: 431917.77 - 407782.47 Level: 81.80
Location:	Barnsley	Dimensions (m): 2.5 × 0.6, Depth 2.00	Scale 1:25
Client:	Countryside Properties		Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	81.60		TOPSOIL: Dark brown slightly sandy CLAY with occasional rootlets. (TOPSOIL)
			HVP=85				Stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=95				
				1.30	80.50		Light brown clayey sandy angular tabular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL) *From 1.3m, slight spalling of trial pit walls.*
				1.70	80.10		Strong brown thickly laminated fine to medium grained SANDSTONE recovered as sandy angular tabular fine to coarse gravel with high cobble content. (COAL MEASURES)
				2.00	79.80		*Difficult to excavate beyond 2.0m.* End of pit at 2.00 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit spalled slightly from 1.3m during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP02
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431741.00 - 407779.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 2.3 × 0.6, Depth 1.30	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			MADE GROUND: Dark brown slightly sandy CLAY with occasional rootlets. (MADE GROUND TOPSOIL)
				0.50			MADE GROUND: Yellowish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and sandstone. (REWORKED NATURAL GROUND)
				1.30			MADE GROUND: Reddish grey clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare sandstone, coal, metal and brick. Low cobble content of sandstone. (OPENCAST BACKFILL) *From 0.5m, slight spalling of trial pit walls.* *From 0.6m to 0.8m, reddish brown sandy gravel of burnt red shale.* *At 0.8m, occasional boulders of concrete up to 500mm across.* *Unable to excavate beyond 1.3m due to concrete obstruction running length of trial pit.* End of pit at 1.30 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit spalled slightly from 0.5m during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP03**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431810.00 - 407831.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 2.7 × 0.6 Depth 3.20	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			MADE GROUND: Dark brown slightly sandy CLAY with occasional rootlets. (MADE GROUND TOPSOIL)
				0.40			MADE GROUND: Yellowish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (REWORKED NATURAL GROUND)
							MADE GROUND: Grey sandy clayey angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare sandstone and coal. Low cobble content of mudstone and sandstone. (OPENCAST BACKFILL)
							From 0.5m, slight spalling of trial pit walls.
▼							*At 1.8m, groundwater seepage.*
							At 2.0m, mudstone boulder in north wall of trial pit.
▼							*At 2.2m, groundwater inflow.*
				3.20			End of pit at 3.20 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 1.8m during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit spalled slightly from 0.5m during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP04**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431904.50 - 407865.24 Level: 79.50	Date 16/04/2019
Location: Barnsley		Dimensions (m): 2.5 × 0.6 Depth 1.80	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	79.20		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine of mixed lithologies. (MADE GROUND TOPSOIL)
				1.00	78.50		MADE GROUND: Greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of predominantly sandstone and mudstone with rare coal. (REWORKED NATURAL GROUND)
			HVP=120	1.50	78.00		Stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				1.70	77.80		Greyish brown slightly clayey sandy angular to subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
				1.80	77.70		Strong light brown thickly laminated fine grained SANDSTONE recovered as sandy angular tabular fine to coarse gravel and cobbles. (COAL MEASURES) *Difficult to excavate beyond 1.8m.* End of pit at 1.80 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP05**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431854.73 - 407835.31 Level: 80.75	Date 16/04/2019
Location: Barnsley		Dimensions (m): 2.4 × 0.6, Depth 2.90	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	80.55		MADE GROUND: Dark brown slightly sandy CLAY with occasional rootlets. (MADE GROUND TOPSOIL)
							MADE GROUND: Greyish brown slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of predominantly sandstone and mudstone with rare brick and burnt red shale. (REWORKED NATURAL GROUND)
				1.10	79.65		Stiff grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of ironstone. (COHESIVE RESIDUAL SOIL)
			HVP=120				
							From 1.7m, clay contains gravel of mudstone lithorelicts.
			HVP=95				
				2.90	77.85		End of pit at 2.90 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP06**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431756.89 - 407825.52 Level: 83.25	Date 16/04/2019
Location: Barnsley		Dimensions (m): 2.7 × 0.6, Depth 3.50	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	83.05		MADE GROUND: Dark brown slightly sandy CLAY with occasional rootlets. (MADE GROUND TOPSOIL)
				0.50	82.75		MADE GROUND: Yellowish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
							MADE GROUND: Grey slightly clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare sandstone. High cobble content of sandstone and mudstone. (OPENCAST BACKFILL) *From 0.7m to 1.5m, major spalling and overbreak of trial pit walls due to cobble content.*
				1.30	81.95		MADE GROUND: Grey clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare sandstone and ironstone. Low cobble content of mudstone and sandstone. (OPENCAST BACKFILL)
▼							*At 3.1m, groundwater inflow.*
				3.50	79.75		End of pit at 3.50 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 3.1m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between 0.7m and 1.5m depth during excavation due to cobble content.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP07
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431715.00 - 407875.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 3 × 0.6 Depth 2.90	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine of mixed lithologies. (MADE GROUND TOPSOIL)
				0.50			MADE GROUND: Yellowish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (REWORKED NATURAL GROUND)
							MADE GROUND: Grey clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare sandstone. Medium cobble content of mudstone. (OPENCAST BACKFILL)
▼							*From 2.0m, spalling and overbreak of trial pit walls.*
							At 2.1m, groundwater inflow.
							From 2.5m, low boulder content.
				2.90			End of pit at 2.90 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 2.1m during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable from 2.0m depth during excavation due to cobble content.

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Trial Pit Log

Trialpit No
TP201
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431701.03 - 407918.59 Level: 81.40	Date 30/11/2021
Location: Barnsley		Dimensions (m): Depth 3.50	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.20	81.20		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies including rare coal. (MADE GROUND TOPSOIL)
			HVP=75	0.60	80.80		MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and rare coal. Cobbles are subangular of sandstone. (REWORKED NATURAL GROUND)
	0.80	D&B	HVP=100				Stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=125				*From 1.0m, low cobble content of sandstone.*
							At 1.3m, subrounded sandstone boulder.
				1.50	79.90		Weak black vitreous COAL recovered as sandy angular tabular fine to coarse gravel. (THIN COAL)
▼	1.70	D		1.80	79.60		Stiff grey CLAY. (COHESIVE RESIDUAL SOIL)
			HVP=130				*At 1.8m, groundwater seepage.*
				2.70	78.70		Grey clayey sandy angular to subangular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				3.10	78.30		Weak grey thinly laminated MUDSTONE recovered as slightly clayey sandy angular fine to coarse gravel. (COAL MEASURES)
				3.50	77.90		End of pit at 3.50 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 1.8m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP202
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431752.91 - 407905.73 Level: 79.85	Date 30/11/2021
Location: Barnsley		Dimensions (m): Depth 3.70	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine of mixed lithologies. (MADE GROUND TOPSOIL)
	0.20	B		0.30	79.55		MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (REWORKED NATURAL GROUND)
	0.50	J,K&T	HVP=115	0.60	79.25		MADE GROUND: Stiff brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of mixed lithologies including sandstone, mudstone, rare brick and ironstone. Cobbles are subrounded of mudstone and ironstone. (REWORKED NATURAL GROUND)
			HVP=118				
	1.00	D		1.10	78.75		Stiff grey mottled orangish brown slightly gravelly CLAY. Gravel is subrounded fine to medium of mudstone and ironstone. (COHESIVE RESIDUAL SOIL)
			HVP=115				
	1.70	D		1.60	78.25		Weak black vitreous COAL recovered as sandy angular fine to coarse gravel. (THIN COAL)
▼				1.90	77.95		Stiff light grey slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine of mudstone. (COHESIVE RESIDUAL SOIL) *At 1.9m, groundwater seepage.* *Locally clay is gravelly.*
▼				2.80	77.05		*At 2.7m, thin (5cm) bed of black coal.* *At 2.7m, groundwater seepage.* Greyish brown clayey sandy angular to subangular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				3.10	76.75		Very weak grey thinly laminated SILTSTONE with occasional ironstone nodules recovered as sandy angular tabular fine to coarse gravel. (COAL MEASURES) *From 3.4m, low cobble content.*
				3.70	76.15		End of pit at 3.70 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 1.9m and 2.7m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No **TP203**

Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431799.42 - 407882.54 Level: 79.70	Date 30/11/2021
Location: Barnsley		Dimensions (m): Depth 5.50	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	79.40		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
	0.40	J,K&T					*Surface water running into trial pit.*
			HVP=130				MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
	0.70	D&B					
				0.80	78.90		MADE GROUND: Stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mixed lithologies including sandstone, mudstone, ironstone and coal. (OPENCAST BACKFILL)
			HVP=112				
	1.10	J,K&T					
				1.20	78.50		MADE GROUND: Stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of predominantly mudstone with rare coal and siltstone. Cobbles are subangular to subrounded of mudstone. (OPENCAST BACKFILL)
			HVP=110				
							From 1.8m, clay is gravelly.
	1.90	D					
	2.00	J,K&T					*At 2.0m, subangular sandstone boulder (0.9m x 0.4m x 0.3m).*
	2.50	D&B					*No hand vane shear tests were undertaken due to gravel content of clay.*
			HVP=95				
							Continued on next sheet

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP203
Sheet 2 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431799.42 - 407882.54 Level: 79.70	Date 30/11/2021
Location: Barnsley		Dimensions (m): Depth 5.50	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				5.50	74.20		End of pit at 5.50 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP204
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431868.69 - 407883.78 Level: 79.25	Date 30/11/2021
Location: Barnsley		Dimensions (m): Depth 3.90	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	79.05		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subrounded fine to medium of mixed lithologies including rare coal and brick. (MADE GROUND TOPSOIL)
▼	0.30	J,K&T		0.40	78.85		MADE GROUND: Grey clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare sandstone and ironstone. Medium cobble content of mudstone. (REWORKED NATURAL GROUND)
	0.50	J,K&T		0.60	78.65		MADE GROUND: Reddish brown very clayey sandy angular to subangular fine to coarse GRAVEL of burnt shale. (BURNT SHALE)
			HVP=145	0.90	78.35		*At 0.4m, groundwater seepage.*
	1.20	D	HVP=110				Stiff greyish brown CLAY. (COHESIVE RESIDUAL SOIL)
			HVP=150				Stiff light brown mottled grey CLAY. (COHESIVE RESIDUAL SOIL)
							From 1.5m, clay is slightly gravelly.
	2.30	D		2.90	76.35		Grey clayey sandy angular to subangular tabular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
							From 3.0m, slight spalling of trial pit walls.
				3.60	75.65		Very weak grey thinly laminated MUDSTONE recovered as sandy angular tabular fine to coarse gravel. (COAL MEASURES)
▼				3.90	75.35		End of pit at 3.90 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 0.4m and 3.9m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit spalled slightly from 3.0m during excavation.

AGS

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Trial Pit Log

Trialpit No
TP205
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431756.22 - 407789.73 Level: 84.90	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 3.90	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	84.70		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subrounded fine to medium of mudstone. (MADE GROUND TOPSOIL)
	0.40	J,K&T	HVP=92	0.60	84.30		MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of sandstone. (REWORKED NATURAL GROUND)
	0.80	J,K&T	HVP=120				MADE GROUND: Stiff grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of predominantly mudstone with rare brick, sandstone, concrete and burnt shale. (OPENCAST BACKFILL)
							Locally very clayey gravel.
	1.20	D		1.30	83.60		MADE GROUND: Dark grey very clayey sandy angular to subangular fine to coarse GRAVEL of mixed lithologies including coal, mudstone, sandstone and rare brick. (OPENCAST BACKFILL)
	1.60	D&B		1.80	83.10		MADE GROUND: Grey very clayey sandy angular to subangular fine to coarse GRAVEL of mudstone and siltstone. Medium cobble content of mudstone. (OPENCAST BACKFILL)
	2.80	D&B		3.90	81.00		End of pit at 3.90 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP206
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431733.95 - 407853.85 Level: 82.40	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 4.00	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30	82.10		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to rounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
	0.50	D	HVP=72	0.60	81.80		MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (REWORKED NATURAL GROUND)
	0.70	J,K&T					MADE GROUND: Stiff grey slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of predominantly mudstone with rare brick, sandstone and coal. Cobbles are subangular of mudstone. (OPENCAST BACKFILL)
	1.00	D&B	HVP=105	1.30	81.10		MADE GROUND: Grey very clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare sandstone and coal. Medium cobble and low boulder content of mudstone. (OPENCAST BACKFILL)
							Significant collapse of trial pit walls from 1.3m during excavations.
				2.00	80.40		MADE GROUND: Firm grey slightly sandy gravelly CLAY with low cobble content. Gravel is subangular to subrounded fine to coarse of mudstone. Cobbles are subrounded of mudstone. (OPENCAST BACKFILL)
▼	2.30	D					*At 2.5m, significant groundwater inflow.*
				4.00	78.40		End of pit at 4.00 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.5m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit completely collapsed from 1.3m during excavation.

AGS

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Trial Pit Log

Trialpit No
TP207
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431703.29 - 407846.91 Level: 83.80	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 5.00	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	B		0.20	83.60		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine of mixed lithologies. (MADE GROUND TOPSOIL)
				0.60	83.20		MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of sandstone and ironstone. (REWORKED NATURAL GROUND)
	0.90	J,K&T					MADE GROUND: Firm grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of predominantly mudstone with rare brick, sandstone and coal. Cobbles are subangular of mudstone. (OPENCAST BACKFILL)
	1.40	D&B					*Significant collapse of trial pit walls from 1.7m during excavations.*
	2.00	D					
▼				3.00	80.80		MADE GROUND: Firm grey slightly sandy very gravelly CLAY with medium cobble content. Gravel is angular to subangular fine to coarse of mudstone. Cobbles are subangular of mudstone. (OPENCAST BACKFILL) *At 3.3m, significant groundwater inflow.*
	3.90	D&B					
				5.00	78.80		End of pit at 5.00 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 3.3m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit completely collapsed from 1.7m during excavation.

AGS

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Trial Pit Log

Trialpit No
TP208
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431774.13 - 407854.48 Level: 81.25	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 2.80	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.20	81.05		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine of mixed lithologies. (MADE GROUND TOPSOIL)
	0.40	D&B		0.50	80.75		MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (REWORKED NATURAL GROUND)
	0.70	J,K&T					MADE GROUND: Stiff grey slightly sandy gravelly CLAY with low cobble content. Gravel is ag to subrounded fine to coarse of mudstone. Cobbles are subrounded of mudstone. (OPENCAST BACKFILL)
▼							*At 1.1m, significant groundwater inflow.*
				1.30	79.95		MADE GROUND: Grey very clayey sandy angular to subangular fine to coarse GRAVEL of mudstone. High cobble and low boulder content of mudstone. (OPENCAST BACKFILL)
	1.70	D&B					
				2.80	78.45		End of pit at 2.80 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 1.1m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP209
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431880.33 - 407846.47 Level: 80.00	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 3.70	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to rounded fine to coarse of mixed lithologies including rare brick. (MADE GROUND TOPSOIL)
	0.20	B		0.30	79.70		MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
			HVP=145	0.70	79.30		Stiff grey mottled brown slightly gravelly CLAY. Gravel is subangular fine to coarse of ironstone. (COHESIVE RESIDUAL SOIL)
			HVP=150				
	1.00	D&B					
			HVP=130				
	1.80	D					*From 2.1m, clay is gravelly.*
				2.30	77.70		Greyish brown very clayey sandy angular to subangular fine to coarse GARVEL of mudstone and ironstone. (GRANULAR RESIDUAL SOIL)
				3.20	76.80		Very weak grey thinly laminated MUDSTONE with occasional ironstone nodules. (COAL MEASURES)
				3.70	76.30		End of pit at 3.70 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP210
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431845.71 - 407814.32 Level: 81.45	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 3.70	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	81.25		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subrounded fine to medium of mixed lithologies including rare coal. (MADE GROUND TOPSOIL)
	0.50	J,K&T	HVP=105	0.60	80.85		MADE GROUND: Stiff greyish brown and light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone, ironstone, rare coal and burnt shale. (REWORKED NATURAL GROUND)
	0.80	D	HVP=108				Stiff grey mottled brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of ironstone. (COHESIVE RESIDUAL SOIL)
			HVP=135				
	1.60	D	HVP=140				
				2.20	79.25		Brown clayey sandy angular to subangular fine to medium GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				2.60	78.85		Weak black vitreous COAL recovered as slightly clayey sandy angular tabular fine to coarse gravel. (THIN COAL)
				2.90	78.55		Stiff grey CLAY. (COHESIVE RESIDUAL SOIL)
▼							*At 3.4m, thin (10cm) bed of black coal.*
				3.50	77.95		*At 3.4m, groundwater seepage.* Very weak grey thinly laminated MUDSTONE recovered as clayey sandy angular to subangular fine to coarse gravel. (COAL MEASURES)
				3.70	77.75		End of pit at 3.70 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 3.4m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No **TP211** Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431930.36 - 407729.20 Level: 82.95	Date 03/12/2021
Location: Barnsley		Dimensions (m): Depth 2.10	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies including rare brick and coal. (TOPSOIL)
	0.20	B		0.30	82.65		Firm greyish brown slightly sandy CLAY. (COHESIVE RESIDUAL SOIL)
	0.60	D	HVP=45 HVP=78	0.70	82.25		Stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of ironstone and sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=90				
	1.50	D					*No hand vane shear tests were undertaken as no blocks of clay were recovered.*
▼				2.00	80.95		Strong light brown fine grained SANDSTONE recovered as sandy gravelly angular tabular cobbles. (COAL MEASURES)
				2.10	80.85		*At 2.0m, slight groundwater seepage.* End of pit at 2.10 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.0m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No **TP212**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431899.94 - 407759.08 Level: 82.85	Date 03/12/2021
Location: Barnsley		Dimensions (m): Depth 4.20	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	82.65		Dark brown slightly sandy CLAY with occasional rootlets. (TOPSOIL)
			HVP=85	0.70	82.15		Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and ironstone. (COHESIVE RESIDUAL SOIL)
	0.80	D&B	HVP=88 HVP=130				Stiff orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
▼	1.30	D		1.40	81.45		Brown clayey sandy angular to subangular tabular fine to coarse GRAVEL of sandstone with medium cobble content. (GRANULAR RESIDUAL SOIL) *At 1.6m groundwater seepage.*
				1.80	81.05		Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of siltstone. (COHESIVE RESIDUAL SOIL)
	2.20	D		2.40	80.45		Grey clayey sandy angular tabular fine to medium GRAVEL of siltstone. (GRANULAR RESIDUAL SOIL)
				3.30	79.55		Very weak grey thinly laminated SILTSTONE interbedded with dark grey MUDSTONE recovered as sandy angular tabular fine to coarse gravel. (COAL MEASURES)
				4.20	78.65		End of pit at 4.20 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 1.6m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP213
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431857.63 - 407730.77 Level: 84.50	Date 03/12/2021
Location: Barnsley		Dimensions (m): Depth 4.30	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
	0.20	B		0.30	84.20		
			HVP=85				Stiff light brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and ironstone. (COHESIVE RESIDUAL SOIL)
	0.70	D	HVP=100				
			HVP=125				
				1.20	83.30		Stiff grey mottled brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of siltstone. (COHESIVE RESIDUAL SOIL)
	1.60	D					*No hand vane shear tests were undertaken as no blocks of clay were recovered.*
				2.10	82.40		Greyish brown clayey sandy angular to subangular fine to coarse GRAVEL of siltstone. (GRANULAR RESIDUAL SOIL)
	2.30	D					
				2.90	81.60		Very weak grey thinly laminated SILTSTONE interbedded with dark grey MUDSTONE recovered as sandy angular tabular fine to coarse gravel. (COAL MEASURES)
				4.30	80.20		End of pit at 4.30 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

Appendix G

Trial Trench Logs

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT01SE
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431827.00 - 407816.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 16.5 × 0.6, Depth 2.60	Scale 1:20
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Dark brown slightly sandy CLAY with occasional rootlets. (MADE GROUND TOPSOIL)
				0.20			MADE GROUND: Yellowish brown slightly sandy CLAY. (REWORKED NATURAL GROUND)
				0.30			MADE GROUND: Reddish brown sandy angular to subangular fine to coarse GRAVEL of burnt red shale. (OPENCAST BACKFILL)
				0.50			MADE GROUND: Greyish brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of predominantly mudstone and sandstone with rare brick. (OPENCAST BACKFILL)
				0.90			Stiff greyish brown slightly sandy CLAY. (COHESIVE RESIDUAL SOIL)
				1.90			Weak black COAL recovered as sandy angular gravel. (THIN COAL)
				2.40			Stiff light grey CLAY. (COHESIVE RESIDUAL SOIL)
				2.60			End of pit at 2.60 m

1
2
3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT01C
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431817.00 - 407822.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 16.5 × 0.6 Depth 2.70	Scale 1:20
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Dark brown slightly sandy CLAY with occasional rootlets. (MADE GROUND TOPSOIL)
				0.20			MADE GROUND: Greyish brown slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of predominantly mudstone with rare sandstone and brick. Cobbles of mudstone and sandstone. (OPENCAST BACKFILL)
				1.70			Weak black COAL recovered as sandy angular gravel. (THIN COAL)
				2.00			Stiff light grey CLAY (COHESIVE RESIDUAL SOIL)
							From 2.5m, clay contains gravel of mudstone lithorelicts.
				2.70			*Groundwater inflow in TT01NW prevented identification and inspection of highwall.* End of pit at 2.70 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT01NW
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431812.00 - 407827.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 16.5 × 0.6 Depth 2.70	Scale 1:20
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			MADE GROUND: Dark brown slightly sandy CLAY with occasional rootlets. (MADE GROUND TOPSOIL)
							MADE GROUND: Greyish brown slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of predominantly mudstone with rare sandstone and brick. Cobbles of mudstone and sandstone. (OPENCAST BACKFILL)
▼							*At 2.2m, groundwater inflow.*
				2.70			*Trial pit abandoned due to major groundwater inflow.* End of pit at 2.70 m

1
2
3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 2.2m during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT02E
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431920.00 - 407729.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 18.3 × 0.6 Depth 1.00	Scale 1:20
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
			HVP=80	0.20			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of sandstone. (TOPSOIL)
				0.60			Stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				1.00			Orangish brown and grey clayey sandy angular to subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL) End of pit at 1.00 m

1
2
3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT02C
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431905.00 - 407727.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 18.3 × 0.6 Depth 1.90	Scale 1:20
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of sandstone. (TOPSOIL)
				0.60			Stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				1.50			Orangish brown and grey clayey sandy angular to subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
				1.90			Medium strong light brown thickly laminated fine grained SANDSTONE recovered as sandy angular tabular fine to coarse gravel. (COAL MEASURES) *Crest of highwall identified at 1.9m dipping at around 50 degrees from vertical.* *Unable to excavate beyond 1.9m.* End of pit at 1.90 m

1
2
3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT02W
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431904.00 - 407726.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 18.3 × 0.6, Depth 2.30	Scale 1:20
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of sandstone. (MADE GROUND TOPSOIL)
				0.50			MADE GROUND: Yellowish brown slightly sandy CLAY. (REWORKED NATURAL GROUND)
				2.30			MADE GROUND: Grey clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare sandstone and metal. (OPENCAST BACKFILL) End of pit at 2.30 m

1
2
3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT03N
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431733.00 - 407909.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 9 × 0.6 Depth 2.40	Scale 1:20
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of sandstone. (MADE GROUND TOPSOIL)
				0.50			MADE GROUND: Yellowish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and mudstone. (REWORKED NATURAL GROUND)
				1.00			MADE GROUND: Greyish brown clayey GRAVEL of mudstone and sandstone. (OPENCAST BACKFILL)
				1.30			Weak black COAL recovered as sandy angular gravel. (THIN COAL)
				2.10			Stiff grey slightly gravelly CLAY. Gravel is subangular fine to medium of mudstone lithorelicts. (COHESIVE RESIDUAL SOIL) *At 1.9m, thin (<0.1m) coal.*
				2.40			Grey slightly clayey sandy angular tabular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL) *Crest of highwall identified at 2.4m dipping at around 40 degrees from vertical.* *Unable to excavate beyond 2.4m.* End of pit at 2.40 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT03S
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431732.00 - 407903.00 Level:	Date 16/04/2019
Location: Barnsley		Dimensions (m): 9 × 0.6 Depth 3.00	Scale 1:20
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of sandstone. (MADE GROUND TOPSOIL)
				0.40			MADE GROUND: Yellowish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and mudstone. (REWORKED NATURAL GROUND)
				0.70			MADE GROUND: Grey slightly sandy gravelly CLAY with medium cobble content. Gravel is angular to subangular fine to coarse of predominantly mudstone with rare sandstone and coal. Cobbles of mudstone and sandstone. (OPENCAST BACKFILL)
							At 1.3m, mudstone boulder 600mm across.
▼							*at 2.9m, groundwater inflow.*
				3.00			End of pit at 3.00 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 2.9m during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT201NW
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431676.87 - 407912.15 Level: 82.55	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 4.20	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	82.25		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies including rare brick. (MADE GROUND TOPSOIL)
							MADE GROUND: Firm grey slightly sandy gravelly CLAY with low cobble content. Gravel is subangular to subrounded fine to medium of mudstone. Cobbles are subrounded of mudstone. (OPENCAST BACKFILL)
							Locally topsoil is up to 0.5m thick.
				1.00	81.55		Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of siltstone and ironstone. (COHESIVE RESIDUAL SOIL)
			HVP=100				
				2.00	80.55		Stiff brown mottled grey very gravelly CLAY. Gravel is angular to subangular tabular fine to medium of siltstone. (COHESIVE RESIDUAL SOIL)
				3.80	78.75		Brown clayey sandy angular to subangular fine to coarse GRAVEL of siltstone. (GRANULAR RESIDUAL SOIL)
▼							*At 4.2m, groundwater seepage.*
				4.20	78.35		*Refusal at 4.2m.* End of pit at 4.20 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 4.2m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT201SE
Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431679.97 - 407905.20 Level: 82.65	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 6.00	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	82.35		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies including rare brick. (MADE GROUND TOPSOIL)
	0.70	J,K&T					MADE GROUND: Firm to stiff grey slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of mudstone. Cobbles are subangular of mudstone. (OPENCAST BACKFILL)
	1.20	D&B					

1
2
3
4
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Continued on next sheet

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit completely collapsed from 0.0m on completion.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT201SE
Sheet 2 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431679.97 - 407905.20 Level: 82.65	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 6.00	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				6.00	76.65		*Complete collapse of trial pit walls from surface on completion.* End of pit at 6.00 m

6
7
8
9
10

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit completely collapsed from 0.0m on completion.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT202N
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431759.32 - 407904.49 Level: 79.75	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 3.20	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	79.45		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
							MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND) *At 0.6m, terracotta land drain with water inflow.*
	0.90	J,K&T		0.80	78.95		MADE GROUND: Firm grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone and siltstone. (OPENCAST BACKFILL)
				1.20	78.55		Stiff brown mottled grey slightly sandy CLAY. (COHESIVE RESIDUAL SOIL)
	1.50	D	HVP=98				
	1.80	D		1.70	78.05		Weak black COAL recovered as slightly clayey sandy angular to subangular fine to coarse gravel. (THIN COAL)
				2.00	77.75		Stiff grey CLAY. (COHESIVE RESIDUAL SOIL)
			HVP=105				
				2.50	77.25		Weathered black COAL recovered as very clayey sandy angular to subangular fine to medium gravel. (THIN COAL)
				2.70	77.05		Stiff grey gravelly CLAY. Gravel is angular fine to coarse of mudstone. (COHESIVE RESIDUAL SOIL)
				3.20	76.55		End of pit at 3.20 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT202S
Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431756.17 - 407896.81 Level: 79.95	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 5.20	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	79.65		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
							MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
				0.80	79.15		MADE GROUND: Stiff grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone and siltstone. Cobbles are subangular of mudstone. (OPENCAST BACKFILL)
	1.40	D&B					
	1.80	J,K&T					
							At 4.3m, two siltstone boulders measuring 1.0m x 0.6m x 0.2m.
							Continued on next sheet

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT202S
Sheet 2 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431756.17 - 407896.81 Level: 79.95	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 5.20	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				5.20	74.75		End of pit at 5.20 m

6
7
8
9
10

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT203
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431843.67 - 407883.60 Level: 79.25	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 2.00	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	78.95		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
				0.50	78.75		MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
							MADE GROUND: Grey very clayey sandy angular to subangular fine to coarse GRAVEL of mudstone. Medium cobble content of mudstone. (OPENCAST BACKFILL)
							At 0.8m, terracotta land drain with significant water inflow.
				2.00	77.25		*Trial trench abandoned due to significant water inflow from land drain. Unable to keep trench dry.*
							End of pit at 2.00 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT204N
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431851.72 - 407889.39 Level: 79.15	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 3.00	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40	78.75		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies including rare metal. (MADE GROUND TOPSOIL)
			HVP=130	1.00	78.15		MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles are subangular of sandstone. (REWORKED NATURAL GROUND)
	1.40	D	HVP=110	1.20	77.95		MADE GROUND: Stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of mudstone. Cobbles are subangular of mudstone. (OPENCAST BACKFILL) Stiff grey mottled brown CLAY. (COHESIVE RESIDUAL SOIL)
				2.50	76.65		Stiff brown gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone. (COHESIVE RESIDUAL SOIL)
				3.00	76.15		End of pit at 3.00 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT204S
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431848.94 - 407882.57 Level: 79.25	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 3.20	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30	78.95		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies including rare metal. (MADE GROUND TOPSOIL)
				0.80	78.45		MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles are subangular of sandstone. (REWORKED NATURAL GROUND)
	0.90	J,K&T					MADE GROUND: Stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of mudstone. Cobbles are subangular of mudstone. (OPENCAST BACKFILL)
	1.20	D					
	1.50	J,K&T					*At 1.7m, subrounded mudstone boulder (0.8m x 0.6m x 0.3m).*
▼							*At 2.0m, steel rope.* *At 2.0m, significant groundwater inflow.*
	2.80	D		3.20	76.05		End of pit at 3.20 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.0m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT205NW
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431793.69 - 407799.27 Level: 83.25	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 4.90	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	83.05		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies including rare brick and coal. (MADE GROUND TOPSOIL)
				0.40	82.85		MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
	0.50	J,K&T					
	0.60	D&B					
				0.80	82.45		MADE GROUND: Reddish brown clayey sandy angular to subangular fine to coarse GRAVEL of predominantly burnt shale with rare mudstone. (BURNT SHALE)
							MADE GROUND: Firm grey slightly sandy gravelly CLAY with medium cobble content. Gravel is angular to subrounded fine to coarse of mudstone and siltstone. Cobbles are subangular of mudstone. (OPENCAST BACKFILL)
	1.80	D					
							From 2.0m, major collapsing of trial pit walls.
▼							*At 3.0m, significant groundwater inflow.*
							From 3.5m, clay is very gravelly.
				4.90	78.35		*At 4.9m, trench terminated. Water ingress prevented inspection of highwall.*
							End of pit at 4.90 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 3.0m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between 2.0m and 4.9m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT205SE
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431805.39 - 407795.15 Level: 83.20	Date 01/12/2021
Location: Barnsley		Dimensions (m): Depth 4.20	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.20	83.00		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies including rare brick and coal. (MADE GROUND TOPSOIL)
				0.40	82.80		MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
				0.80	82.40		MADE GROUND: Reddish brown clayey sandy angular to subangular fine to coarse GRAVEL of predominantly burnt shale with rare mudstone. (BURNT SHALE)
	1.00	D&B	HVP=130				Stiff yellowish brown slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				1.50	81.70		Weak black vitreous COAL recovered as clayey sandy angular to subangular fine to coarse gravel. (THIN COAL)
				1.90	81.30		Stiff grey CLAY. (COHESIVE RESIDUAL SOIL)
				3.20	80.00		Greyish brown clayey sandy angular to subangular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				4.20	79.00		End of pit at 4.20 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT206C
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431774.31 - 407768.10 Level: 85.15	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 3.40	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 0.15	J&T B		0.20	84.95		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine of mixed lithologies. (MADE GROUND TOPSOIL)
				0.40	84.75		MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
	0.80	D&B					MADE GROUND: Dark reddish grey slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of predominantly burnt shale and mudstone with rare brick and concrete. Cobbles are angular to subangular of brick and concrete. (OPENCAST BACKFILL)
	1.00	J,K&T					*From 0.9m, high boulder content of concrete up to 1.6m across.*
							Significant overbreak of walls due to cobbles and boulders.
				1.70	83.45		Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of siltstone. (COHESIVE RESIDUAL SOIL)
				3.00	82.15		Brown clayey sandy angular to subangular tabular fine to coarse GRAVEL of siltstone. (GRANULAR RESIDUAL SOIL)
				3.40	81.75		End of pit at 3.40 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT206NW
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431770.05 - 407769.67 Level: 85.20	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 4.80	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	85.00		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine of mixed lithologies. (MADE GROUND TOPSOIL)
				0.40	84.80		MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (REWORKED NATURAL GROUND)
							MADE GROUND: Dark reddish grey slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of predominantly burnt shale and mudstone with rare brick and concrete. Cobbles are angular to subangular of brick and concrete. (OPENCAST BACKFILL)
				4.80	80.40		End of pit at 4.80 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT206SE
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431780.09 - 407765.99 Level: 85.00	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 1.20	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	84.80		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine of mixed lithologies. (MADE GROUND TOPSOIL)
				0.50	84.50		MADE GROUND: Grey and brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of predominantly mudstone and sandstone with rare brick. Cobbles are subangular of brick. (REWORKED NATURAL GROUND)
	0.60	J,K&T		0.80	84.20		MADE GROUND: Reddish brown clayey sandy angular to subangular fine to coarse GRAVEL of burnt shale. (BURNT SHALE)
	1.00	D	HVP=145				Stiff orangish brown mottled grey CLAY. (COHESIVE RESIDUAL SOIL)
				1.20	83.80		End of pit at 1.20 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT207C
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431836.91 - 407847.64 Level: 80.60	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 1.40	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	80.40		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
				0.50	80.10		MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
	0.90	J,K&T					MADE GROUND: Stiff grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone. (OPENCAST BACKFILL)
				1.00	79.60		Stiff grey mottled brown CLAY. (COHESIVE RESIDUAL SOIL) *At 1.1m, terracotta land drain with water inflow.*
	1.30	D					
				1.40	79.20		End of pit at 1.40 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT207NW
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431828.27 - 407850.76 Level: 80.55	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 3.40	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	80.35		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
				0.50	80.05		MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
							MADE GROUND: Stiff grey slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of mudstone. Cobbles are subangular of mudstone. (OPENCAST BACKFILL)
	1.20	D					
							From 1.4m, constant spalling and collapse of trench walls.
	1.60	J,K&T					
▼				1.80	78.75		MADE GROUND: Grey clayey sandy angular to subangular fine to coarse GRAVEL of mudstone. Medium cobble and low boulder content of mudstone. (OPENCAST BACKFILL)
							At 1.8m, significant groundwater inflow.
	2.40	D&B					
				3.40	77.15		End of pit at 3.40 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 1.8m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between 1.6m and 3.4m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT207SE
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431842.38 - 407846.90 Level: 80.45	Date 02/12/2021
Location: Barnsley		Dimensions (m): Depth 1.00	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	80.25		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
				0.60	79.85		MADE GROUND: Stiff light brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
				1.00	79.45		Stiff grey mottled brown slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
							End of pit at 1.00 m

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4
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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT208NW
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431887.60 - 407730.13 Level: 84.15	Date 03/12/2021
Location: Barnsley		Dimensions (m): Depth 3.00	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	83.95		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
				0.50	83.65		MADE GROUND: Firm greyish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick, concrete and sandstone. (REWORKED NATURAL GROUND)
							Stiff orangish brown mottled grey slightly sandy CLAY. (COHESIVE RESIDUAL SOIL)
				1.80	82.35		Brown clayey sandy angular to subangular fine to coarse GRAVEL of siltstone. (GRANULAR RESIDUAL SOIL)
				2.50	81.65		Weak brown thinly laminated SILTSTONE recovered as sandy angular tabular fine to coarse gravel. (COAL MEASURES)
				3.00	81.15		End of pit at 3.00 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT208SE
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431889.28 - 407721.93 Level: 84.10	Date 03/12/2021
Location: Barnsley		Dimensions (m): Depth 3.40	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.40	J,K&T		0.20	83.90		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
	0.90	D&B					MADE GROUND: Greyish brown slightly sandy gravelly CLAY with medium cobble and low boulder content. Gravel is angular to subrounded fine to coarse of mixed lithologies including sandstone, mudstone, brick and concrete with rare metal, coal, burnt shale and glass. Cobbles and boulders of concrete and brick. (OPENCAST BACKFILL)
							Constant spalling and collapse of trench walls from surface.
							At 0.9m, subangular concrete boulder (1.4m x 0.7m x 0.2m).
	1.40	J,K&T					*At 1.4m, 1 inch diameter wire rope.*
▼							*At 1.7m, significant groundwater inflow.*
							From 1.9m, high cobble content of concrete (reinforced beams).
				3.40	80.70		End of pit at 3.40 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 1.7m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between 0.0m and 3.4m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT209C
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431753.88 - 407743.19 Level: 86.65	Date 03/12/2021
Location: Barnsley		Dimensions (m): Depth 3.00	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 0.15	J&T B		0.20	86.45		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
				0.40	86.25		MADE GROUND: Firm light brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (REWORKED NATURAL GROUND) *Complete collapse of trench walls from surface during excavation.*
				0.90	85.75		MADE GROUND: Firm grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of predominantly mudstone with rare concrete. Cobbles are subangular of mudstone and concrete. (OPENCAST BACKFILL)
				1.10	85.55		MADE GROUND: Reddish brown slightly clayey sandy angular to subangular fine to coarse GRAVEL of burnt shale. (BURNT SHALE)
	1.50	D&B					MADE GROUND: Grey slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of predominantly mudstone with rare sandstone and ironstone. (OPENCAST BACKFILL)
				2.10	84.55		Stiff greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of siltstone. (COHESIVE RESIDUAL SOIL)
				2.60	84.05		Very weak brown thinly laminated SILTSTONE recovered as clayey sandy angular fine to medium gravel. (COAL MEASURES)
				3.00	83.65		End of pit at 3.00 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit completely collapsed from 0.0m during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT209E
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431760.46 - 407742.03 Level: 86.45	Date 03/12/2021
Location: Barnsley		Dimensions (m): Depth 1.60	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	86.25		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
	0.60	J,K&T		0.50	85.95		MADE GROUND: Firm light brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (REWORKED NATURAL GROUND)
	1.00	J,K&T		0.90	85.55		MADE GROUND: Firm grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of predominantly mudstone with rare concrete. Cobbles are subangular of mudstone and concrete. (OPENCAST BACKFILL)
	1.30	D		1.10	85.35		MADE GROUND: Reddish brown slightly clayey sandy angular to subangular fine to coarse GRAVEL of burnt shale. (BURNT SHALE)
				1.60	84.85		Stiff light brown mottled grey CLAY. (COHESIVE RESIDUAL SOIL) End of pit at 1.60 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT209SW
Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431749.45 - 407739.71 Level: 86.95	Date 03/12/2021
Location: Barnsley		Dimensions (m): Depth 5.80	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	86.75		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
				0.40	86.55		MADE GROUND: Firm light brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (REWORKED NATURAL GROUND)
				0.90	86.05		MADE GROUND: Firm grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of predominantly mudstone with rare concrete. Cobbles are subangular of mudstone and concrete. (OPENCAST BACKFILL)
				1.10	85.85		MADE GROUND: Reddish brown slightly clayey sandy angular to subangular fine to coarse GRAVEL of burnt shale. (BURNT SHALE)
							MADE GROUND: Grey slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of predominantly mudstone with rare sandstone and ironstone. (OPENCAST BACKFILL)
				2.10	84.85		MADE GROUND: Grey clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare coal and sandstone. Medium cobble content of mudstone. (OPENCAST BACKFILL)
							Constant spalling and collapse of trench wall from 2.1m.
							Continued on next sheet

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between 2.1m and 5.8m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT209SW
Sheet 2 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431749.45 - 407739.71 Level: 86.95	Date 03/12/2021
Location: Barnsley		Dimensions (m): Depth 5.80	Scale 1:25
Client: Countryside Properties			Logged LEW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				5.80	81.15		End of pit at 5.80 m

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9
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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between 2.1m and 5.8m depth during excavation.

AGS

Appendix H

Probehole Logs

Borehole Log

Borehole No. **PH101**

Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431734.42 - 407910.80	Hole Type PH
Location:	Barnsley		Level:	80.35	Scale 1:100
Client:	Countryside Properties		Dates:	30/07/2020 - 30/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					0.70	79.65		Black COAL. (THIN COAL)
					1.70	78.65		Grey MUDSTONE. (COAL MEASURES)
								From 10.0m mudstone is dark grey.
					10.50	69.85		Black dull ashy COAL. (SWALLOW WOOD COAL)
					11.50	68.85		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Borehole Log

Borehole No. **PH101**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431734.42 - 407910.80	Hole Type PH
Location:	Barnsley		Level:	80.35	Scale 1:100
Client:	Countryside Properties		Dates:	30/07/2020 - 30/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					25.20	55.15		Black COAL. 30cm mudstone parting. (TOP HAIGH MOOR COAL)
					26.30	54.05		Grey MUDSTONE. (COAL MEASURES)
					28.00	52.35		End of borehole at 28.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Borehole Log

LITHOS CONSULTING

Borehole No. **PH102**

Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431827.91 - 407812.91	Hole Type PH
Location:	Barnsley		Level:	81.90	Scale 1:100
Client:	Countryside Properties		Dates:	30/07/2020 - 30/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.40	80.50		Black COAL. (THIN COAL)
					2.60	79.30		Grey MUDSTONE. (COAL MEASURES)
								From 9.5m mudstone is dark grey.
					10.30	71.60		Black COAL. (SWALLOW WOOD COAL)
					11.30	70.60		Grey MUDSTONE. (COAL MEASURES)
					15.00	66.90		End of borehole at 15.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH102A**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: -	Hole Type PH
Location: Barnsley		Level:	Scale 1:100
Client: Countryside Properties		Dates: 30/07/2020 - 30/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.40			Black COAL. (THIN COAL)
					2.00			Grey MUDSTONE. (COAL MEASURES)
					6.00			End of borehole at 6.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH103
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431804.38 - 407825.88	Hole Type PH
Location:	Barnsley		Level:	81.85	Scale 1:100
Client:	Countryside Properties		Dates:	30/07/2020 - 30/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
								From 5.0m ingress of groundwater during drilling.
					10.20	71.65		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH103
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431804.38 - 407825.88	Hole Type PH
Location:	Barnsley		Level:	81.85	Scale 1:100
Client:	Countryside Properties		Dates:	30/07/2020 - 30/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					24.70	57.15		Black COAL. (TOP HAIGH MOOR COAL)
					26.00	55.85		Grey MUDSTONE. (COAL MEASURES)
					28.50	53.35		End of borehole at 28.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH104
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431775.40 - 407893.96	Hole Type PH
Location:	Barnsley		Level:	79.75	Scale 1:100
Client:	Countryside Properties		Dates:	30/07/2020 - 30/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
					10.60	69.15		Black COAL. (SWALLOW WOOD COAL)
					11.00	68.75		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH104
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431775.40 - 407893.96	Hole Type PH
Location:	Barnsley		Level:	79.75	Scale 1:100
Client:	Countryside Properties		Dates:	30/07/2020 - 30/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					25.00	54.75		Black COAL. 20cm mudstone parting. (TOP HAIGH MOOR COAL)
					26.00	53.75		Grey MUDSTONE. (COAL MEASURES)
					33.00	46.75		Black COAL. (LOW HAIGH MOOR COAL)
					34.20	45.55		Grey MUDSTONE. (COAL MEASURES)
					36.00	43.75		End of borehole at 36.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH105
Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431832.37 - 407897.86	Hole Type PH
Location: Barnsley		Level: 79.20	Scale 1:100
Client: Countryside Properties		Dates: 31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.60	77.60		Brownish grey MUDSTONE. (COAL MEASURES)
					3.00	76.20		Grey MUDSTONE. (COAL MEASURES)
					3.80	75.40		Black COAL. (THIN COAL)
					4.50	74.70		Grey MUDSTONE. (COAL MEASURES)
								From 11.6m mudstone is dark grey.
					12.70	66.50		Black coal. 30cm mudstone parting. (SWALLOW WOOD COAL)
					13.70	65.50		Grey MUDSTONE. (COAL MEASURES)
								at 18.2m c. 20cm flash of dull ashy coal.
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH105
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431832.37 - 407897.86	Hole Type PH
Location:	Barnsley		Level:	79.20	Scale 1:100
Client:	Countryside Properties		Dates:	31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					27.00	52.20		Black COAL. 20cm mudstone parting. (TOP HAIGH MOOR COAL)
					28.00	51.20		Grey MUDSTONE. (COAL MEASURES)
					34.50	44.70		Black COAL. (LOW HAIGH MOOR COAL)
					35.50	43.70		Grey MUDSTONE. (COAL MEASURES)
					36.00	43.20		End of borehole at 36.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH105A
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: -	Hole Type PH
Location: Barnsley		Level:	Scale 1:100
Client: Countryside Properties		Dates: 31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.50			Grey MUDSTONE. (COAL MEASURES)
					3.80			Black COAL. (THIN COAL)
					4.50			Grey MUDSTONE. (COAL MEASURES)
					6.00			End of borehole at 6.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH106
Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431865.05 - 407843.71	Hole Type PH
Location: Barnsley		Level: 80.35	Scale 1:100
Client: Countryside Properties		Dates: 31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.50	78.85		Grey MUDSTONE. (COAL MEASURES)
	▼							*From 3.0m ingress of groundwater during drilling.*
					3.50	76.85		Black COAL. (THIN COAL)
					4.00	76.35		Grey MUDSTONE. (COAL MEASURES)
					12.50	67.85		Black COAL. (SWALLOW WOOD COAL)
					13.50	66.85		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH106**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431865.05 - 407843.71	Hole Type PH
Location:	Barnsley		Level:	80.35	Scale 1:100
Client:	Countryside Properties		Dates:	31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					28.00	52.35		Black COAL. (TOP HAIGH MOOR COAL)
					29.00	51.35		Grey MUDSTONE. (COAL MEASURES)
					30.00	50.35		End of borehole at 30.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH107
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431681.52 - 407895.14	Hole Type PH
Location:	Barnsley		Level:	82.85	Scale 1:100
Client:	Countryside Properties		Dates:	31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
					9.60	73.25		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH107**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431681.52 - 407895.14	Hole Type PH
Location:	Barnsley		Level:	82.85	Scale 1:100
Client:	Countryside Properties		Dates:	31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					24.30	58.55		Black COAL. (TOP HAIGH MOOR COAL)
					25.30	57.55		Grey MUDSTONE. (COAL MEASURES)
					27.00	55.85		End of borehole at 27.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Borehole Log

Borehole No. **PH107A**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: -	Hole Type PH
Location: Barnsley		Level:	Scale 1:100
Client: Countryside Properties		Dates: 31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
					6.00			End of borehole at 6.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH108
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431919.76 - 407726.26	Hole Type PH
Location:	Barnsley		Level:	83.35	Scale 1:100
Client:	Countryside Properties		Dates:	31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.70	81.65		Grey MUDSTONE. (COAL MEASURES)
								From 6.0m mudstone is dark grey.
					6.89	76.46		Black COAL. (THIN COAL)
					7.50	75.85		Grey MUDSTONE. (COAL MEASURES)
					16.10	67.25		Black COAL. (SWALLOW WOOD COAL)
					17.20	66.15		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH108**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431919.76 - 407726.26	Hole Type PH
Location:	Barnsley		Level:	83.35	Scale 1:100
Client:	Countryside Properties		Dates:	31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								at 20.4m c. 30cm flash of dull ashy coal.
					30.00	53.35		End of borehole at 30.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Borehole Log

Borehole No. **PH108A**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: -	Hole Type PH
Location: Barnsley		Level:	Scale 1:100
Client: Countryside Properties		Dates: 31/07/2020 - 31/07/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.70			Grey MUDSTONE. (COAL MEASURES)
					6.00			End of borehole at 6.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH109
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431687.48 - 407867.39	Hole Type PH
Location:	Barnsley		Level:	83.50	Scale 1:100
Client:	Countryside Properties		Dates:	03/08/2020 - 03/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
								From 5.0m ingress of groundwater during drilling.
					9.00	74.50		Black COAL. (SWALLOW WOOD COAL)
					9.40	74.10		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH109**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431687.48 - 407867.39	Hole Type PH
Location:	Barnsley		Level:	83.50	Scale 1:100
Client:	Countryside Properties		Dates:	03/08/2020 - 03/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					22.50	61.00		Black COAL. 2x c. 20cm mudstone partings. (TOP HAIGH MOOR COAL)
					23.50	60.00		Grey MUDSTONE. (COAL MEASURES)
					30.00	53.50		End of borehole at 30.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Borehole Log

Borehole No. **PH110**

Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431703.71 - 407833.11	Hole Type PH
Location:	Barnsley		Level:	84.55	Scale 1:100
Client:	Countryside Properties		Dates:	03/08/2020 - 03/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼				5.80	78.75		MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
								Grey MUDSTONE. (COAL MEASURES) *From 6.0m ingress of groundwater during drilling.*
					19.50	65.05		Black COAL. C. 30cm mudstone parting.
								Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH110
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431703.71 - 407833.11	Hole Type PH
Location:	Barnsley		Level:	84.55	Scale 1:100
Client:	Countryside Properties		Dates:	03/08/2020 - 03/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								(TOP HAIGH MOOR COAL)
					20.60	63.95		Grey MUDSTONE. (COAL MEASURES)
					33.00	51.55		End of borehole at 33.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH110A**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: -	Hole Type PH
Location: Barnsley		Level:	Scale 1:100
Client: Countryside Properties		Dates: 03/08/2020 - 03/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
					5.50			End of borehole at 5.50 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH111
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431731.68 - 407788.07	Hole Type PH
Location:	Barnsley		Level:	85.55	Scale 1:100
Client:	Countryside Properties		Dates:	03/08/2020 - 03/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
								From 4.5m ingress of groundwater during drilling.
					6.60	78.95		Grey MUDSTONE. (COAL MEASURES)
								at 10.0m c. 30cm flash of dull ashy coal.
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH111
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431731.68 - 407788.07	Hole Type PH
Location:	Barnsley		Level:	85.55	Scale 1:100
Client:	Countryside Properties		Dates:	03/08/2020 - 03/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					21.10	64.45		Black COAL. (TOP HAIGH MOOR COAL)
					22.10	63.45		Grey MUDSTONE. (COAL MEASURES)
					24.00	61.55		End of borehole at 24.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH112
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431734.95 - 407885.35	Hole Type PH
Location:	Barnsley		Level:	81.25	Scale 1:100
Client:	Countryside Properties		Dates:	04/08/2020 - 04/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
	▼							*From 8.7m ingress of groundwater during drilling.*
					10.50	70.75		Grey MUDSTONE. (COAL MEASURES)
								at 12.0m c. 20cm flash of dull ashy coal.
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH112**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431734.95 - 407885.35	Hole Type PH
Location:	Barnsley		Level:	81.25	Scale 1:100
Client:	Countryside Properties		Dates:	04/08/2020 - 04/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					24.20	57.05		Black COAL. (TOP HAIGH MOOR COAL)
					25.40	55.85		Grey MUDSTONE. (COAL MEASURES)
					32.50	48.75		Black COAL. (LOW HAIGH MOOR COAL)
					33.30	47.95		Grey MUDSTONE. (COAL MEASURES)
					36.00	45.25		End of borehole at 36.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH113
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords: 431781.52 - 407882.87	Hole Type PH
Location:	Barnsley		Level: 79.90	Scale 1:100
Client:	Countryside Properties		Dates: 04/08/2020 - 04/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
					10.00	69.90		Grey MUDSTONE. (COAL MEASURES)
					14.50	65.40		Black COAL. (SWALLOW WOOD COAL)
					15.00	64.90		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No. **PH113**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431781.52 - 407882.87	Hole Type PH
Location:	Barnsley		Level:	79.90	Scale 1:100
Client:	Countryside Properties		Dates:	04/08/2020 - 04/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								From 23.0m mudstone is dark grey.
					24.20	55.70		Black COAL. (TOP HAIGH MOOR COAL)
					25.20	54.70		Grey MUDSTONE. (COAL MEASURES)
					32.40	47.50		Black COAL. (LOW HAIGH MOOR COAL)
					33.40	46.50		Grey MUDSTONE. (COAL MEASURES)
					36.00	43.90		End of borehole at 36.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH114
Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431925.39 - 407780.74	Hole Type PH
Location: Barnsley		Level: 81.60	Scale 1:100
Client: Countryside Properties		Dates: 04/08/2020 - 04/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.70	79.90		Grey MUDSTONE. (COAL MEASURES)
					6.50	75.10		Black COAL. (THIN COAL)
					7.10	74.50		Grey MUDSTONE. (COAL MEASURES)
								From 14.5m mudstone is dark grey.
					15.50	66.10		Black COAL. (SWALLOW WOOD COAL)
					16.80	64.80		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

LITHOS CONSULTING			Borehole No. **PH114** Sheet 2 of 2
Project Name: Barugh Green	Project No. 3407	Co-ords: 431925.39 - 407780.74	Hole Type PH
Location: Barnsley		Level: 81.60	Scale 1:100
Client: Countryside Properties		Dates: 04/08/2020 - 04/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					21.20	60.40		Black COAL. (TOP HAIGH MOOR COAL)
					22.00	59.60		Grey MUDSTONE. (COAL MEASURES)
					27.00	54.60		End of borehole at 27.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH115
Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431913.43 - 407866.64	Hole Type PH
Location: Barnsley		Level: 79.55	Scale 1:100
Client: Countryside Properties		Dates: 04/08/2020 - 04/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.80	77.75		Grey MUDSTONE. (COAL MEASURES)
					7.10	72.45		Black COAL. (THIN COAL)
					8.10	71.45		Grey MUDSTONE. (COAL MEASURES)
					16.00	63.55		Black COAL. c. 30cm mudstone parting. (SWALLOW WOOD COAL)
					17.00	62.55		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH115**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431913.43 - 407866.64	Hole Type PH
Location:	Barnsley		Level:	79.55	Scale 1:100
Client:	Countryside Properties		Dates:	04/08/2020 - 04/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					30.00	49.55		End of borehole at 30.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Borehole Log

Borehole No. **PH115A**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: -	Hole Type PH
Location: Barnsley		Level:	Scale 1:100
Client: Countryside Properties		Dates: 04/08/2020 - 04/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.80			Grey MUDSTONE. (COAL MEASURES)
					6.00			End of borehole at 6.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH116
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431828.76 - 407840.81	Hole Type PH
Location:	Barnsley		Level:	80.90	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.60	79.30		Black COAL. (THIN COAL)
					2.20	78.70		Grey MUDSTONE. (COAL MEASURES)
	▼							*From 6.0m ingress of groundwater during drilling.*
					10.40	70.50		Black COAL. (SWALLOW WOOD COAL)
					11.50	69.40		Grey MUDSTONE. With occasional beds of buff sandstone. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH116
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431828.76 - 407840.81	Hole Type PH
Location:	Barnsley		Level:	80.90	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					24.70	56.20		Black COAL. (TOP HAIGH MOOR COAL)
					25.70	55.20		Grey MUDSTONE. (COAL MEASURES)
					33.50	47.40		Black COAL. (LOW HAIGH MOOR COAL)
					34.50	46.40		Grey MUDSTONE. (COAL MEASURES)
					39.00	41.90		End of borehole at 39.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH117
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431803.87 - 407797.79	Hole Type PH
Location:	Barnsley		Level:	83.15	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.50	81.65		Black COAL. (THIN COAL)
					2.40	80.75		Grey MUDSTONE. (COAL MEASURES)
					10.00	73.15		Black COAL. (SWALLOW WOOD COAL)
					11.00	72.15		Grey MUDSTONE. (COAL MEASURES)
	▼							*From 15.0m ingress of groundwater during drilling.*
								Continued on next sheet

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH117**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431803.87 - 407797.79	Hole Type PH
Location:	Barnsley		Level:	83.15	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					25.50	57.65		Black COAL. (TOP HAIGH MOOR COAL)
					26.50	56.65		Grey MUDSTONE. (COAL MEASURES)
					30.00	53.15		End of borehole at 30.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH118
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431783.50 - 407778.85	Hole Type PH
Location:	Barnsley		Level:	84.50	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.00	83.50		Grey MUDSTONE. (COAL MEASURES)
	▼							*From 8.0m ingress of groundwater during drilling.*
					9.30	75.20		Black COAL. (SWALLOW WOOD COAL)
					10.00	74.50		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH118
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431783.50 - 407778.85	Hole Type PH
Location:	Barnsley		Level:	84.50	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					24.50	60.00		Black COAL. c. 30cm mudstone parting. (TOP HAIGH MOOR COAL)
					25.50	59.00		Grey MUDSTONE. (COAL MEASURES)
					30.00	54.50		End of borehole at 30.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH119**

Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431757.21 - 407814.96	Hole Type PH
Location:	Barnsley		Level:	83.65	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
								From 4.0m ingress of groundwater during drilling.
					8.70	74.95		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH119
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431757.21 - 407814.96	Hole Type PH
Location:	Barnsley		Level:	83.65	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					22.40	61.25		Black COAL. c. 20cm mudstone parting. (TOP HAIGH MOOR COAL)
					23.40	60.25		Grey MUDSTONE. (COAL MEASURES)
					27.00	56.65		End of borehole at 27.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH120
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431737.43 - 407853.46	Hole Type PH
Location:	Barnsley		Level:	82.30	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
								From 4.0m ingress of groundwater during drilling.
					7.90	74.40		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH120
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431737.43 - 407853.46	Hole Type PH
Location:	Barnsley		Level:	82.30	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					22.00	60.30		Black COAL. c. 30cm mudstone parting. (TOP HAIGH MOOR COAL)
					23.00	59.30		grey MUDSTONE. (COAL MEASURES)
					36.00	46.30		End of borehole at 36.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH121
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431739.72 - 407746.27	Hole Type PH
Location:	Barnsley		Level:	87.10	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
					8.00	79.10		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH121**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431739.72 - 407746.27	Hole Type PH
Location:	Barnsley		Level:	87.10	Scale 1:100
Client:	Countryside Properties		Dates:	05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					22.00	65.10		Black COAL. (TOP HAIGH MOOR COAL)
					23.00	64.10		Grey MUDSTONE. (COAL MEASURES)
					27.00	60.10		End of borehole at 27.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Borehole Log

Borehole No. **PH121A**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: -	Hole Type PH
Location: Barnsley		Level:	Scale 1:100
Client: Countryside Properties		Dates: 05/08/2020 - 05/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
					6.00			End of borehole at 6.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

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Borehole Log

Borehole No.
PH122
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431833.76 - 407715.24	Hole Type PH
Location:	Barnsley		Level:	85.65	Scale 1:100
Client:	Countryside Properties		Dates:	06/08/2020 - 06/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.20	84.45		Grey MUDSTONE. (COAL MEASURES)
					3.00	82.65		Black COAL. (THIN COAL)
					3.60	82.05		Grey MUDSTONE. (COAL MEASURES)
	▼							*From 8.6m ingress of groundwater during drilling.*
					11.90	73.75		Black COAL. (SWALLOW WOOD COAL)
					12.90	72.75		Grey MUDSTONE. (COAL MEASURES)
								Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH122**

Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431833.76 - 407715.24	Hole Type PH
Location:	Barnsley		Level:	85.65	Scale 1:100
Client:	Countryside Properties		Dates:	06/08/2020 - 06/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					27.40	58.25		Black COAL. (TOP HAIGH MOOR COAL)
					28.40	57.25		Grey MUDSTONE. (COAL MEASURES)
					30.00	55.65		End of borehole at 30.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Borehole Log

Borehole No. **PH122A**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: -	Hole Type PH
Location: Barnsley		Level:	Scale 1:100
Client: Countryside Properties		Dates: 06/08/2020 - 06/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.20			Grey MUDSTONE. (COAL MEASURES)
					3.00			Black COAL. (THIN COAL)
					3.60			Grey MUDSTONE. (COAL MEASURES)
					6.00			End of borehole at 6.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Borehole Log

Borehole No. **PH123**

Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431889.76 - 407755.59	Hole Type PH
Location: Barnsley		Level: 83.10	Scale 1:100
Client: Countryside Properties		Dates: 06/08/2020 - 06/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Topsoil over gravelly CLAY. (WEATHERED COAL MEASURES)
					1.70	81.40		Grey MUDSTONE. (COAL MEASURES)
					5.50	77.60		Black COAL. (THIN COAL)
					6.00	77.10		Grey MUDSTONE. (COAL MEASURES)
								From 14.0m mudstone is dark grey.
					15.00	68.10		Black COAL. c. 30cm mudstone parting. (SWALLOW WOOD COAL)
					16.00	67.10		Grey MUDSTONE. (COAL MEASURES)
					20.00	63.10		Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

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Borehole Log

Borehole No.
PH123
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431889.76 - 407755.59	Hole Type PH
Location:	Barnsley		Level:	83.10	Scale 1:100
Client:	Countryside Properties		Dates:	06/08/2020 - 06/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					20.70	62.40		Black COAL. (TOP HAIGH MOOR COAL)
								Grey MUDSTONE. (COAL MEASURES)
					30.00	53.10		End of borehole at 30.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH124
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431889.85 - 407717.59	Hole Type PH
Location:	Barnsley		Level:	84.15	Scale 1:100
Client:	Countryside Properties		Dates:	06/08/2020 - 06/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
	▼							*From 4.0m ingress of groundwater during drilling.*
					6.50	77.65		Grey MUDSTONE. (COAL MEASURES)
					12.00	72.15		End of borehole at 12.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

AGS

Borehole Log

Borehole No. **PH125**

Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431889.75 - 407710.54	Hole Type PH
Location:	Barnsley		Level:	84.35	Scale 1:100
Client:	Countryside Properties		Dates:	06/08/2020 - 06/08/2020	Logged By GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Clayey GRAVEL. (OPENCAST BACKFILL)
								From 4.5m ingress of groundwater into probehole during drilling.
					10.50	73.85		*10.5m Refusal on unknown obstruction; possible metal item.* End of borehole at 10.50 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Surveyed in on completion of drilling.

Appendix I

Borehole Logs

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Borehole Log

Borehole No. **BH201**

Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431743.25 - 407767.32	Hole Type CP
Location: Barnsley		Level: 86.10	Scale 1:25
Client: Countryside Properties		Dates: 01/12/2021 - 01/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 0.60	B		0.30	85.80		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
		0.60 - 1.00	B		0.60	85.50		MADE GROUND: Firm light brown slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
		1.00 1.00	D	N=15 (3,4/3,4,4,4)				MADE GROUND: Firm grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of predominantly mudstone with rare coal. (OPENCAST BACKFILL)
		2.00 2.00 2.00 - 3.00	D B	N=7 (2,1/1,2,2,2)				
		3.00 3.00	D	N=13 (1,3/2,3,4,4)				
		4.00 4.00 4.00 - 5.00	D B	N=17 (4,4/5,6,3,3)				*Locally very clayey gravel.*
		5.00	D					

Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.5m and rose to 6.0m after 20 minutes. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
BH201
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431743.25 - 407767.32	Hole Type CP
Location:	Barnsley		Level:	86.10	Scale 1:25
Client:	Countryside Properties		Dates:	01/12/2021 - 01/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		5.00		N=22 (3,3/9,5,4,4)				
		6.00	D					
		6.00		N=11 (2,2/3,2,2,4)				
		6.00 - 7.00	B					
		6.50	D					*At 6.5m, groundwater encountered.*
		7.90		50 (25 for 20mm/50 for 0mm)	7.90	78.20		Weak grey thinly laminated MUDSTONE recovered as sandy angular tabular fine to medium gravel. (COAL MEASURES)
					8.00	78.10		End of borehole at 8.00 m

6
7
8
9
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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.5m and rose to 6.0m after 20 minutes. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
BH202
Sheet 1 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431716.50 - 407809.72	Hole Type CP
Location:	Barnsley		Level:	85.15	Scale 1:25
Client:	Countryside Properties		Dates:	01/12/2021 - 01/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00 - 0.70	B		0.20	84.95		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
					0.70	84.45		MADE GROUND: Firm light brown slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (REWORKED NATURAL GROUND)
		1.00 1.00	D	N=10 (4,5/3,2,3,2)				MADE GROUND: Firm brownish grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of predominantly mudstone with rare coal. (OPENCAST BACKFILL)
		2.00 2.00 2.00 - 3.00	D B	N=5 (1,1/1,2,1,1)				
		3.00 3.00	D	N=4 (1,1/1,1,1,1)				
		4.00 4.00 4.00 - 5.00	D B	N=7 (2,1/2,1,2,2)				
		5.00	D					

Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 5.9m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
BH202
Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431716.50 - 407809.72	Hole Type CP
Location:	Barnsley		Level:	85.15	Scale 1:25
Client:	Countryside Properties		Dates:	01/12/2021 - 01/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		5.00		N=8 (2,2/2,2,2,2)				
	▼				5.90	79.25		Weak grey thinly laminated MUDSTONE recovered as clayey sandy angular tabular fine to medium gravel. (COAL MEASURES)
		6.15	D	N=52 (25 for 100mm/12,14,14,12)				*At 5.9m, groundwater encountered.*
		6.15			6.60	78.55		End of borehole at 6.60 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 5.9m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No. **BH203**

Sheet 1 of 3

Project Name: Barugh Green	Project No. 3407	Co-ords: 431775.11 - 407820.14	Hole Type CP
Location: Barnsley		Level: 83.00	Scale 1:25
Client: Countryside Properties		Dates: 01/12/2021 - 02/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 0.20	B					MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
		0.20 - 1.00	B		0.20	82.80		MADE GROUND: Firm brown CLAY. (REWORKED NATURAL GROUND)
		1.00	D		1.00	82.00		MADE GROUND: Firm grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone. (OPENCAST BACKFILL)
		1.00		N=23 (6,6/7,5,7,4)				
		1.00 - 2.00	B					
		2.00	D					
		2.00		N=9 (3,3/3,2,2,2)				
		3.00	D					
		3.00		N=5 (1,2/1,1,1,2)				
		3.00 - 4.00	B					
	▼				3.50	79.50		MADE GROUND: Loose grey very clayey sandy angular to subrounded fine to coarse GRAVEL of mudstone. (OPENCAST BACKFILL) *At 3.5m, groundwater encountered.*
		4.00	D					
		4.00		N=8 (1,2/3,2,2,1)				
								Between 4.8m and 5.5m, locally very gravelly clay.
		5.00	D					

Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 3.5m. 3. The borehole was advanced by chiselling from 9.5m to 9.9m (0.5 hrs). 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No. **BH203**

Sheet 2 of 3

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431775.11 - 407820.14	Hole Type CP
Location:	Barnsley		Level:	83.00	Scale 1:25
Client:	Countryside Properties		Dates:	01/12/2021 - 02/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		5.00 5.00 - 6.00	B	N=9 (2,3/1,2,2,4)				
		6.00	D					
					6.20	76.80		MADE GROUND: Firm brownish grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone. (OPENCAST BACKFILL)
		6.50 6.50	D	N=16 (2,2/3,3,6,4)				
		8.00 8.00	D	N=15 (2,2/3,4,4,4)				
		9.00	D		9.00	74.00		Weak grey thinly laminated MUDSTONE recovered as clayey sandy angular tabular fine to coarse gravel. (COAL MEASURES)
		9.50 9.50	D	50 (3,6/50 for 190mm)				
		9.90		50 (25 for 95mm/50 for 10mm)				

Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 3.5m. 3. The borehole was advanced by chiselling from 9.5m to 9.9m (0.5 hrs). 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
BH203
Sheet 3 of 3

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431775.11 - 407820.14	Hole Type CP
Location:	Barnsley		Level:	83.00	Scale 1:25
Client:	Countryside Properties		Dates:	01/12/2021 - 02/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					10.10	72.90		End of borehole at 10.10 m

11
12
13
14
15

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 3.5m. 3. The borehole was advanced by chiselling from 9.5m to 9.9m (0.5 hrs). 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
BH204
Sheet 1 of 3

Project Name: Barugh Green	Project No. 3407	Co-ords: 431698.34 - 407889.13	Hole Type CP
Location: Barnsley		Level: 82.30	Scale 1:25
Client: Countryside Properties		Dates: 01/12/2021 - 02/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.00 - 0.90	B					MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)	
					0.30	82.00		MADE GROUND: Firm light brown CLAY. (REWORKED NATURAL GROUND)	
		1.00	D		0.90	81.40		MADE GROUND: Firm brownish grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone and siltstone. (OPENCAST BACKFILL)	1
		1.00		N=9 (1,2/2,2,2,3)					
		1.00 - 2.00	B						
		2.00	D						2
		2.00		N=4 (1,1/1,1,1,1)					
		3.00	D						3
		3.00		N=6 (3,2/2,2,1,1)					
		3.00 - 4.00	B						
		4.00	D						4
		4.00		N=6 (1,1/1,2,1,2)					
					4.50	77.80		MADE GROUND: Firm grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone. (OPENCAST BACKFILL)	
		5.00	D						5

Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.0m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No. **BH204**

Sheet 2 of 3

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431698.34 - 407889.13	Hole Type CP
Location:	Barnsley		Level:	82.30	Scale 1:25
Client:	Countryside Properties		Dates:	01/12/2021 - 02/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		5.00		N=8 (2,3/2,2,2,2)				
	▼	6.00	D					*At 6.0m, groundwater encountered.*
		6.00		N=17 (5,5/6,6,2,3)				
		6.00 - 6.70	B					
		6.70	D					
		6.70		N=25 (3,3/4,5,8,8)				
					7.20	75.10		MADE GROUND: Firm brownish grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone and rare coal. (OPENCAST BACKFILL)
		8.00	D					
		8.00		N=12 (3,2/2,2,4,4)				
		8.50 - 9.50	B					
		9.50	D					
		9.50		N=18 (3,3/4,4,5,5)				

Continued on next sheet

6 7 8 9 10

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.0m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
BH204
Sheet 3 of 3

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431698.34 - 407889.13	Hole Type CP
Location:	Barnsley		Level:	82.30	Scale 1:25
Client:	Countryside Properties		Dates:	01/12/2021 - 02/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.50		50 (25 for 10mm/50 for 0mm)	10.50 10.60	71.80 71.70		Weak grey thinly laminated MUDSTONE recovered as clayey sandy angular tabular fine to coarse gravel. (COAL MEASURES) End of borehole at 10.60 m

11
12
13
14
15

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.0m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No. **BH205**

Sheet 1 of 3

Project Name: Barugh Green	Project No. 3407	Co-ords: 431816.13 - 407864.29	Hole Type CP
Location: Barnsley		Level: 80.55	Scale 1:25
Client: Countryside Properties		Dates: 02/12/2021 - 03/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 0.50	B					MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
					0.40	80.15		
		0.50 - 1.00	B					MADE GROUND: Firm brown CLAY. (REWORKED NATURAL GROUND)
		1.00	D					
		1.00		N=9 (3,2/2,2,2,3)	1.10	79.45		
		1.10 - 2.00	B					MADE GROUND: Firm grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of predominantly mudstone with rare coal and brick. (OPENCAST BACKFILL)
								At 2.0m, obstruction in borehole. Unable to carry out SPT.
					2.50	78.05		MADE GROUND: Firm grey slightly sandy very gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone. (OPENCAST BACKFILL)
	▼	3.00		N=22 (7,6/6,8,6,2)				*At 3.0m, groundwater encountered.*
		3.00 - 4.00	B					*Locally very clayey gravel.*
		4.00		N=9 (2,1/3,2,2,2)				
		4.00 - 5.00	B					
		5.00	D		5.00	75.55		

Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 3.0m. 3. The borehole was advanced by chiselling from 5.0m to 5.7m (0.5 hrs). 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No. **BH205** Sheet 2 of 3

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431816.13 - 407864.29	Hole Type CP
Location:	Barnsley		Level:	80.55	Scale 1:25
Client:	Countryside Properties		Dates:	02/12/2021 - 03/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		5.00		50 (3,2/50 for 155mm)				MADE GROUND: Grey very clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare siltstone and coal. (OPENCAST BACKFILL) *At 5.0m, mudstone cobble/boulder.*	
		5.00 - 5.70	B						
		5.70		N=20 (3,6/6,4,6,4)					
		6.00	D						6
		7.00	D						7
		8.00	D		8.00	72.55			8
		8.00		N=14 (2,3/3,3,4,4)				MADE GROUND: Firm grey slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone. (OPENCAST BACKFILL)	
		8.00 - 9.00	B						
		9.00	D		9.00	71.55			9
		9.00		N=26 (11,3/4,8,5,9)				MADE GROUND: Grey clayey sandy angular to subangular fine to coarse GRAVEL of mudstone and siltstone. (OPENCAST BACKFILL)	
		9.50	D						
									10

Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 3.0m. 3. The borehole was advanced by chiselling from 5.0m to 5.7m (0.5 hrs). 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No. **BH205**

Sheet 3 of 3

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431816.13 - 407864.29	Hole Type CP
Location:	Barnsley		Level:	80.55	Scale 1:25
Client:	Countryside Properties		Dates:	02/12/2021 - 03/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		11.00 11.00	D	50 (25,/50 for 50mm)	11.00 11.10	69.55 69.45		Weak grey thinly laminated MUDSTONE recovered as clayey sandy angular tabular fine to coarse gravel. (COAL MEASURES) End of borehole at 11.10 m

11
12
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14
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Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 3.0m. 3. The borehole was advanced by chiselling from 5.0m to 5.7m (0.5 hrs). 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No. **BH206**

Sheet 1 of 2

Project Name: Barugh Green	Project No. 3407	Co-ords: 431764.75 - 407873.94	Hole Type CP
Location: Barnsley		Level: 80.55	Scale 1:25
Client: Countryside Properties		Dates: 02/12/2021 - 03/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30 - 1.00	B		0.30	80.25		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
								MADE GROUND: Firm light brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (REWORKED NATURAL GROUND)
		1.00 1.00	D	N=5 (1,1/2,1,1,1)	1.00	79.55		MADE GROUND: Firm grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of predominantly mudstone with rare coal. (OPENCAST BACKFILL) *At 1.2m, groundwater encountered.*
		2.00 2.00	D	N=5 (1,1/1,1,2,1)				
					2.50	78.05		MADE GROUND: Grey very clayey sandy angular to subangular fine to coarse GRAVEL of mudstone. (OPENCAST BACKFILL)
		3.00 3.00 3.00 - 4.00	D B	N=12 (1,1/4,4,2,2)				
		4.00 4.00	D	N=12 (4,3/3,3,3,3)				
		5.00	D		5.00	75.55		

Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 1.2m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No. **BH206** Sheet 2 of 2

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431764.75 - 407873.94	Hole Type CP
Location:	Barnsley		Level:	80.55	Scale 1:25
Client:	Countryside Properties		Dates:	02/12/2021 - 03/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		5.00		N=8 (2,2/2,2,2,2)				Firm grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone. (OPENCAST BACKFILL)
		5.50 - 6.50	B					
								Locally clay is very gravelly.
		6.50	D					
		6.50		N=8 (6,3/2,2,2,2)				
		8.00		N=10 (2,3/2,2,3,3)				
		8.20	D					
		8.50 - 9.50	B					
		9.50	D		9.50	71.05		Weak grey thinly laminated MUDSTONE recovered as clayey sandy angular tabular fine to coarse gravel. (COAL MEASURES)
		9.50		50 (25,/50 for 20mm)	9.60	70.95		End of borehole at 9.60 m

6 7 8 9 10

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 1.2m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
BH207
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords: 431808.57 - 407865.25	Hole Type CP
Location:	Barnsley		Level: 80.55	Scale 1:25
Client:	Countryside Properties		Dates: 03/12/2021 - 03/12/2021	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30	80.25		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (MADE GROUND TOPSOIL)
								MADE GROUND: Firm light brown CLAY. (REWORKED NATURAL GROUND)
					1.00	79.55		MADE GROUND: Firm grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of predominantly mudstone with rare coal. (OPENCAST BACKFILL)
					4.00	76.55		End of borehole at 4.00 m

1 2 3 4 5

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not encountered during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Appendix J

Cored Borehole Logs

Rotary Core Log

Borehole No.
RC201
Sheet 1 of 4

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431723.61 - 407882.15	Hole Type RC
Location:	Barnsley		Level:	81.65	Scale 1:25
Client:	Countryside Properties		Dates:	25/01/2022 - 26/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
										MADE GROUND. (OPENCAST BACKFILL)
										From 0.0m to 11.0m, openhole drilling.
										Continued on next sheet

1
2
3
4
5

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 5.8m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Rotary Core Log

Borehole No.
RC201
Sheet 2 of 4

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431723.61 - 407882.15	Hole Type RC
Location:	Barnsley		Level:	81.65	Scale 1:25
Client:	Countryside Properties		Dates:	25/01/2022 - 26/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
	▼									

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Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 5.8m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Rotary Core Log

Borehole No. **RC201** Sheet 3 of 4

Project Name: Barugh Green	Project No. 3407	Co-ords: 431723.61 - 407882.15	Hole Type RC
Location: Barnsley		Level: 81.65	Scale 1:25
Client: Countryside Properties		Dates: 25/01/2022 - 26/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							11.00	70.65		Recovered as grey very clayey sandy angular to subangular fine to coarse GRAVEL of predominantly mudstone with rare sandstone. (COAL MEASURES - MUDSTONE)
		11.00 - 12.50	NI	92	69	57	11.25	70.40		*From 11.0m to 11.25m, possibly collapsed material from advancing casing.* Medium strong light grey thin to thickly laminated fine grained SANDSTONE with very close to closely spaced thin and cross laminations of grey siltstone. Discontinuities: predominantly close to widely spaced (occasionally very close), horizontal to subhorizontal (20°), planar, smooth, partly open, clean. (COAL MEASURES - SANDSTONE)
			250							*From 12.1m to 12.4m, subvertical (80°), planar, rough, partly open fracture (possibly drilling induced).*
							12.60	69.05		Extremely weak grey thinly laminated MUDSTONE. Discontinuities: extremely closely space, horizontal and vertical, planar, smooth, tight to partly open with grey clay infill. (COAL MEASURES - MUDSTONE)
			NI				13.00	68.65		*From 12.6m to 12.65m, very thin bed of black thinly laminated carbonaceous mudstone.* Very weak grey thinly laminated MUDSTONE. Discontinuities: extremely to very closely spaced, horizontal to subhorizontal (45°), planar (occasionally undulating), smooth, partly open with grey clay infill. (COAL MEASURES - MUDSTONE)
		12.50 - 14.00		97	16	0				*From 13.35m to 13.5m, subvertical (70° to 80°), planar, smooth, tight fracture with grey clay on surfaces.*
			30							*From 13.7m to 13.75m, subvertical (70° to 80°), planar, smooth, tight fracture with grey clay on surfaces.*
							14.20	67.45		Moderately weak light grey thin to thickly laminated SILTSTONE. Discontinuities: medium spaced, horizontal, undulating, rough, closed, clean. (COAL MEASURES - SILTSTONE)
			300							Extremely to very weak grey thinly laminated MUDSTONE. Discontinuities: Extremely to very closely spaced, horizontal to subhorizontal (30°), planar (occasional undulating), open to moderately wide with grey clay infill.
		14.00 - 15.50		96	26	18	14.50	67.15		
			10							

Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 5.8m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Rotary Core Log

Borehole No.
RC201
Sheet 4 of 4

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431723.61 - 407882.15	Hole Type RC
Location:	Barnsley		Level:	81.65	Scale 1:25
Client:	Countryside Properties		Dates:	25/01/2022 - 26/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
										(COAL MEASURES - MUDSTONE) *From 14.5m to 14.55m, very thin bed of black thinly laminated carbonaceous mudstone.* *From 14.85m to 14.9m, recovered as clayey sandy angular fine to medium gravel.* *From 15.1m to 15.25m, recovered as clayey sandy angular fine to medium gravel.*
		15.50 - 17.00	80	97	80	43	15.50	66.15		Moderately weak to medium strong light grey thin to thickly laminated SILTSTONE with very close to closely spaced thin laminations of grey mudstone. Discontinuities: very close to closely spaced, horizontal, planar (occasional undulating), smooth, open, clean. (COAL MEASURES - SILTSTONE) *From 16.25m to 16.45m, medium thick bed of weak grey thinly laminated mudstone.*
							17.00	64.65		End of borehole at 17.00 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 5.8m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Rotary Core Log

Borehole No.
RC202
Sheet 1 of 4

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431774.44 - 407842.57	Hole Type RC
Location:	Barnsley		Level:	81.85	Scale 1:25
Client:	Countryside Properties		Dates:	24/01/2022 - 25/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
	▼									MADE GROUND. (OPENCAST BACKFILL)
										From 0.0m to 11.0m, openhole drilling.
										Continued on next sheet

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 2.0m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Rotary Core Log

Borehole No.
RC202
Sheet 2 of 4

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431774.44 - 407842.57	Hole Type RC
Location:	Barnsley		Level:	81.85	Scale 1:25
Client:	Countryside Properties		Dates:	24/01/2022 - 25/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring			Depth (m)	Level (m)	Legend	Stratum Description
				TCR	SCR	RQD				

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Continued on next sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 2.0m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Rotary Core Log

Borehole No. **RC202** Sheet 3 of 4

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431774.44 - 407842.57	Hole Type RC
Location:	Barnsley		Level:	81.85	Scale 1:25
Client:	Countryside Properties		Dates:	24/01/2022 - 25/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							11.00	70.85		Recovered as subrounded fine to coarse GRAVEL of siltstone. (COAL MEASURES - SILTSTONE)
							11.20	70.65		*From 11.0m to 11.2m, possibly collapsed material from advancing casing or drilling induced disturbance.* Weak grey thinly laminated SILTSTONE. Discontinuities: predominantly extremely to very closely spaced, horizontal to subhorizontal (30°), planar, smooth, partly open with grey clay on surfaces. (COAL MEASURES - SILTSTONE) *From 11.2m to 11.3m, recovered as clayey sandy angular to subangular fine to medium gravel.*
		11.00 - 12.50	30	89	33	9				
							12.25	69.60		*From 12.15m to 12.2m, recovered as clayey sandy angular to subangular fine to medium gravel.* *At 12.2m, wide (30mm), horizontal, planar fracture with grey clay infill.* Medium strong light grey thickly laminated fine grained SANDSTONE with close to medium spaced thin and cross laminations of grey siltstone. Discontinuities: close to medium spaced, horizontal, undulating, rough, tight, clean. (COAL MEASURES - SANDSTONE)
		12.50 - 14.00	100	94	85	63	12.90	68.95		Weak to moderately weak grey thinly laminated SILTSTONE with extremely to very closely spaced thin laminations of light grey fine grained sandstone. Discontinuities: predominantly close to medium spaced, horizontal, planar, smooth, tight to partly open, clean. (COAL MEASURES - SILTSTONE) *From 13.8m to 13.9m, subvertical (60°), planar, smooth, tight, clean fracture (possibly drilling induced).*
		14.00 - 15.50	10	97	54	28	14.20	67.65		Extremely weak grey thinly laminated MUDSTONE. Discontinuities: extremely to very closely spaced, horizontal and vertical, planar, smooth, partly open with grey clay infill. (COAL MEASURES - MUDSTONE) *From 14.2m to 14.25m, recovered as sandy angular fine to coarse gravel.* *From 14.3m to 14.4m, thin bed of black extremely weak thinly laminated carbonaceous mudstone.*
							14.85	67.00		*From 14.4m to 14.5m, recovered as sandy angular fine to medium gravel.*

Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 2.0m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Rotary Core Log

Borehole No. **RC202** Sheet 4 of 4

Project Name: Barugh Green	Project No. 3407	Co-ords: 431774.44 - 407842.57	Hole Type RC
Location: Barnsley		Level: 81.85	Scale 1:25
Client: Countryside Properties		Dates: 24/01/2022 - 25/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							15.10	66.75		Medium strong light grey thickly laminated fine grained SANDSTONE with extremely to very closely spaced thin laminations of grey siltstone. Discontinuities: close to medium spaced, horizontal, planar, rough, tight, clean. (COAL MEASURES - SANDSTONE)
		15.50 - 17.00	80	95	74	45				Weak to moderately weak grey thinly laminated SILTSTONE with very close to closely spaced thin and cross laminations of light grey fine grained sandstone. Discontinuities: predominantly close to medium spaced (occasional very close), horizontal to subhorizontal (30°), planar, smooth, partly open, clean. (COAL MEASURES - SILTSTONE) *From 15.2m to 15.5m, subvertical (70° to 80°), undulating, rough, tight, clean fracture (possibly drilling induced).* *From 15.2m to 15.35m, soft sediment deformation.* *At 15.8m, wide (20mm), horizontal, planar fracture with grey clayey sand infill.* *From 15.85m to 15.95m, subvertical (70°), planar, smooth, tight, clean fracture (possibly drilling induced).* *From 16.45m to 16.5m, extremely closely spaced fractures recovered as sandy angular fine to medium gravel.*
							17.00	64.85		End of borehole at 17.00 m

16 17 18 19 20

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 2.0m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Rotary Core Log

Borehole No.
RC203
Sheet 1 of 4

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431742.89 - 407792.62	Hole Type RC
Location:	Barnsley		Level:	85.10	Scale 1:25
Client:	Countryside Properties		Dates:	21/01/2022 - 24/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
										MADE GROUND. (OPENCAST BACKFILL)
										From 0.0m to 9.4m, openhole drilling.
										Continued on next sheet

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.8m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Rotary Core Log

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Borehole No. **RC203**

Sheet 2 of 4

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431742.89 - 407792.62	Hole Type RC
Location:	Barnsley		Level:	85.10	Scale 1:25
Client:	Countryside Properties		Dates:	21/01/2022 - 24/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							9.40	75.70		Recovered as brownish grey clayey sandy subangular to subrounded fine to coarse GRAVEL of siltstone. (COAL MEASURES - SILTSTONE) *From 9.4m to 9.6m, possibly collapsed material from advancing casing or drilling induced disturbance.*
			NI				9.60	75.50		Medium strong light grey thickly laminated fine grained SANDSTONE with very closely spaced

Continued on next sheet

6 7 8 9 10

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.8m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Rotary Core Log

Borehole No. **RC203**

Sheet 3 of 4

Project Name: Barugh Green	Project No. 3407	Co-ords: 431742.89 - 407792.62	Hole Type RC
Location: Barnsley		Level: 85.10	Scale 1:25
Client: Countryside Properties		Dates: 21/01/2022 - 24/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		9.40 - 10.90	70	90	60	33				thin and cross laminations of grey siltstone. Discontinuities: close to medium spaced, horizontal, planar to undulating, tight, clean. (COAL MEASURES - SANDSTONE) *From 9.8m to 10.1m, extremely closely spaced thin laminations of grey siltstone.*
			NI				10.60	74.50		Recovered as brown angular to subrounded fine to coarse GRAVEL of siltstone and ironstone. (COAL MEASURES - SILTSTONE) *From 10.6m to 11.1m, possibly collapsed material from advancing casing or drilling induced disturbance.*
		10.90 - 12.40	250	89	54	53	11.10	74.00		Medium strong light grey thickly laminated to thinly bedded fine grained SANDSTONE with very close to closely spaced thin and cross laminations of grey siltstone. Discontinuities: predominantly medium spaced, horizontal, undulating, rough, tight, clean. (COAL MEASURES - SANDSTONE)
							12.10	73.00		Very weak grey thinly laminated SILTSTONE. Discontinuities: extremely to very closely spaced, horizontal to subvertical (60°), planar, smooth, partly open, clean. (COAL MEASURES - SILTSTONE) *At 12.2m, moderately wide, horizontal, planar fracture with grey clay infill.* *From 12.4m to 12.6m, recovered as sandy angular to subangular fine to coarse gravel.*
		12.40 - 13.90	20	81	45	21	12.60	72.50		Extremely to very weak grey thinly laminated MUDSTONE. Discontinuities: extremely to very closely spaced, horizontal to subhorizontal (30°), planar to undulating, smooth, open to moderately wide with grey clay infill. (COAL MEASURES - MUDSTONE) *From 12.9m to 13.0m, recovered as clayey sandy angular to subangular fine to coarse gravel.*
							13.20	71.90		Moderately weak to medium strong light grey thickly laminated to thinly bedded fine grained SANDSTONE with extremely to very closely spaced thin and cross laminations of grey siltstone. Discontinuities: close to medium spaced, horizontal, planar to undulating, rough, tight, clean. (COAL MEASURES - SANDSTONE)
		13.90 - 15.40	120	93	79	59	14.10	71.00		*At 14.05m, soft sediment deformation.* Weak grey thinly laminated SILTSTONE with extremely to very closely spaced thin laminations of light grey fine grained sandstone. Discontinuities: close to medium spaced, horizontal, planar to undulating, smooth, tight, clean. (COAL MEASURES - SILTSTONE) *From 14.25m to 14.35m, subvertical (60° to 70°), planar, rough, tight, clean fracture (possibly drilling induced).*

Continued on next sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.8m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

Rotary Core Log

Borehole No.
RC203
Sheet 4 of 4

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431742.89 - 407792.62	Hole Type RC
Location:	Barnsley		Level:	85.10	Scale 1:25
Client:	Countryside Properties		Dates:	21/01/2022 - 24/01/2022	Logged By LEW

Well	Water Strikes	Depth (m)	Type / IF	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							15.40	69.70		End of borehole at 15.40 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.8m. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.



RC201
11.0m to 13.0m (cut)



RC201
13.0m (cut) to 15.0m (cut)



RC201
15.0m (cut) to 17.0m



RC202
11.0m to 14.0m



RC202
14.0m to 16.0m (cut)



RC202
16.0m (cut) to 17.0m



RC203
9.4m to 12.4m



RC203
12.4m to 15.4m

Appendix K

Stitch Drill Probehole Logs

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Borehole Log

Borehole No.
ST201A
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431893.65 - 407722.57	Hole Type PH
Location:	Barnsley		Level:	83.95	Scale 1:100
Client:	Countryside Properties		Dates:	11/01/2022 - 11/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND. (OPENCAST BACKFILL)
					9.60	74.35		Solid ground (no returns). (COAL MEASURES)
					10.50	73.45		End of borehole at 10.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.6m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
ST201B
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431892.87 - 407725.67	Hole Type PH
Location:	Barnsley		Level:	84.00	Scale 1:100
Client:	Countryside Properties		Dates:	11/01/2022 - 11/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND. (OPENCAST BACKFILL)
					7.00	77.00		Solid ground (no returns). (COAL MEASURES)
					11.80	72.20		End of borehole at 11.80 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.0m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST201C
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431891.58 - 407728.20	Hole Type PH
Location:	Barnsley		Level:	84.10	Scale 1:100
Client:	Countryside Properties		Dates:	11/01/2022 - 11/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					2.40	81.70		Grey MUDSTONE (COAL MEASURES - MUDSTONE)
					4.80	79.30		End of borehole at 4.80 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
ST202A
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431810.86 - 407811.10	Hole Type PH
Location:	Barnsley		Level:	82.40	Scale 1:100
Client:	Countryside Properties		Dates:	11/01/2022 - 11/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					4.60	77.80		Grey MUDSTONE (COAL MEASURES - MUDSTONE)
					7.50	74.90		End of borehole at 7.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 4.2m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
ST202B
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431807.58 - 407811.53	Hole Type PH
Location:	Barnsley		Level:	82.45	Scale 1:100
Client:	Countryside Properties		Dates:	11/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND. (OPENCAST BACKFILL)
					7.00	75.45		Grey MUDSTONE (COAL MEASURES - MUDSTONE)
					9.00	73.45		End of borehole at 9.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 3.0m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

Borehole No. **ST202C**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431805.39 - 407811.97	Hole Type PH
Location: Barnsley		Level: 82.50	Scale 1:100
Client: Countryside Properties		Dates: 12/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
								Between 1.5m and 2.8m, mudstone boulder(s).
					7.80	74.70		Solid ground (no returns). (COAL MEASURES)
					9.10	73.40		End of borehole at 9.10 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

Borehole No.
ST203A
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431833.15 - 407843.43	Hole Type PH
Location: Barnsley		Level: 80.85	Scale 1:100
Client: Countryside Properties		Dates: 12/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								OVERBURDEN.
					2.20	78.65		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					2.80	78.05		Weathered black COAL. (THIN COAL)
					3.40	77.45		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					5.50	75.35		End of borehole at 5.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
ST203B
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431831.31 - 407843.89	Hole Type PH
Location:	Barnsley		Level:	80.75	Scale 1:100
Client:	Countryside Properties		Dates:	12/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							OVERBURDEN.
					2.00	78.75		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					2.50	78.25		Weathered black COAL. (THIN COAL)
					3.20	77.55		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					5.50	75.25		End of borehole at 5.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 1.7m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

Borehole No. **ST203C**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431829.53 - 407844.61	Hole Type PH
Location: Barnsley		Level: 80.80	Scale 1:100
Client: Countryside Properties		Dates: 12/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					3.00	77.80		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					5.50	75.30		End of borehole at 5.80 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Borehole No. **ST203D**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431828.25 - 407845.59	Hole Type PH
Location: Barnsley		Level: 80.80	Scale 1:100
Client: Countryside Properties		Dates: 12/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					3.10	77.70		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					5.80	75.00		End of borehole at 5.80 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Borehole No. **ST203E**

Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431825.27 - 407847.76	Hole Type PH
Location: Barnsley		Level: 80.75	Scale 1:100
Client: Countryside Properties		Dates: 12/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					3.80	76.95		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					5.80	74.95		End of borehole at 5.80 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

Borehole No.
ST204A
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords: 431836.30 - 407882.47	Hole Type PH
Location:	Barnsley		Level: 79.55	Scale 1:100
Client:	Countryside Properties		Dates: 12/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND. (OPENCAST BACKFILL)
					5.80	73.75		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					7.50	72.05		End of borehole at 7.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.0m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST204B
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431837.11 - 407887.57	Hole Type PH
Location:	Barnsley		Level:	79.35	Scale 1:100
Client:	Countryside Properties		Dates:	12/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND. (OPENCAST BACKFILL)
					5.30	74.05		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					7.50	71.85		End of borehole at 7.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.5m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST204C
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431837.65 - 407889.76	Hole Type PH
Location:	Barnsley		Level:	79.25	Scale 1:100
Client:	Countryside Properties		Dates:	12/01/2022 - 12/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND. (OPENCAST BACKFILL)
					5.20	74.05		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					7.50	71.75		End of borehole at 7.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.5m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST204D
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords: 431838.27 - 407893.43	Hole Type PH
Location:	Barnsley		Level: 79.20	Scale 1:100
Client:	Countryside Properties		Dates: 13/01/2022 - 13/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								OVERBURDEN.
					2.50	76.70		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					4.50	74.70		End of borehole at 4.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST205A
Sheet 1 of 1

Project Name: Barugh Green	Project No. 3407	Co-ords: 431842.24 - 407858.72	Hole Type PH
Location: Barnsley		Level: 80.20	Scale 1:100
Client: Countryside Properties		Dates: 13/01/2022 - 13/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								OVERBURDEN.
					3.40	76.80		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					3.90	76.30		Weathered black COAL. (THIN COAL)
					4.20	76.00		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					6.00	74.20		End of borehole at 6.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST205B
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431839.20 - 407859.49	Hole Type PH
Location:	Barnsley		Level:	80.20	Scale 1:100
Client:	Countryside Properties		Dates:	13/01/2022 - 13/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND. (OPENCAST BACKFILL)
					4.00	76.20		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					6.00	74.20		End of borehole at 6.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.5m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST205C
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431835.43 - 407860.75	Hole Type PH
Location:	Barnsley		Level:	80.25	Scale 1:100
Client:	Countryside Properties		Dates:	13/01/2022 - 13/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					4.40	75.85		Weathered black COAL. (THIN COAL)
					4.50	75.75		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					6.00	74.25		End of borehole at 6.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
ST205D
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431831.02 - 407861.88	Hole Type PH
Location:	Barnsley		Level:	80.25	Scale 1:100
Client:	Countryside Properties		Dates:	13/01/2022 - 13/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					4.50	75.75		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					7.50	72.75		End of borehole at 7.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST206A
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431705.23 - 407837.36	Hole Type PH
Location:	Barnsley		Level:	84.30	Scale 1:100
Client:	Countryside Properties		Dates:	13/01/2022 - 13/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					7.40	76.90		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					10.50	73.80		End of borehole at 10.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 5.0m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST206B
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431699.49 - 407844.70	Hole Type PH
Location:	Barnsley		Level:	84.10	Scale 1:100
Client:	Countryside Properties		Dates:	13/01/2022 - 13/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					7.80	76.30		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					10.40	73.70		End of borehole at 10.40 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 5.0m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST206C
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431696.30 - 407851.19	Hole Type PH
Location:	Barnsley		Level:	83.85	Scale 1:100
Client:	Countryside Properties		Dates:	13/01/2022 - 13/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
					8.90	74.95		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					10.50	73.35		End of borehole at 10.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 5.0m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
ST207A
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431820.53 - 407863.33	Hole Type PH
Location:	Barnsley		Level:	80.30	Scale 1:100
Client:	Countryside Properties		Dates:	14/01/2022 - 14/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼							MADE GROUND. (OPENCAST BACKFILL)
					4.50	75.80		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					8.80	71.50		End of borehole at 8.80 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.5m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
ST207B
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431818.15 - 407861.44	Hole Type PH
Location:	Barnsley		Level:	80.35	Scale 1:100
Client:	Countryside Properties		Dates:	14/01/2022 - 14/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
	▼							*Between 2.0m and 2.5m, siltstone boulder(s).*
					7.30	73.05		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					10.50	69.85		End of borehole at 10.50 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.6m depth. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
ST207C
Sheet 1 of 1

Project Name:	Barugh Green	Project No. 3407	Co-ords:	431814.96 - 407859.60	Hole Type PH
Location:	Barnsley		Level:	80.35	Scale 1:100
Client:	Countryside Properties		Dates:	14/01/2022 - 14/01/2022	Logged By LEW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND. (OPENCAST BACKFILL)
								Between 1.4m and 1.9m, siltstone boulder(s).
								Between 4.8m and 5.5m, boulder(s).
					11.90	68.45		Grey MUDSTONE. (COAL MEASURES - MUDSTONE)
					13.90	66.45		End of borehole at 13.90 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Appendix L

Chemical Test Results

Certificate of Analysis

Certificate Number	21-26564	*Issued:*	23-Dec-21

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference	21-26564
Client Reference	3407
Order No	PO18474
Contract Title	Barugh Green
Description	34 Soil samples.
Date Received	15-Dec-21
Date Started	15-Dec-21
Date Completed	23-Dec-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



Adam Fenwick
Contracts Manager

UKAS TESTING
2139

Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

	Lab No	1948322	1948323	1948324	1948325	1948326	1948327
	.Sample ID	TP211	TP213	TP201	TP202	TP208	TP209
	Depth	0.10	0.10	0.10	0.10	0.10	0.10
	Other ID	1T	1T	1T	1T	1T	1T
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Preparation							
Stones >10mm	DETSC 1003*	1	% m/m	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Moisture Content	DETSC 1004	0.1	%	23	27	27	24	24	20
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	17	14	9.9	14	14	13
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.6	0.7	0.7	0.7	0.6	0.5
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.4	0.4	0.4	0.4	0.4
Chromium	DETSC 2301#	0.15	mg/kg	16	20	20	19	24	22
Chromium III	DETSC 2301*	0.15	mg/kg	16	20	20	19	24	22
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	25	36	23	23	27	27
Lead	DETSC 2301#	0.3	mg/kg	43	44	32	35	36	32
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg	0.10	0.08	0.07	0.07	0.09	0.06
Nickel	DETSC 2301#	1	mg/kg	15	13	15	16	20	22
Selenium	DETSC 2301#	0.5	mg/kg	0.7	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	32	37	32	35	44	37
Zinc	DETSC 2301#	1	mg/kg	63	65	72	71	82	86
Inorganics							
pH	DETSC 2008#		pH	7.1	6.6	6.1	6.3	6.1	6.7
Calorific Value	DETSC 5008	1	MJ/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	6.9	5.8	4.7	3.0	3.6	2.7
Chloride Aqueous Extract	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l						
Petroleum Hydrocarbons							
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg						
EPH (C10-C12)	DETSC 3311	10	mg/kg						
EPH (C12-C16)	DETSC 3311	10	mg/kg						
EPH (C16-C21)	DETSC 3311	10	mg/kg						
EPH (C21-C35)	DETSC 3311	10	mg/kg						
EPH (C35-C40)	DETSC 3311	10	mg/kg						
EPH (C10-C40)	DETSC 3311#	10	mg/kg						
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.19	0.07	0.07	0.06	0.04	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	0.05	< 0.03	< 0.03	< 0.03	< 0.03	0.03

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

			Lab No	1948322	1948323	1948324	1948325	1948326	1948327
			.Sample ID	TP211	TP213	TP201	TP202	TP208	TP209
			Depth	0.10	0.10	0.10	0.10	0.10	0.10
			Other ID	1T	1T	1T	1T	1T	1T
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.23	0.07	0.11	0.11	0.05	0.04
Pyrene	DETSC 3303#	0.03	mg/kg	0.20	0.06	0.09	0.10	0.04	0.04
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03	0.03	0.04	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	0.16	0.04	0.04	0.05	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.10	0.04	0.03	0.04	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.05	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.05	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	1.2	0.24	0.27	0.32	< 0.10	< 0.10

Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

			Lab No	1948328	1948329	1948330	1948331	1948332	1948333
			.Sample ID	TT204 S	TT205 SE	TT206 C	TT209 C	TP204	TP203
			Depth	0.10	0.10	0.10	0.10	0.30	0.40
			Other ID	1T	1T	1T	1T	1T	1T
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Moisture Content	DETSC 1004	0.1	%	19	23	20	28	10	16
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	14	11	9.3	11	7.9	11
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.5	0.5	0.5	0.7	< 0.2	0.3
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.4	0.3	0.4	0.2	0.2
Chromium	DETSC 2301#	0.15	mg/kg	23	20	16	22	16	20
Chromium III	DETSC 2301*	0.15	mg/kg	23	20	16	22	16	20
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	27	24	22	22	32	24
Lead	DETSC 2301#	0.3	mg/kg	33	30	23	28	19	19
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l					< 10	
Mercury	DETSC 2325#	0.05	mg/kg	0.06	0.07	< 0.05	0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	20	17	15	15	41	21
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	37	34	27	40	17	28
Zinc	DETSC 2301#	1	mg/kg	72	74	57	69	93	66
Inorganics									
pH	DETSC 2008#		pH	7.4	5.9	6.3	5.7	8.2	7.7
Calorific Value	DETSC 5008	1	MJ/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	2.9	4.2	3.7	4.6	8.5	1.3
Chloride Aqueous Extract	DETSC 2055	1	mg/l					3.0	
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l					< 1.0	
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l					13	
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg					< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg					< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg					< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg					< 10	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg					< 10	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg					< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg					< 10	< 10
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.06	0.03	0.04	0.04	0.05	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

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Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

			Lab No	1948328	1948329	1948330	1948331	1948332	1948333
			.Sample ID	TT204 S	TT205 SE	TT206 C	TT209 C	TP204	TP203
			Depth	0.10	0.10	0.10	0.10	0.30	0.40
			Other ID	1T	1T	1T	1T	1T	1T
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.11	0.05	0.07	0.05	0.04	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	0.10	0.04	0.06	0.04	0.04	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	0.04	< 0.03	0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.31	< 0.10	0.18	< 0.10	0.13	< 0.10

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Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

			Lab No	1948334	1948335	1948336	1948337	1948338	1948339
			.Sample ID	TP205	TP202	TP210	TP204	TT205 NW	TT206 SE
			Depth	0.40	0.50	0.50	0.50	0.50	0.60
			Other ID	1T	3T	1T	2T	1T	1T
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	< 1.0	7.0	< 1.0	18	24	21
Moisture Content	DETSC 1004	0.1	%	18	14	17	9.7	7.5	7.7
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	8.1	7.3	10	16	14	14
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.2	0.3	0.5	0.6	0.6	0.5
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.2	0.2	0.2	< 0.1	0.1
Chromium	DETSC 2301#	0.15	mg/kg	21	18	18	20	15	19
Chromium III	DETSC 2301*	0.15	mg/kg	21	18	18	20	15	19
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	27	22	23	22	19	20
Lead	DETSC 2301#	0.3	mg/kg	16	21	23	20	12	14
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10	< 10	< 10	< 10	< 10	
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	20	21	20	25	19	22
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	28	27	27	26	19	22
Zinc	DETSC 2301#	1	mg/kg	62	65	67	55	40	53
Inorganics									
pH	DETSC 2008#		pH	6.6	7.7	7.7	7.9	8.1	8.2
Calorific Value	DETSC 5008	1	MJ/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	0.9	0.9	2.0	< 0.5	< 0.5	< 0.5
Chloride Aqueous Extract	DETSC 2055	1	mg/l	3.6	2.3	3.7	2.0	1.9	
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	< 1.0	1.2	1.9	< 1.0	< 1.0	
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	13	110	60	33	29	
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.07	< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

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Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

			Lab No	1948334	1948335	1948336	1948337	1948338	1948339
			.Sample ID	TP205	TP202	TP210	TP204	TT205 NW	TT206 SE
			Depth	0.40	0.50	0.50	0.50	0.50	0.60
			Other ID	1T	3T	1T	2T	1T	1T
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.11	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.09	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	0.04	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	0.31	< 0.10	< 0.10	< 0.10

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Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

	Lab No	1948340	1948341	1948342	1948343	1948344	1948345
	.Sample ID	TT209 E	TT208 SE	TT209 E	TP206	TP208	TT201 SE
	Depth	1.00	0.40	0.60	0.70	0.70	0.70
	Other ID	2T	1T	1T	3T	3T	1T
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Preparation							
Stones >10mm	DETSC 1003*	1	% m/m	28	6.0	8.0	19	12	5.0
Moisture Content	DETSC 1004	0.1	%	10	17	12	9.8	13	12
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	12	13	9.3	6.7	7.9	6.3
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.5	0.5	0.4	< 0.2	< 0.2	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.1	0.3	0.2	0.2	0.1	0.2
Chromium	DETSC 2301#	0.15	mg/kg	15	20	18	21	21	17
Chromium III	DETSC 2301*	0.15	mg/kg	15	20	18	21	21	17
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	21	40	36	37	37	34
Lead	DETSC 2301#	0.3	mg/kg	15	28	21	18	17	22
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	46	< 10		< 10		
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	22	30	37	40	42	36
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	20	30	21	23	19	17
Zinc	DETSC 2301#	1	mg/kg	54	88	92	94	92	91
Inorganics									
pH	DETSC 2008#		pH	7.7	8.0	8.1	7.9	7.9	7.6
Calorific Value	DETSC 5008	1	MJ/kg		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Organic Carbon	DETSC 2084#	0.5	%	1.0	5.0	1.7	0.9	1.9	1.5
Chloride Aqueous Extract	DETSC 2055	1	mg/l	2.7	2.4		1.4		
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	< 1.0	3.2		< 1.0		
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	690	19		87		
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	120	< 10	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	700	< 10	< 10	< 10	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	1500	< 10	< 10	< 10	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	38	< 10	< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	2400	< 10	< 10	< 10	< 10
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.05	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

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Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

			Lab No	1948340	1948341	1948342	1948343	1948344	1948345
			.Sample ID	TT209 E	TT208 SE	TT209 E	TP206	TP208	TT201 SE
			Depth	1.00	0.40	0.60	0.70	0.70	0.70
			Other ID	2T	1T	1T	3T	3T	1T
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.08	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.07	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	0.20	< 0.10	< 0.10	< 0.10	< 0.10

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Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

			Lab No	1948346	1948347	1948348	1948349	1948350	1948351
			.Sample ID	TP205	TP207	TT204 S	TT207C	TT206C	TP203
			Depth	0.80	0.90	0.90	0.90	1.00	1.10
			Other ID	2T	2T	2T	1T	4T	3T
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	34	10	11	5.0	14	8.0
Moisture Content	DETSC 1004	0.1	%	14	14	18	10	12	15
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	13	7.4	7.2	7.6	15	9.1
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.3	< 0.2	0.5	< 0.2	0.5	0.3
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.1	0.2	0.2	0.3	0.2
Chromium	DETSC 2301#	0.15	mg/kg	20	18	21	16	18	16
Chromium III	DETSC 2301*	0.15	mg/kg	20	18	21	16	18	16
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	43	32	35	43	40	33
Lead	DETSC 2301#	0.3	mg/kg	21	21	29	19	30	19
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10	< 10	< 10	65		
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	31	32	31	34	24	29
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	25	19	30	19	26	25
Zinc	DETSC 2301#	1	mg/kg	79	70	91	88	70	75
Inorganics									
pH	DETSC 2008#		pH	7.7	7.8	7.6	7.4	7.8	7.7
Calorific Value	DETSC 5008	1	MJ/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Organic Carbon	DETSC 2084#	0.5	%	1.2	4.6	2.4	3.6	2.9	14
Chloride Aqueous Extract	DETSC 2055	1	mg/l	3.4	3.5	5.5	2.6		
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	< 1.0	< 1.0	< 1.0	< 1.0		
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	45	65	41	520		
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	87	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	260	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	530	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	31	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	< 10	< 10	< 10	910	< 10
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.04	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.03	0.06	< 0.03	< 0.03	0.08	0.15
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.04

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

			Lab No	1948346	1948347	1948348	1948349	1948350	1948351
			.Sample ID	TP205	TP207	TT204 S	TT207C	TT206C	TP203
			Depth	0.80	0.90	0.90	0.90	1.00	1.10
			Other ID	2T	2T	2T	1T	4T	3T
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021	03/12/2021
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.20
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.17
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.07
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.15
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.03	0.11
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.05
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.07
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.04
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.05
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	0.12	1.1

Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

	Lab No	1948352	1948353	1948354	1948355
	.Sample ID	TT204 S	TT207 NW	TT202 S	TP203
	Depth	1.50	1.60	1.80	2.00
	Other ID	4T	3T	2T	5T
	Sample Type	SOIL	SOIL	SOIL	SOIL
	Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021
	Sampling Time	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Preparation					
Stones >10mm	DETSC 1003*	1	% m/m	< 1.0	3.0	< 1.0	< 1.0
Moisture Content	DETSC 1004	0.1	%	20	11	12	13
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	6.5	9.6	5.7	5.3
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.3	< 0.2	< 0.2	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.1	0.2	0.1
Chromium	DETSC 2301#	0.15	mg/kg	19	13	15	15
Chromium III	DETSC 2301*	0.15	mg/kg	19	13	15	15
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	38	29	31	32
Lead	DETSC 2301#	0.3	mg/kg	24	19	15	14
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l		14		16
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	32	53	31	30
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	23	15	19	16
Zinc	DETSC 2301#	1	mg/kg	87	66	86	78
Inorganics							
pH	DETSC 2008#		pH	7.8	8.0	7.8	9.0
Calorific Value	DETSC 5008	1	MJ/kg	< 1.0	3.5	< 1.0	1.4
Total Organic Carbon	DETSC 2084#	0.5	%	2.0	9.2	1.4	3.8
Chloride Aqueous Extract	DETSC 2055	1	mg/l		3.8		4.6
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l		< 1.0		< 1.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		140		120
Petroleum Hydrocarbons							
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	< 10	< 10	< 10
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.04	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.03	0.05	0.04	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

			Lab No	1948352	1948353	1948354	1948355
			.Sample ID	TT204 S	TT207 NW	TT202 S	TP203
			Depth	1.50	1.60	1.80	2.00
			Other ID	4T	3T	2T	5T
			Sample Type	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/12/2021	03/12/2021	03/12/2021	03/12/2021
			Sampling Time	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10

Summary of Asbestos Analysis

Soil Samples

Our Ref 21-26564
Client Ref 3407
Contract Title Barugh Green

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1948322	TP211 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948323	TP213 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948324	TP201 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948325	TP202 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948326	TP208 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948327	TP209 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948328	TT204 S 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948329	TT205 SE 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948330	TT206 C 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948331	TT209 C 1T 0.10	SOIL	NAD	none	Lee Kerridge
1948332	TP204 1T 0.30	SOIL	NAD	none	Lee Kerridge
1948333	TP203 1T 0.40	SOIL	NAD	none	Lee Kerridge
1948334	TP205 1T 0.40	SOIL	NAD	none	Lee Kerridge
1948335	TP202 3T 0.50	SOIL	NAD	none	Lee Kerridge
1948336	TP210 1T 0.50	SOIL	NAD	none	Lee Kerridge
1948337	TP204 2T 0.50	SOIL	NAD	none	Lee Kerridge
1948338	TT205 NW 1T 0.50	SOIL	NAD	none	Lee Kerridge
1948339	TT206 SE 1T 0.60	SOIL	NAD	none	Lee Kerridge
1948340	TT209 E 2T 1.00	SOIL	NAD	none	Lee Kerridge
1948341	TT208 SE 1T 0.40	SOIL	NAD	none	Lee Kerridge
1948342	TT209 E 1T 0.60	SOIL	NAD	none	Lee Kerridge
1948343	TP206 3T 0.70	SOIL	NAD	none	Lee Kerridge
1948344	TP208 3T 0.70	SOIL	NAD	none	Lee Kerridge
1948345	TT201 SE 1T 0.70	SOIL	NAD	none	Lee Kerridge
1948346	TP205 2T 0.80	SOIL	NAD	none	Lee Kerridge
1948347	TP207 2T 0.90	SOIL	NAD	none	Lee Kerridge
1948348	TT204 S 2T 0.90	SOIL	NAD	none	Lee Kerridge
1948349	TT207C 1T 0.90	SOIL	NAD	none	Lee Kerridge
1948350	TT206C 4T 1.00	SOIL	NAD	none	Lee Kerridge
1948351	TP203 3T 1.10	SOIL	NAD	none	Lee Kerridge
1948352	TT204 S 4T 1.50	SOIL	NAD	none	Lee Kerridge
1948353	TT207 NW 3T 1.60	SOIL	NAD	none	Lee Kerridge
1948354	TT202 S 2T 1.80	SOIL	NAD	none	Lee Kerridge
1948355	TP203 5T 2.00	SOIL	NAD	none	Lee Kerridge

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 21-26564
Client Ref 3407
Contract Barugh Green

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1948322	TP211 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948323	TP213 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948324	TP201 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948325	TP202 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948326	TP208 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948327	TP209 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948328	TT204 S 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948329	TT205 SE 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948330	TT206 C 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948331	TT209 C 0.10 SOIL	03/12/21	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1948332	TP204 0.30 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948333	TP203 0.40 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948334	TP205 0.40 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948335	TP202 0.50 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948336	TP210 0.50 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948337	TP204 0.50 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948338	TT205 NW 0.50 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948339	TT206 SE 0.60 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948340	TT209 E 1.00 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948341	TT208 SE 0.40 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948342	TT209 E 0.60 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948343	TP206 0.70 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948344	TP208 0.70 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948345	TT201 SE 0.70 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948346	TP205 0.80 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948347	TP207 0.90 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948348	TT204 S 0.90 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948349	TT207C 0.90 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948350	TT206C 1.00 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948351	TP203 1.10 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948352	TT204 S 1.50 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948353	TT207 NW 1.60 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948354	TT202 S 1.80 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1948355	TP203 2.00 SOIL	03/12/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	

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.

Information in Support of the Analytical Results

Our Ref 21-26564
Client Ref 3407
Contract Barugh Green

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

End of Report

Appendix M

Geotechnical Test Results

LABORATORY REPORT

4043

Contract Number: PSL21/9802

Report Date: 04 February 2022

Client's Reference: 3407

Client Name: Lithos Consulting
Parkhill
Walton Road
Wetherby
North Yorkshire
LS22 5DZ

For the attention of: Lewis Whiteley

Contract Title: Barugh Green

Date Received: 15/12/2021
Date Commenced: 15/12/2021
Date Completed: 04/02/2022

Notes: **Opinions and Interpretations are outside the UKAS Accreditation**

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

Checked and Approved Signatories:

A Watkins (Director)	R Berriman (Quality Manager)	S Royle (Laboratory Manager)
L Knight (Senior Technician)	S Eyre (Senior Technician)	T Watkins (Senior Technician)

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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP211	2	B	0.20		Brown slightly gravelly very sandy very silty CLAY.
TP213	2	B	0.20		Brown gravelly sandy very silty CLAY.
TP207	1	B	0.10		Brown gravelly sandy very silty CLAY.
TT206C	2	B	0.20		Brown gravelly sandy very silty CLAY.
TP209	2	B	0.20		Brown gravelly sandy very silty CLAY.
TP208	2	D&B	0.40		Brown slightly sandy CLAY.
TP206	2	D&B	0.50		Brown slightly sandy CLAY.
TP203	2	D&B	0.70		Brown sandy CLAY.
BH205	3	D	1.00		Brown slightly gravelly sandy CLAY.
TP202	4	D	1.00		Brown very gravelly slightly sandy CLAY.
TT206C	3	D&B	0.80		Brown very gravelly very sandy CLAY.
TT208SE	2	D&B	0.90		Brown very gravelly sandy CLAY.
BH201	3	D	1.00		Brown very gravelly sandy CLAY.
BH203	3	D	1.00		Brown sandy CLAY.
TP206	4	D&B	1.00		Brown very gravelly sandy CLAY.
TT204S	3	D	1.20		Brown slightly gravelly sandy CLAY.
TT201SE	2	D&B	1.20		Brown sandy very clayey GRAVEL with cobbles.
TP207	3	D&B	1.40		Brown very gravelly very sandy very silty CLAY.
TT202S	1	D&B	1.40		Brown gravelly sandy CLAY.

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP205	4	D&B	1.60		Dark brown very gravelly very sandy CLAY
TP208	4	D&B	1.70		Brown very sandy very silty slightly clayey GRAVEL.
TT205NW	3	D&B	1.80		Dark brown very gravelly sandy CLAY.
TP203	4	D&B	1.90		Dark brown gravelly sandy CLAY.
BH201	4	D&B	2.00		Brown mottled grey sandy CLAY.
BH202	3	D	2.00		Brown mottled grey sandy CLAY.
BH206	3	D	2.00		Brown very gravelly sandy CLAY.
TT207NW	3	D&B	2.40		Brown highly weathered MUDSTONE.
TP203	6	D&B	2.50		Brown very gravelly sandy CLAY.
TP205	5	D&B	2.80		Brown highly weathered MUDSTONE.
BH205	5	B	3.00		Brown very gravelly slightly clayey GRAVEL.
BH201	6	D	3.00		Brown gravelly sandy CLAY.
BH204	5	D	3.00		Brown slightly gravelly sandy CLAY.
TP207	5	D&B	3.90		Brown very gravelly sandy CLAY
BH205	6	B	4.00		Brown very gravelly very sandy CLAY.
BH203	8	D	4.00		Brown very gravelly very clayey GRAVEL.
BH206	6	D	4.00		Brown slightly sandy silty GRAVEL.
BH201	9	D	5.00		Brown gravelly sandy CLAY.
BH203	9	D	5.00		Brown very gravelly sandy CLAY.

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH201	10	D	6.00		Dark brown gravelly sandy CLAY.
BH204	9	D	6.00		Brown very gravelly very sandy CLAY.
BH206	9	D	6.50		Brown gravelly sandy CLAY.
BH204	11	D	6.70		Brown very gravelly sandy CLAY.
BH205	11	D	8.00		Brown gravelly sandy CLAY.
BH204	13	B	8.50		Brown gravelly sandy CLAY.
TP201	2	D&B	0.80		Brown gravelly slightly sandy CLAY.
TP211	3	D	0.60		Brown sandy CLAY.
TP210	2	D	0.80		Brown mottled grey sandy CLAY.
TP212	1	D&B	0.80		Brown mottled grey slightly gravelly sandy CLAY.
TT206SE	2	D	1.00		Brown mottled grey slightly sandy CLAY.
TP209	3	D&B	1.00		Brown slightly gravelly sandy CLAY.
TT205SE	2	D&B	1.00		Brown mottled grey slightly gravelly slightly sandy CLAY.
TT204N	1	D	1.40		Brown mottled grey slightly sandy CLAY.
TP211	4	D	1.50		Brown mottled grey slightly gravelly sandy CLAY.
TT202N	2	D	1.50		Brown mottled grey CLAY.
TP210	3	D	1.60		Brown mottled grey sandy CLAY.
TP212	3	D	2.20		Brown slightly gravelly sandy CLAY.

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
TP208	2	D&B	0.40		23			58	26	32	100	High Plasticity CH
TP206	2	D&B	0.50		24			52	25	27	100	High Plasticity CH
TP203	2	D&B	0.70		23			50	25	25	100	High Plasticity CH
BH205	3	D	1.00		31			50	24	26	89	High Plasticity CH
TP202	4	D	1.00		19			51	25	26	70	High Plasticity CH
TT206C	3	D&B	0.80		14		2.57	32	16	16	46	Low Plasticity CL
TT208SE	2	D&B	0.90		23		2.55	49	24	25	53	Intermediate Plasticity CI
BH201	3	D	1.00		12			44	21	23	50	Intermediate Plasticity CI
BH203	3	D	1.00		7.7			38	19	19	100	Intermediate Plasticity CI
TP206	4	D&B	1.00		10			36	18	18	60	Intermediate Plasticity CI
TT204S	3	D	1.20		18			48	23	25	90	Intermediate Plasticity CI
TT201SE	2	D&B	1.20		15		2.69	53	25	28	41	High Plasticity CH
TP207	3	D&B	1.40		13		2.65	39	19	20	49	Intermediate Plasticity CI
TT202S	1	D&B	1.40		15			40	20	20	80	Intermediate Plasticity CI
TP205	4	D&B	1.60		9.4		2.20	34	20	14	38	Low Plasticity CL
TP208	4	D&B	1.70		15		2.68		NP			
TT205NW	3	D&B	1.80		12			39	18	21	72	Intermediate Plasticity CI
TP203	4	D&B	1.90		17			40	20	20	80	Intermediate Plasticity CI
BH201	4	D&B	2.00		17			45	22	23	100	Intermediate Plasticity CI

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL Professional Soils Laboratory

Barugh Green

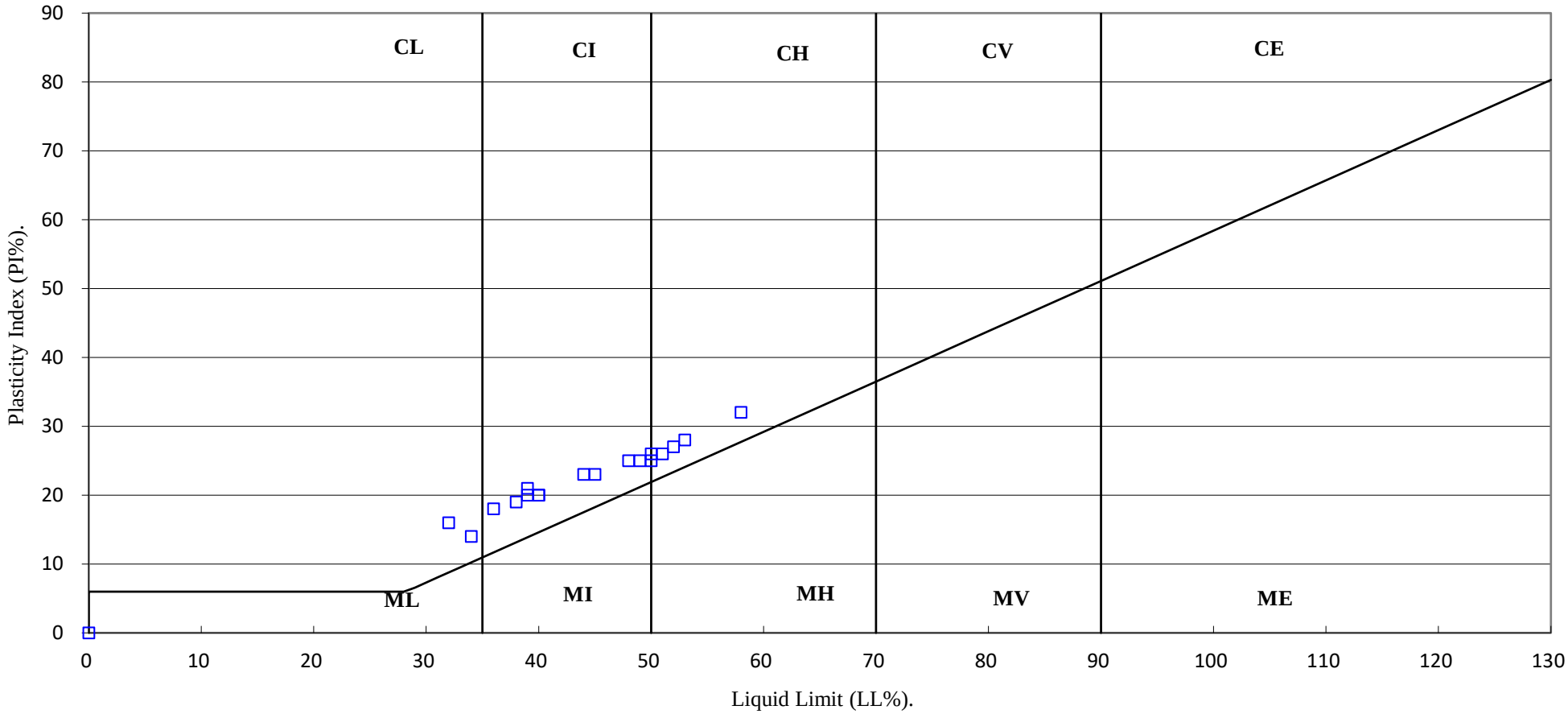
Contract No:

PSL21/9802

Client Ref:

3407

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract No:**
			PSL21/9802
			Client Ref:
			3407

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH202	3	D	2.00		23			46	23	23	92	Intermediate Plasticity CI
BH206	3	D	2.00		20			44	21	23	50	Intermediate Plasticity CI
TT207NW	3	D&B	2.40		15		2.30		NP			
TP203	6	D&B	2.50		18		2.70	44	24	20	43	Intermediate Plasticity CI
TP205	5	D&B	2.80		11			40	19	21	85	Intermediate Plasticity CI
BH205	5	B	3.00		28				NP			
BH201	6	D	3.00		10			48	23	25	70	Intermediate Plasticity CI
BH204	5	D	3.00		14			40	20	20	90	Intermediate Plasticity CI
TP207	5	D&B	3.90		15			50	23	27	38	High Plasticity CH
BH205	6	B	4.00		16			40	19	21	62	Intermediate Plasticity CI
BH203	8	D	4.00		14			38	19	19	50	Intermediate Plasticity CI
BH206	6	D	4.00		17				NP			
BH201	9	D	5.00		14			49	23	26	80	Intermediate Plasticity CI
BH203	9	D	5.00		14			39	19	20	79	Intermediate Plasticity CI
BH201	10	D	6.00		19			50	23	27	78	High Plasticity CH
BH204	9	D	6.00		12			34	17	17	78	Low Plasticity CL
BH206	9	D	6.50		13			40	20	20	89	Intermediate Plasticity CI
BH204	11	D	6.70		10			38	19	19	67	Intermediate Plasticity CI
BH205	11	D	8.00		12			39	19	20	91	Intermediate Plasticity CI

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL Professional Soils Laboratory

Barugh Green

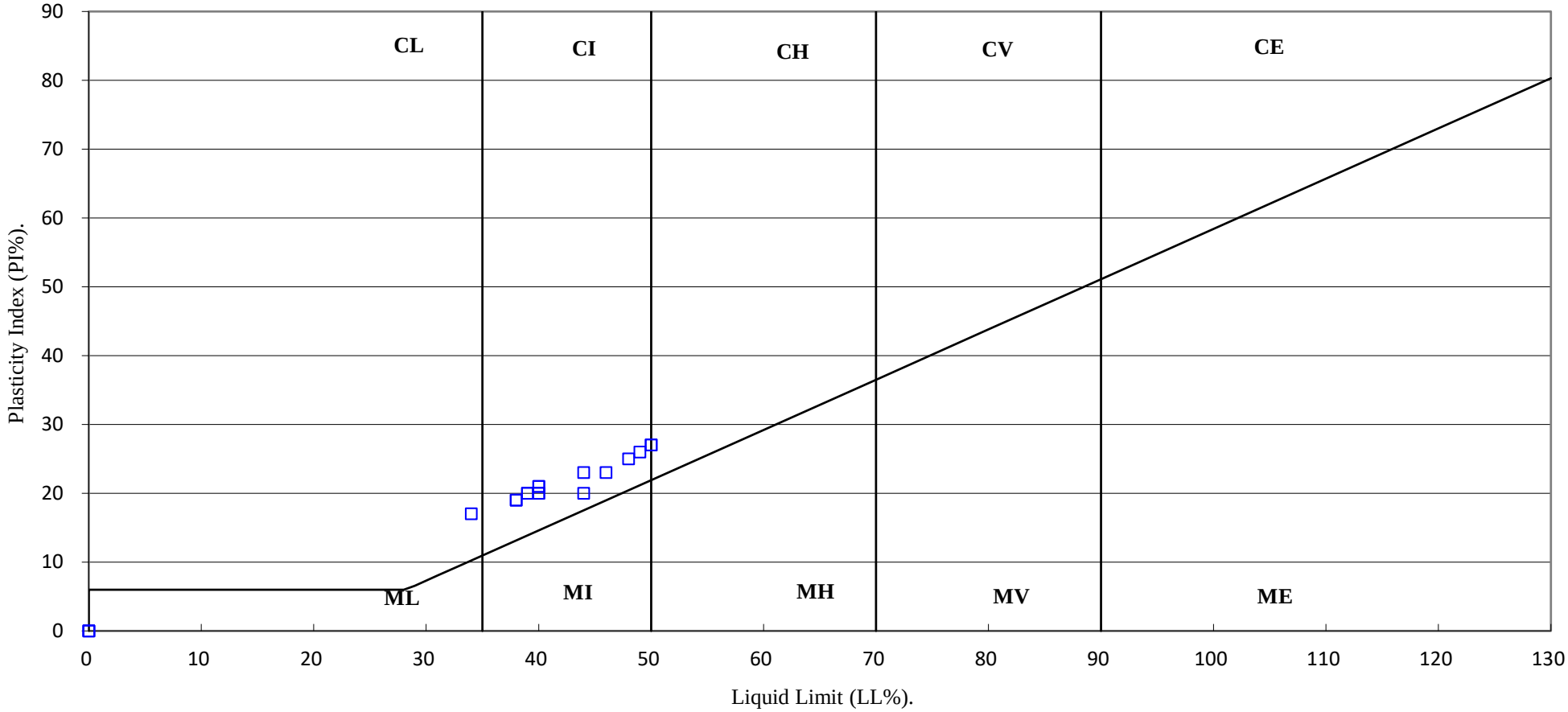
Contract No:

PSL21/9802

Client Ref:

3407

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract No:**
			PSL21/9802
			Client Ref:
			3407

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH204	13	B	8.50		16			48	23	25	60	Intermediate Plasticity CI
TP201	2	D&B	0.80		19		2.71	46	20	26	85	Intermediate Plasticity CI
TP211	3	D	0.60		22			37	27	10	100	Intermediate Plasticity MI
TP210	2	D	0.80		17			49	23	26	100	Intermediate Plasticity CI
TP212	1	D&B	0.80		19		2.70	41	20	21	91	Intermediate Plasticity CI
TT206SE	2	D	1.00		24			55	25	30	100	High Plasticity CH
TP209	3	D&B	1.00		17		2.70	40	20	20	94	Intermediate Plasticity CI
TT205SE	2	D&B	1.00		25		2.65	64	28	36	92	High Plasticity CH
TT204N	1	D	1.40		22			56	25	31	100	High Plasticity CH
TP211	4	D	1.50		13			39	19	20	92	Intermediate Plasticity CI
TT202N	2	D	1.50		28			70	29	41	100	Very High Plasticity CV
TP210	3	D	1.60		19			53	23	30	100	High Plasticity CH
TP212	3	D	2.20		18			50	24	26	90	High Plasticity CH

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL Professional Soils Laboratory

Barugh Green

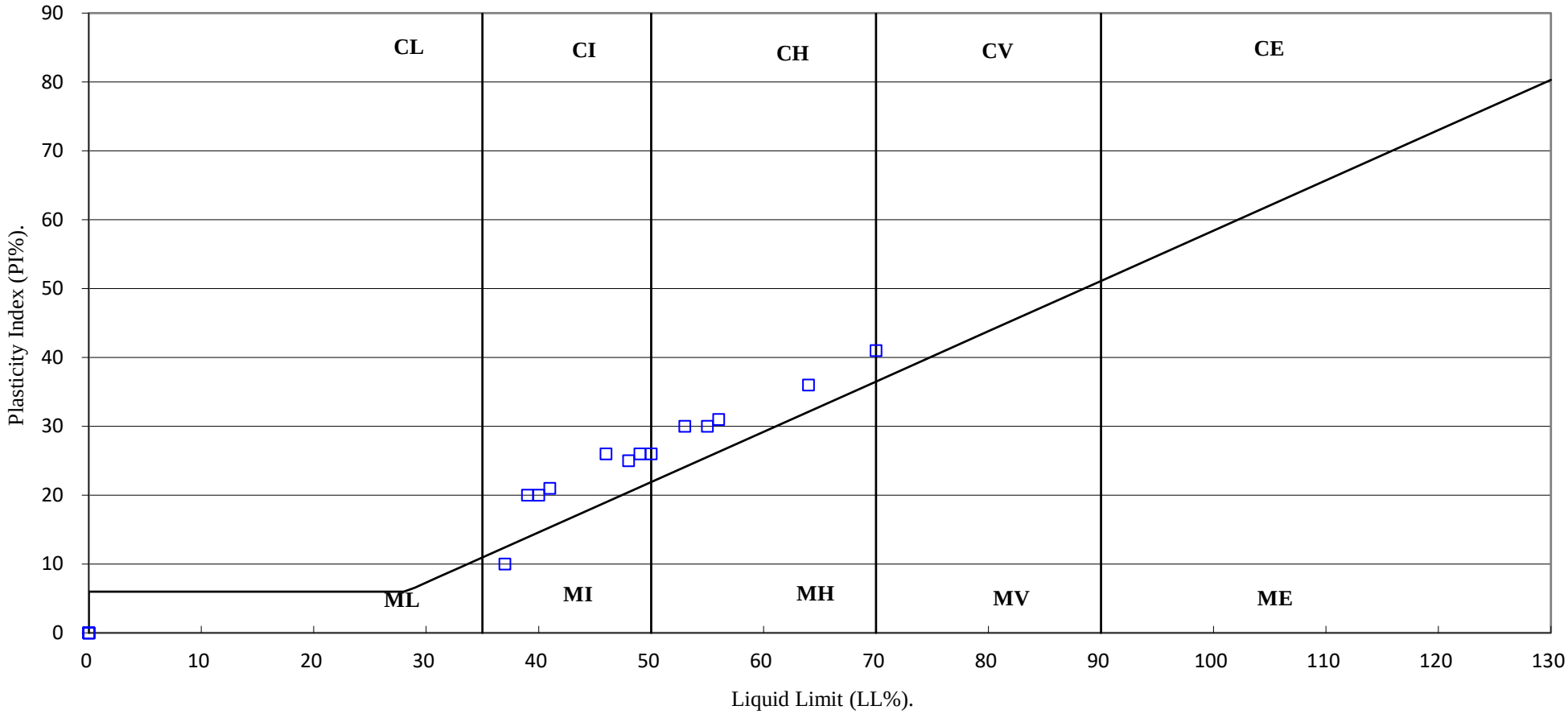
Contract No:

PSL21/9802

Client Ref:

3407

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract No:** PSL21/9802 **Client Ref:** 3407

PARTICLE SIZE DISTRIBUTION TEST

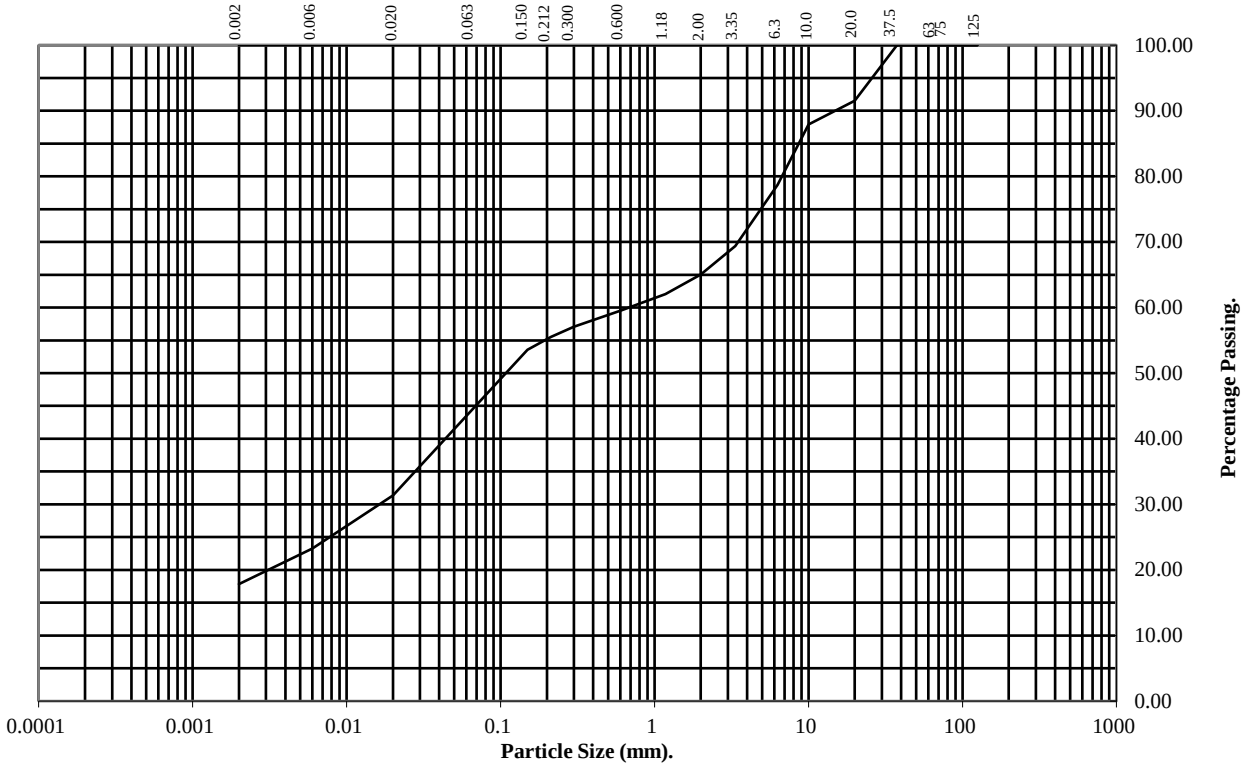
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP201** **Top Depth (m):** **0.80**

Sample Number: **2** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	92
10	88
6.3	79
3.35	69
2	65
1.18	62
0.6	60
0.3	57
0.212	56
0.15	54
0.063	44

Particle Diameter	Percentage Passing
0.02	31
0.006	23
0.002	18

Soil Fraction	Total Percentage
Cobbles	0
Gravel	35
Sand	21
Silt	26
Clay	18

Remarks:
See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

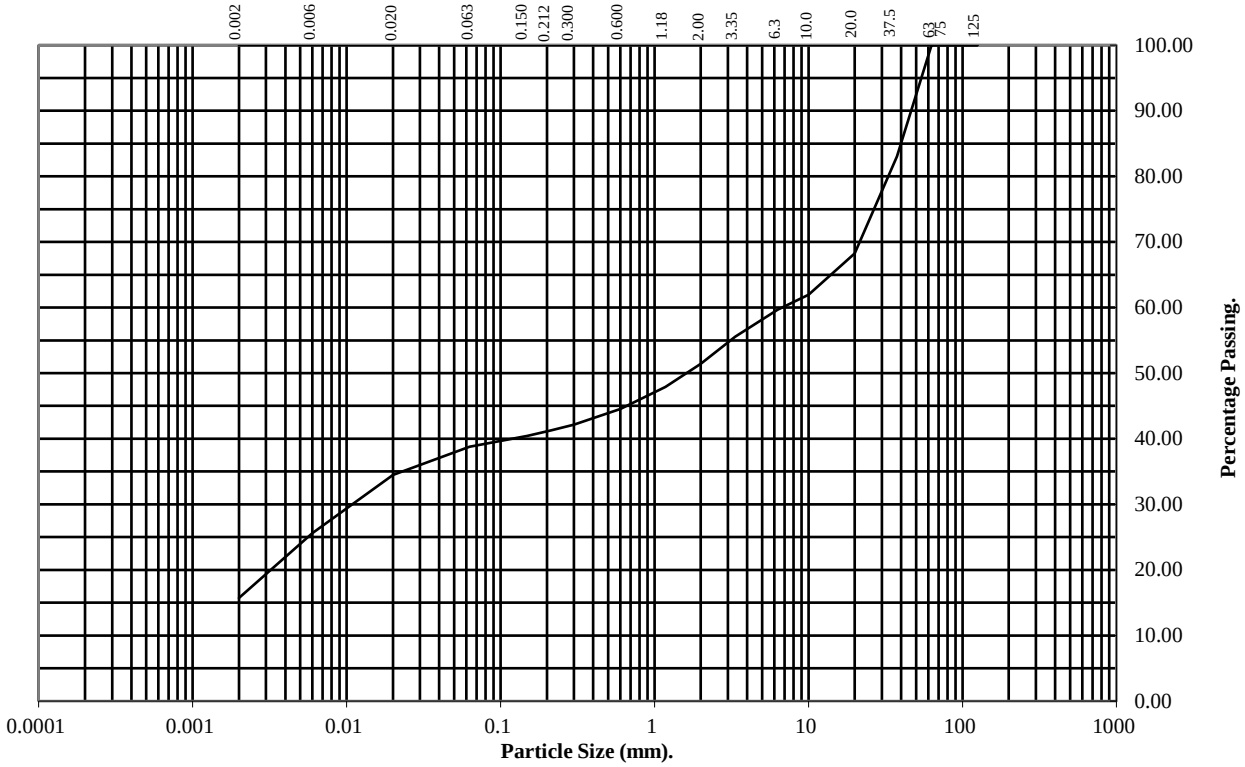
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP203** **Top Depth (m):** **2.50**

Sample Number: **6** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	83
20	68
10	62
6.3	60
3.35	56
2	51
1.18	48
0.6	45
0.3	42
0.212	41
0.15	40
0.063	39

Particle Diameter	Percentage Passing
0.02	34
0.006	26
0.002	16

Soil Fraction	Total Percentage
Cobbles	0
Gravel	49
Sand	12
Silt	23
Clay	16

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

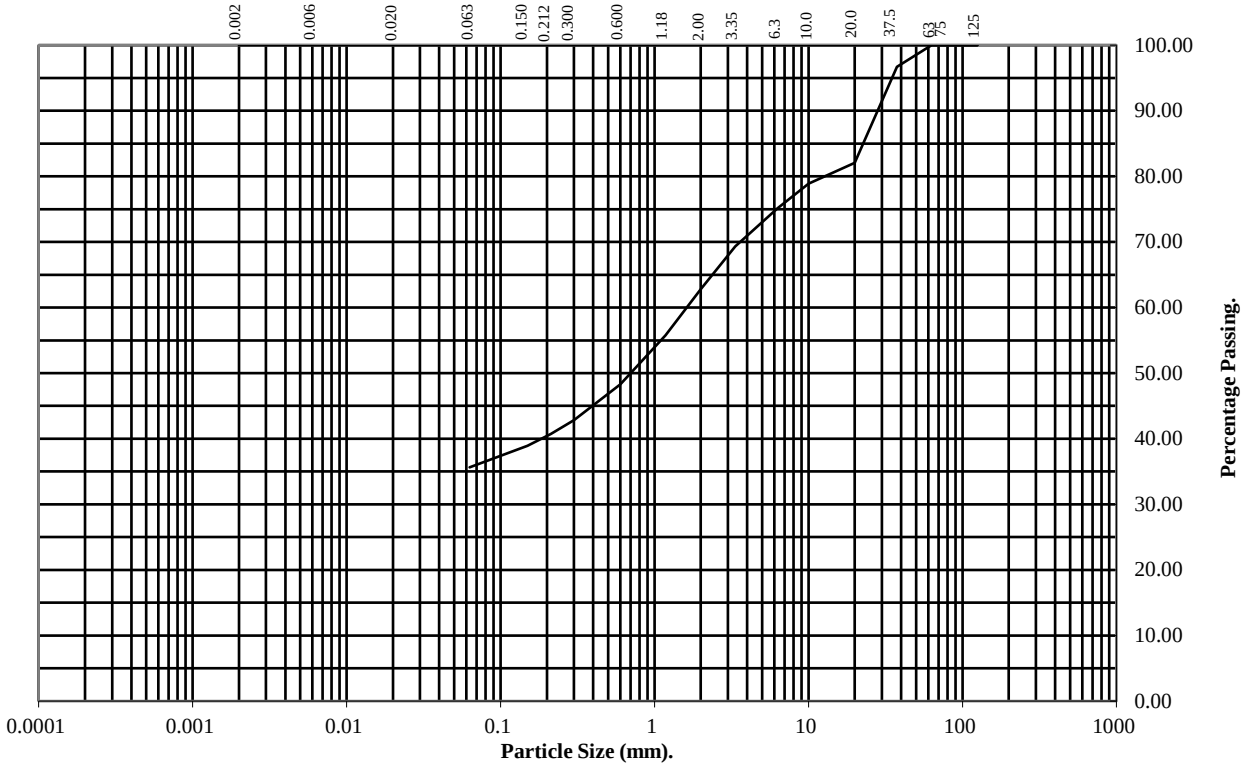
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP205** **Top Depth (m):** **1.60**

Sample Number: **4** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	97
20	82
10	79
6.3	75
3.35	69
2	63
1.18	56
0.6	48
0.3	43
0.212	41
0.15	39
0.063	36

Soil Fraction	Total Percentage
Cobbles	0
Gravel	37
Sand	27
Silt/Clay	36

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

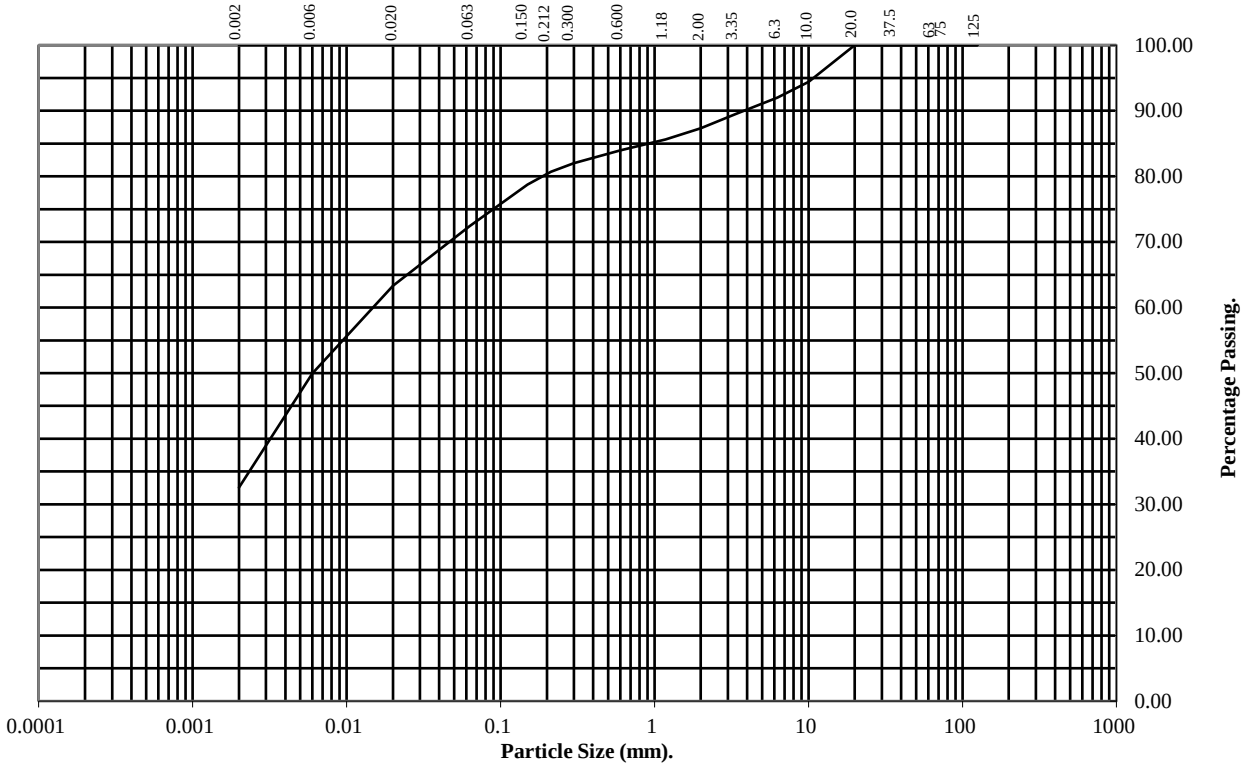
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP207** **Top Depth (m):** **0.10**

Sample Number: **1** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	94
6.3	92
3.35	89
2	87
1.18	86
0.6	84
0.3	82
0.212	81
0.15	79
0.063	72

Particle Diameter	Percentage Passing
0.02	63
0.006	50
0.002	33

Soil Fraction	Total Percentage
Cobbles	0
Gravel	13
Sand	15
Silt	39
Clay	33

Remarks:
See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

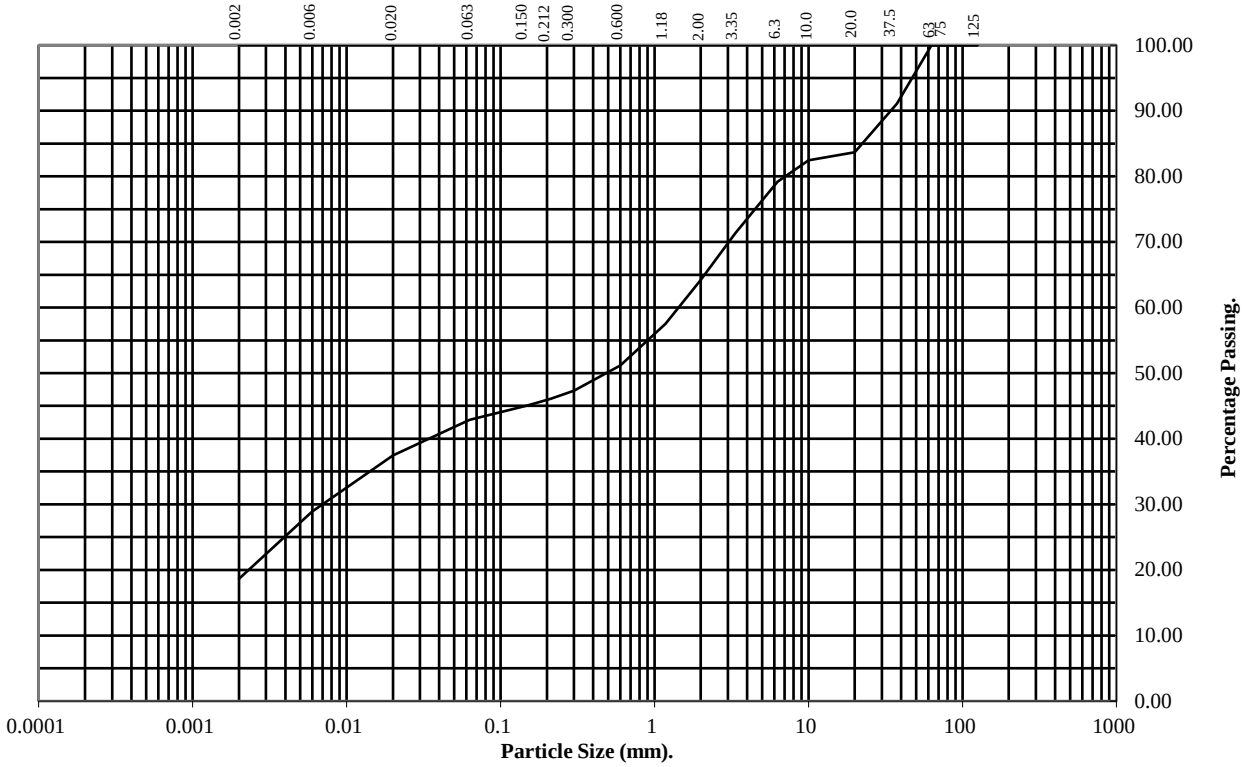
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP207** **Top Depth (m):** **1.40**

Sample Number: **3** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	91
20	84
10	82
6.3	79
3.35	71
2	64
1.18	57
0.6	51
0.3	47
0.212	46
0.15	45
0.063	43

Particle Diameter	Percentage Passing
0.02	37
0.006	29
0.002	19

Soil Fraction	Total Percentage
Cobbles	0
Gravel	36
Sand	21
Silt	24
Clay	19

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract No:** PSL21/9802 **Client Ref:** 3407

PARTICLE SIZE DISTRIBUTION TEST

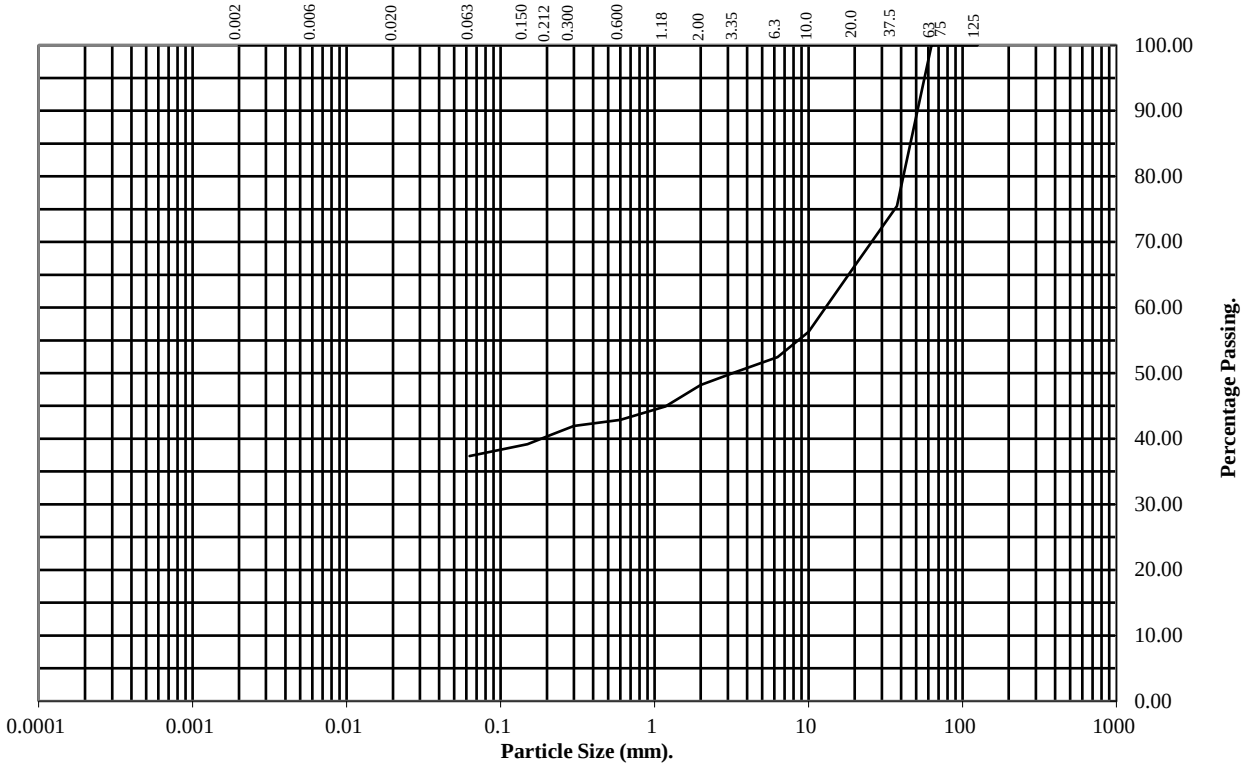
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP207** **Top Depth (m):** **3.90**

Sample Number: **5** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	75
20	66
10	56
6.3	52
3.35	50
2	48
1.18	45
0.6	43
0.3	42
0.212	41
0.15	39
0.063	37

Soil Fraction	Total Percentage
Cobbles	0
Gravel	52
Sand	11
Silt/Clay	37

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

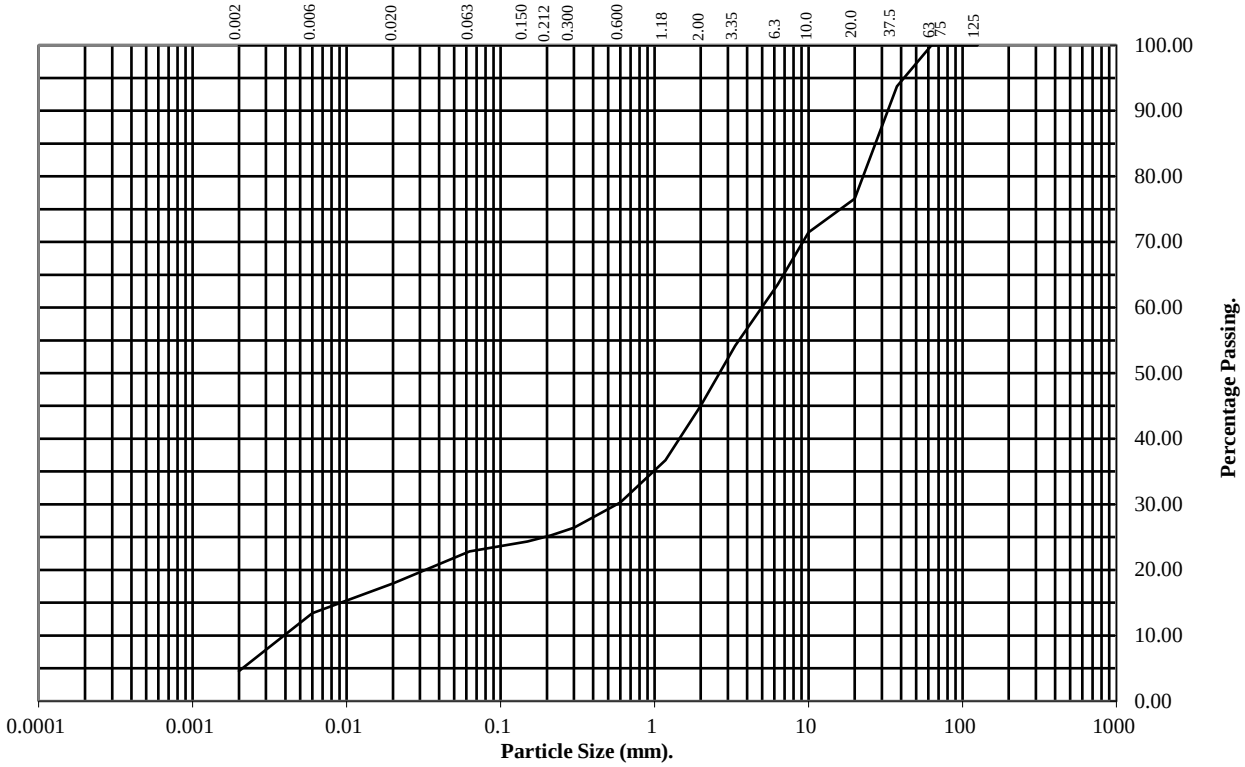
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP208** **Top Depth (m):** **1.70**

Sample Number: **4** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	94
20	77
10	71
6.3	63
3.35	54
2	45
1.18	37
0.6	30
0.3	26
0.212	25
0.15	24
0.063	23

Particle Diameter	Percentage Passing
0.02	18
0.006	13
0.002	5

Soil Fraction	Total Percentage
Cobbles	0
Gravel	55
Sand	22
Silt	18
Clay	5

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract No:** PSL21/9802 **Client Ref:** 3407

PARTICLE SIZE DISTRIBUTION TEST

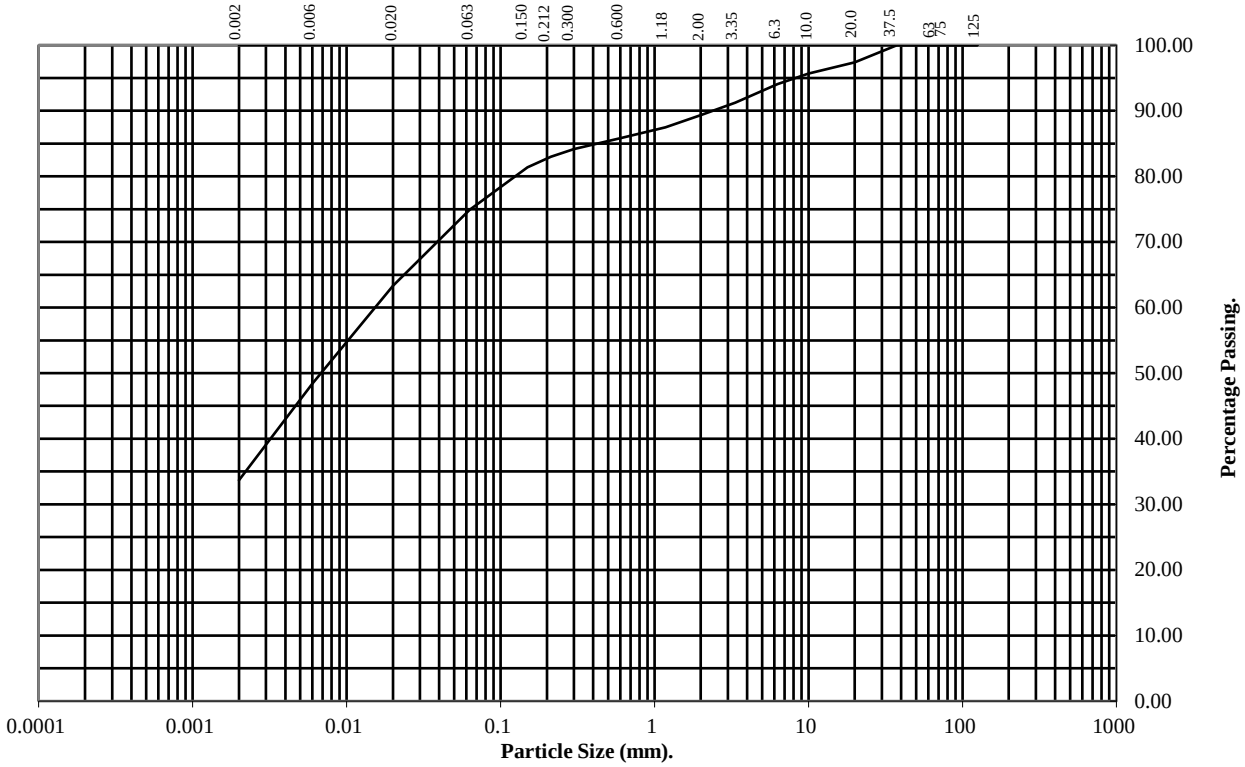
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP209** **Top Depth (m):** **0.20**

Sample Number: **2** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	96
6.3	94
3.35	91
2	89
1.18	87
0.6	86
0.3	84
0.212	83
0.15	81
0.063	75

Particle Diameter	Percentage Passing
0.02	63
0.006	48
0.002	34

Soil Fraction	Total Percentage
Cobbles	0
Gravel	11
Sand	14
Silt	41
Clay	34

Remarks:
See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

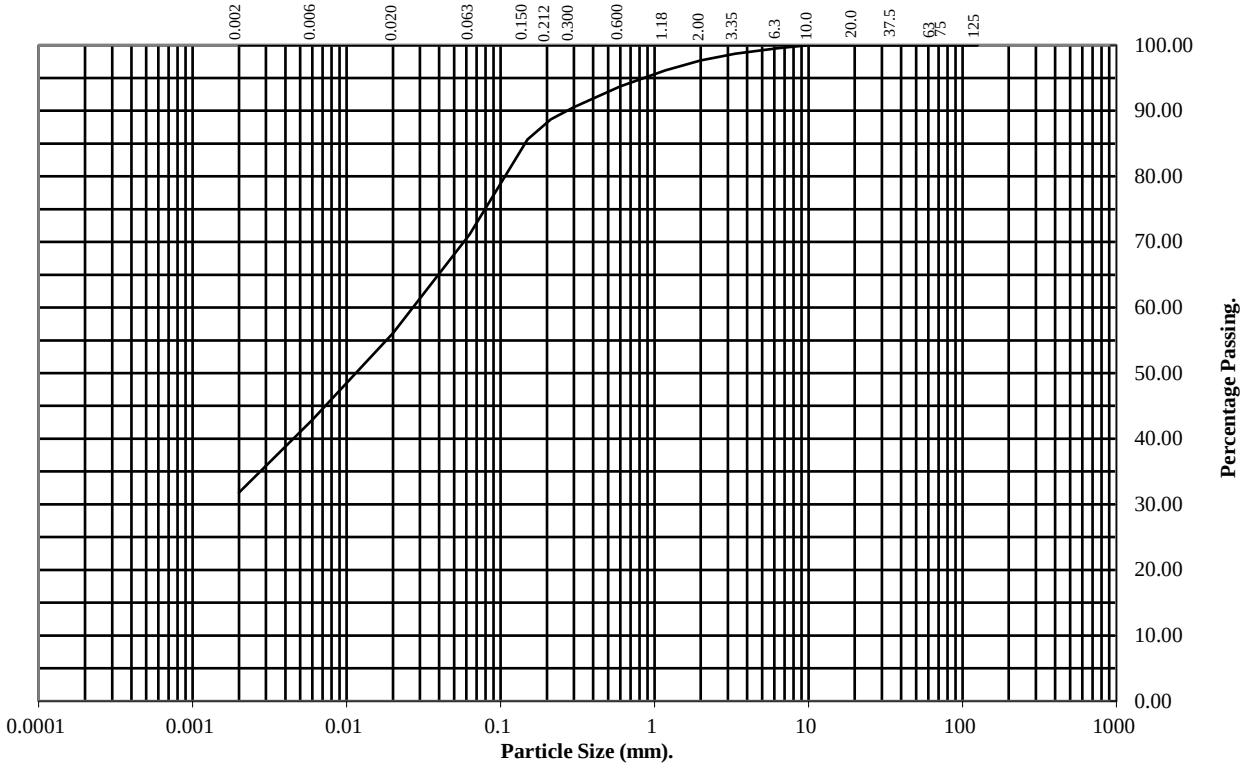
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP211** **Top Depth (m):** **0.20**

Sample Number: **2** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	99
2	98
1.18	96
0.6	94
0.3	91
0.212	89
0.15	86
0.063	71

Particle Diameter	Percentage Passing
0.02	56
0.006	43
0.002	32

Soil Fraction	Total Percentage
Cobbles	0
Gravel	2
Sand	27
Silt	39
Clay	32

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

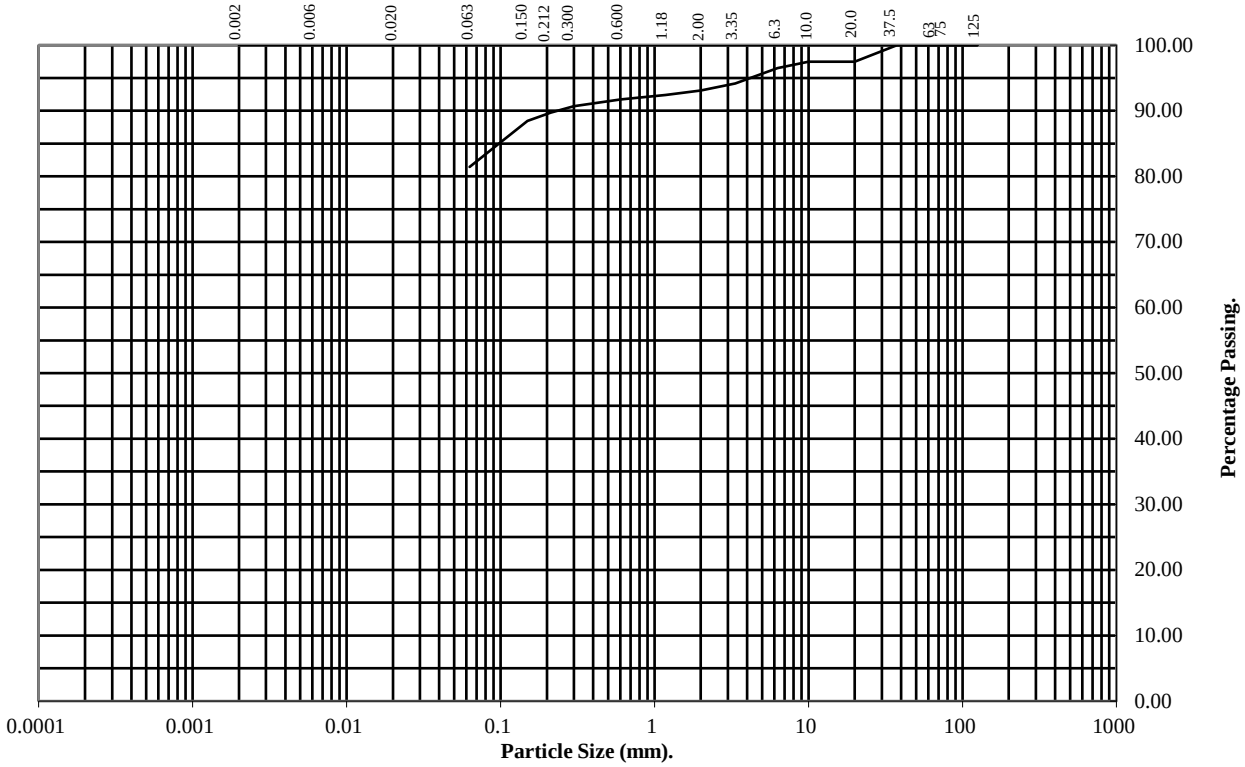
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP212** **Top Depth (m):** **0.80**

Sample Number: **1** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	97
6.3	97
3.35	94
2	93
1.18	92
0.6	92
0.3	91
0.212	90
0.15	88
0.063	81

Soil Fraction	Total Percentage
Cobbles	0
Gravel	7
Sand	12
Silt/Clay	81

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

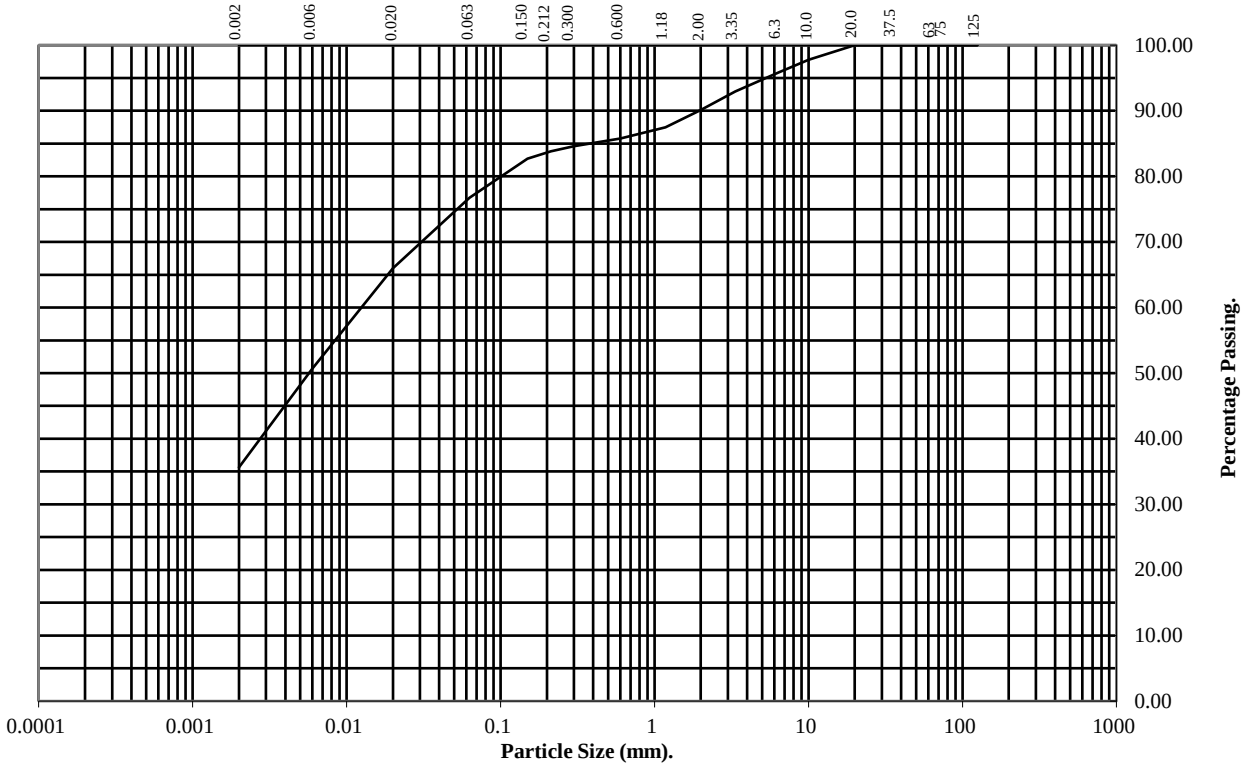
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP213** **Top Depth (m):** **0.20**

Sample Number: **2** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	98
6.3	96
3.35	93
2	90
1.18	87
0.6	86
0.3	85
0.212	84
0.15	83
0.063	77

Particle Diameter	Percentage Passing
0.02	66
0.006	51
0.002	36

Soil Fraction	Total Percentage
Cobbles	0
Gravel	10
Sand	13
Silt	41
Clay	36

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

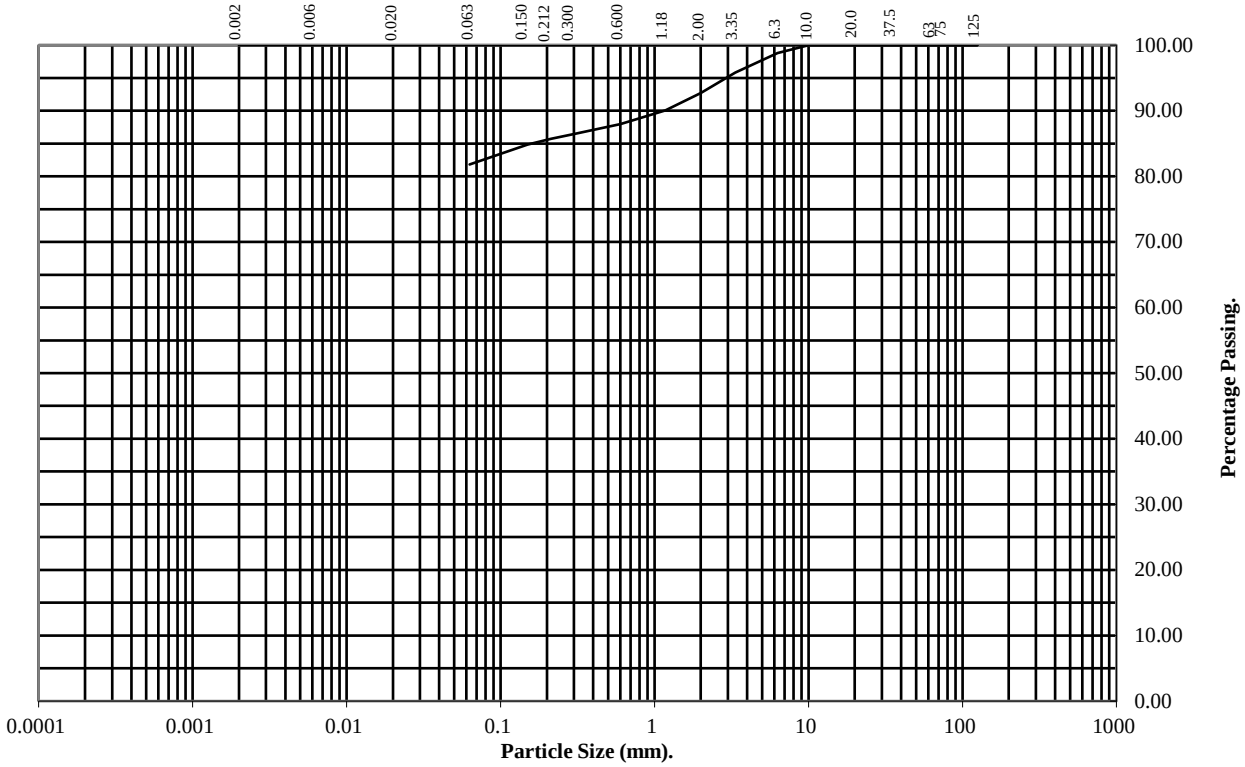
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP209** **Top Depth (m):** **1.00**

Sample Number: **3** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	99
3.35	96
2	93
1.18	90
0.6	88
0.3	86
0.212	86
0.15	85
0.063	82

Soil Fraction	Total Percentage
Cobbles	0
Gravel	7
Sand	11
Silt/Clay	82

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

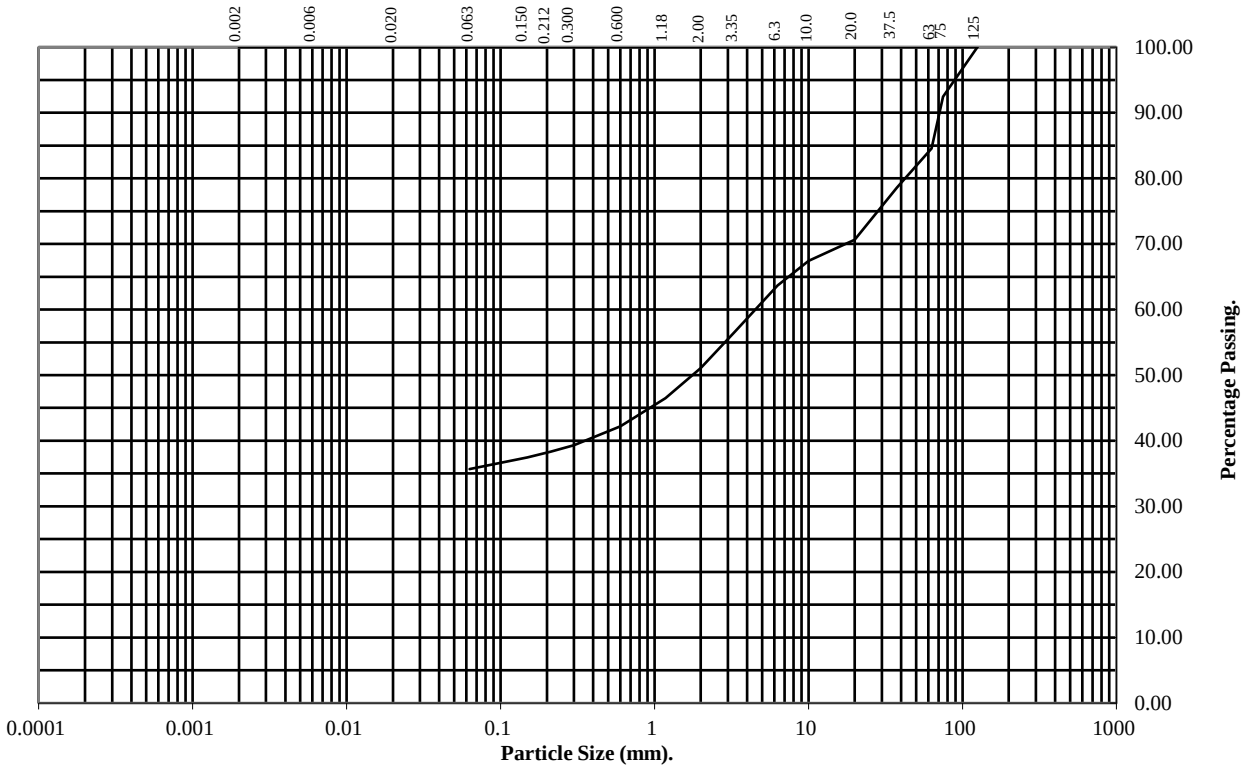
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TT201SE** **Top Depth (m):** **1.20**

Sample Number: **2** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	92
63	85
37.5	79
20	71
10	67
6.3	64
3.35	57
2	51
1.18	46
0.6	42
0.3	39
0.212	38
0.15	37
0.063	36

Soil Fraction	Total Percentage
Cobbles	15
Gravel	34
Sand	15
Silt/Clay	36

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

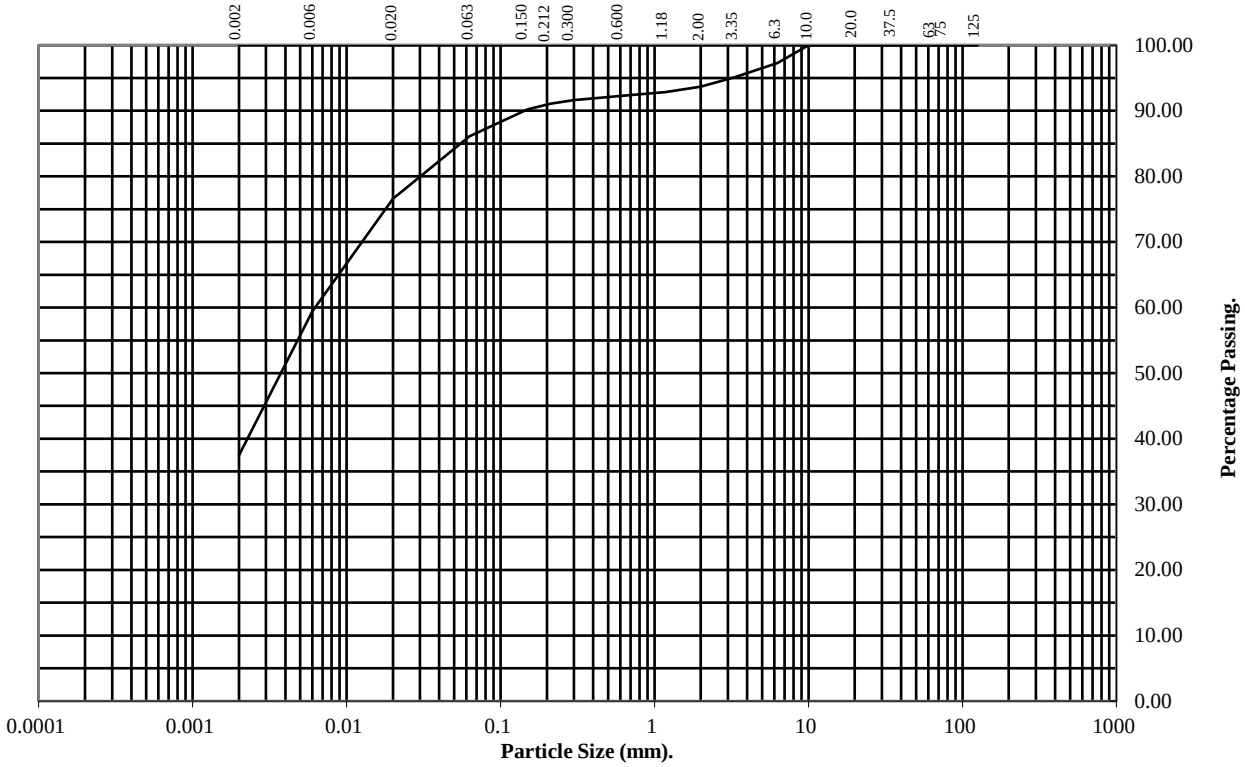
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TT205SE** **Top Depth (m):** **1.00**

Sample Number: **2** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	97
3.35	95
2	94
1.18	93
0.6	92
0.3	92
0.212	91
0.15	90
0.063	86

Particle Diameter	Percentage Passing
0.02	77
0.006	59
0.002	37

Soil Fraction	Total Percentage
Cobbles	0
Gravel	6
Sand	8
Silt	49
Clay	37

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

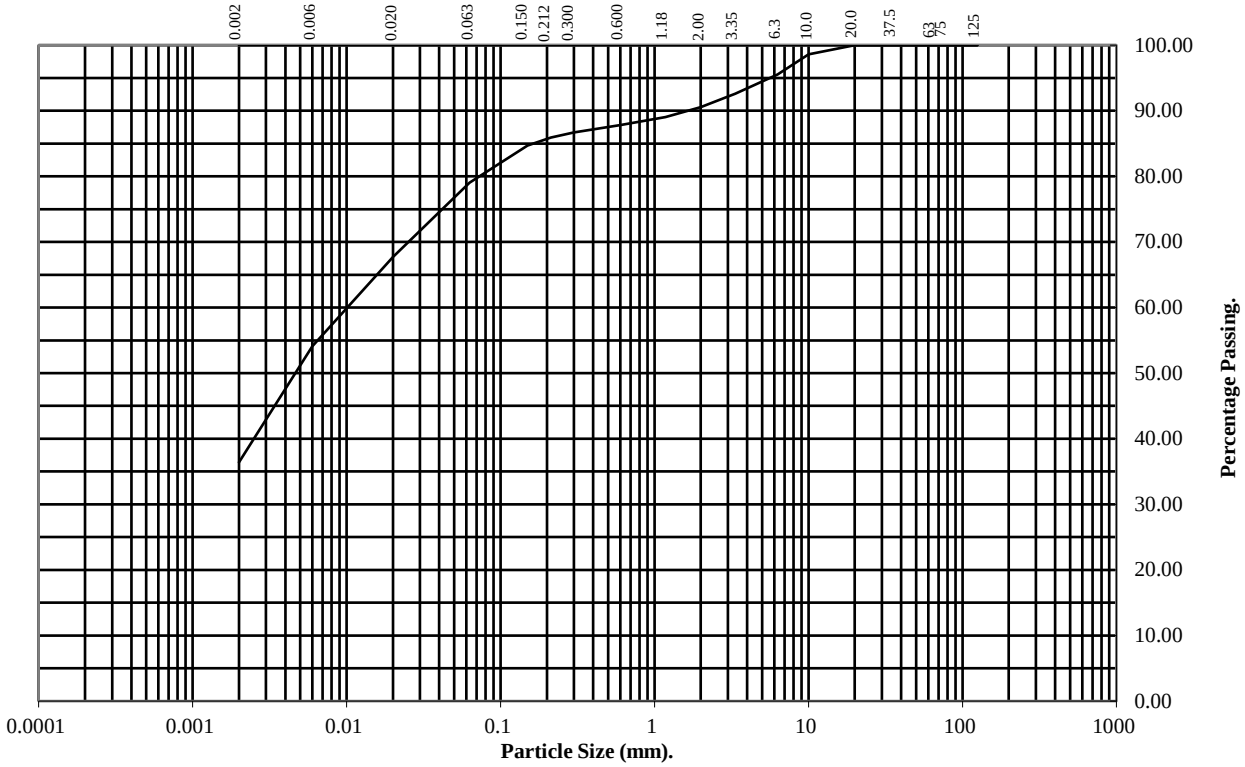
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP206C** **Top Depth (m):** **0.20**

Sample Number: **2** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	99
6.3	96
3.35	93
2	91
1.18	89
0.6	88
0.3	87
0.212	86
0.15	85
0.063	79

Particle Diameter	Percentage Passing
0.02	68
0.006	54
0.002	36

Soil Fraction	Total Percentage
Cobbles	0
Gravel	9
Sand	12
Silt	43
Clay	36

Remarks:
See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

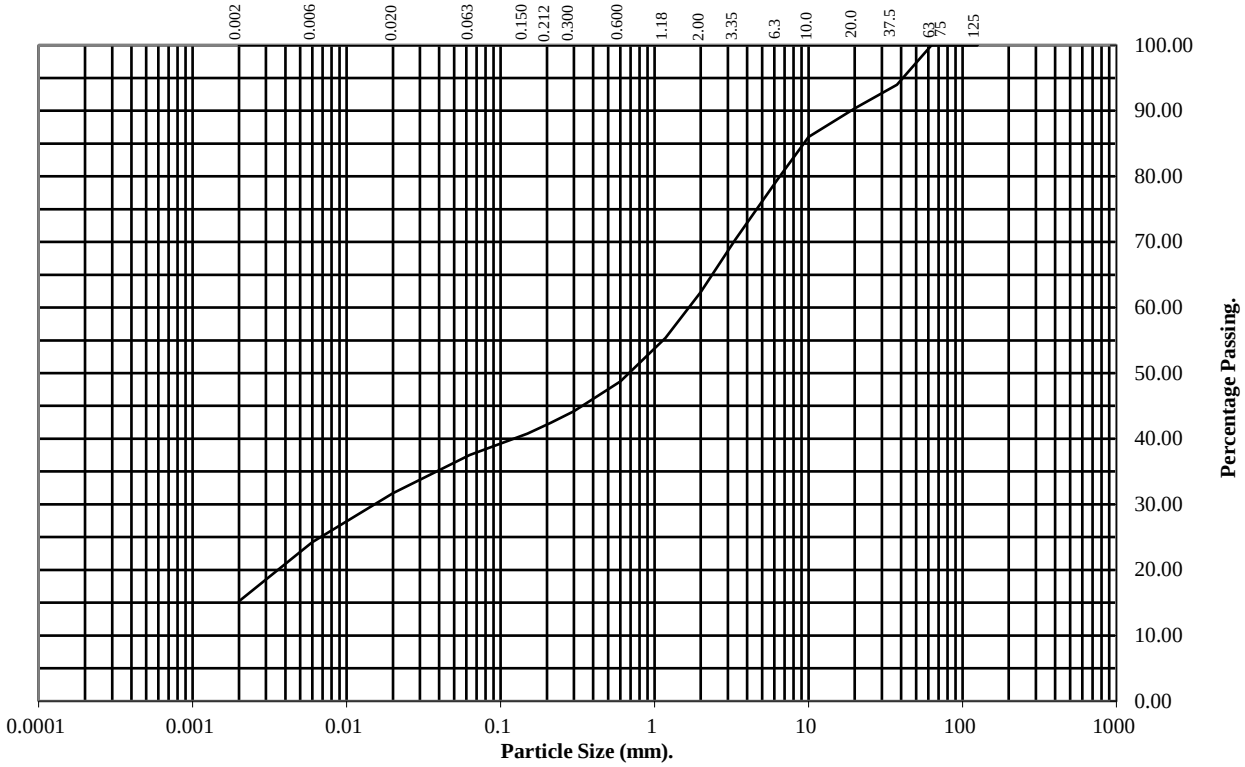
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TT206C** **Top Depth (m):** **0.80**

Sample Number: **3** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	94
20	90
10	86
6.3	80
3.35	70
2	62
1.18	55
0.6	49
0.3	44
0.212	42
0.15	41
0.063	38

Particle Diameter	Percentage Passing
0.02	32
0.006	24
0.002	15

Soil Fraction	Total Percentage
Cobbles	0
Gravel	38
Sand	24
Silt	23
Clay	15

Remarks:
See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

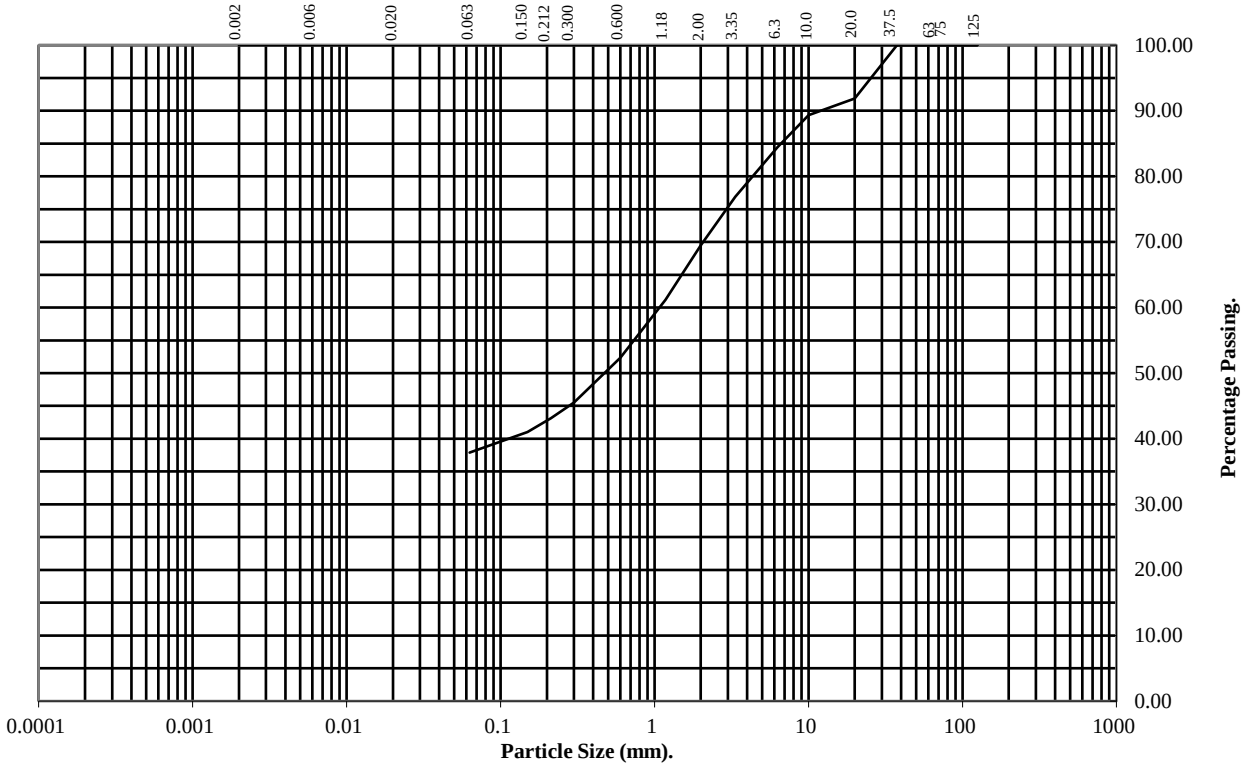
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TT207NW** **Top Depth (m):** **2.40**

Sample Number: **3** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	92
10	89
6.3	84
3.35	77
2	69
1.18	61
0.6	52
0.3	46
0.212	43
0.15	41
0.063	38

Soil Fraction	Total Percentage
Cobbles	0
Gravel	31
Sand	31
Silt/Clay	38

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

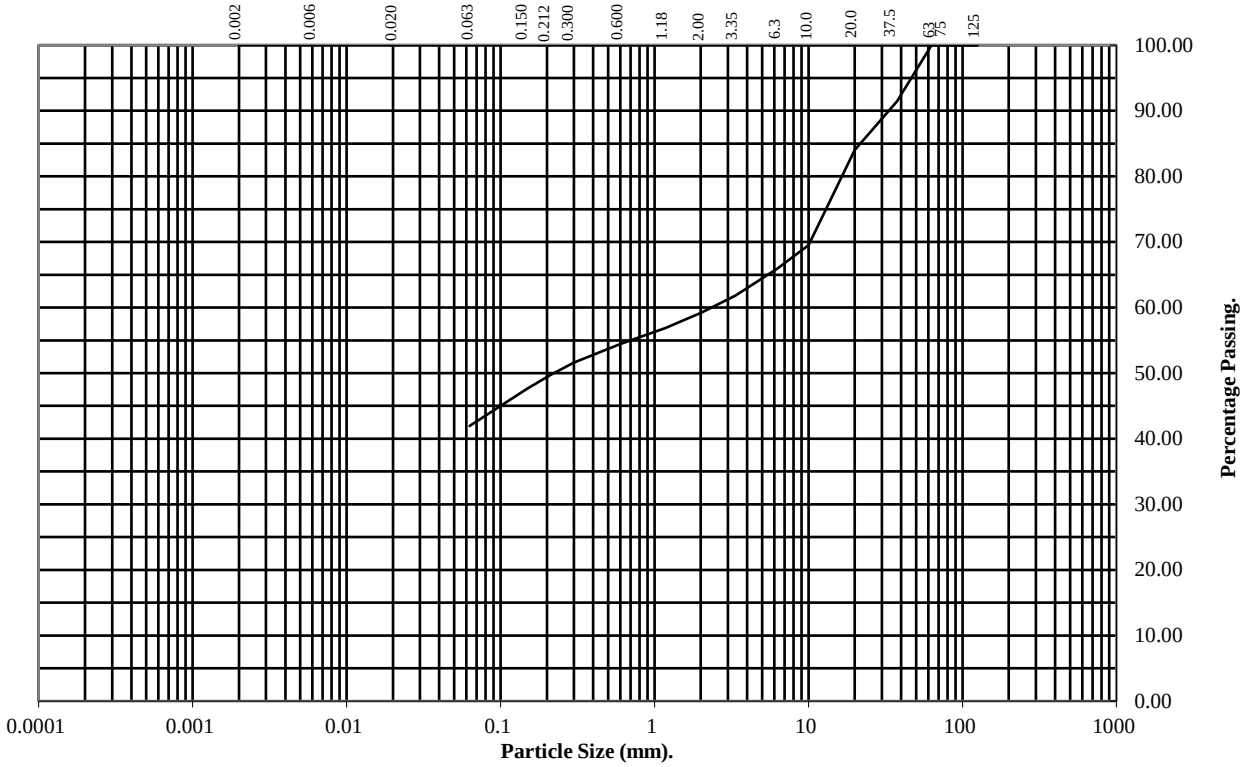
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TT208SE** **Top Depth (m):** **0.90**

Sample Number: **2** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	91
20	84
10	70
6.3	66
3.35	62
2	59
1.18	57
0.6	54
0.3	52
0.212	50
0.15	48
0.063	42

Soil Fraction	Total Percentage
Cobbles	0
Gravel	41
Sand	17
Silt/Clay	42

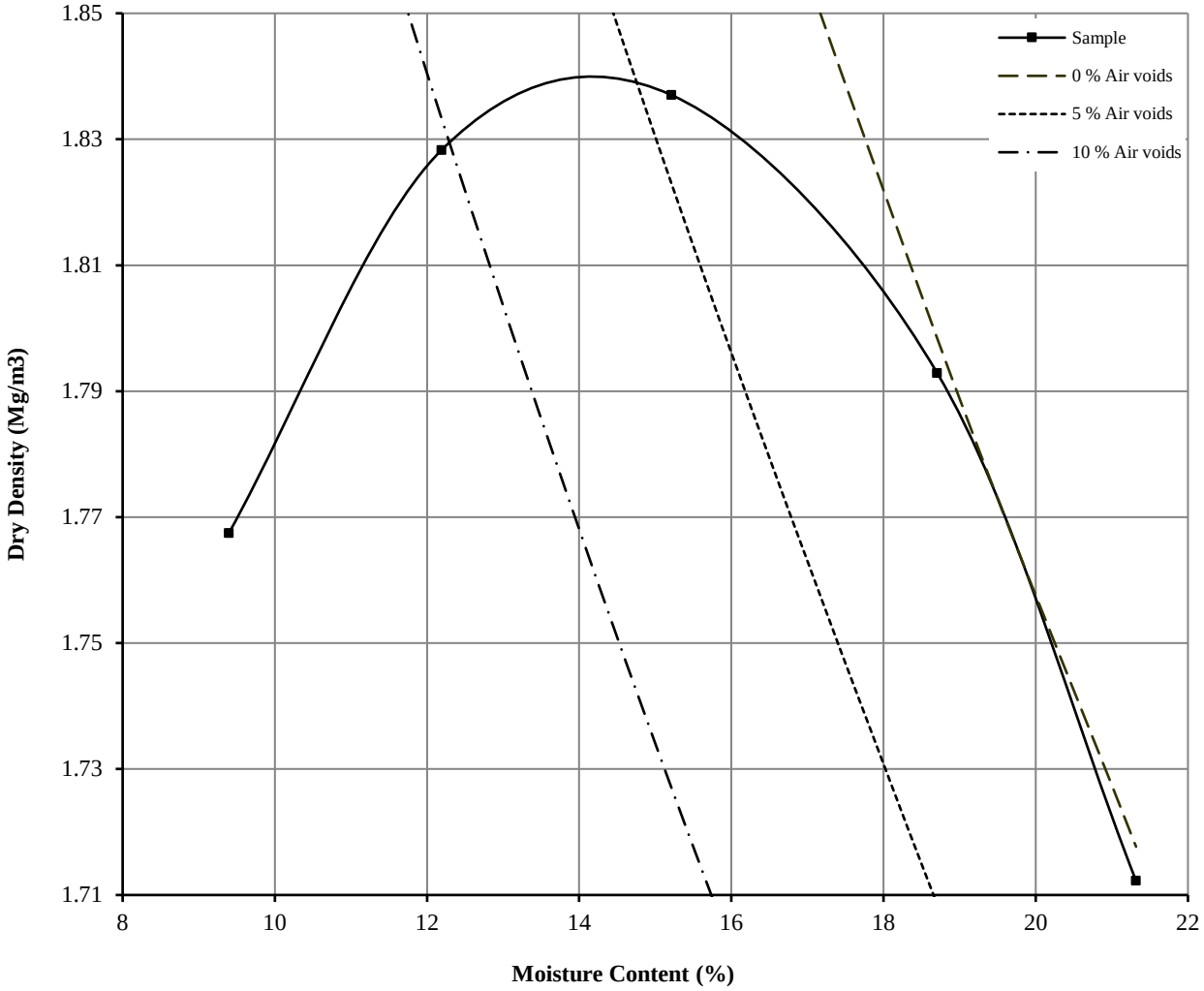
Remarks:

See Summary of Soil Descriptions

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.6 : 1990

Hole Number:	**TP201**	**Top Depth (m) :**	**0.80**
Sample Number:	**2**	**Base Depth (m) :**	
Sample Type:	**D&B**		



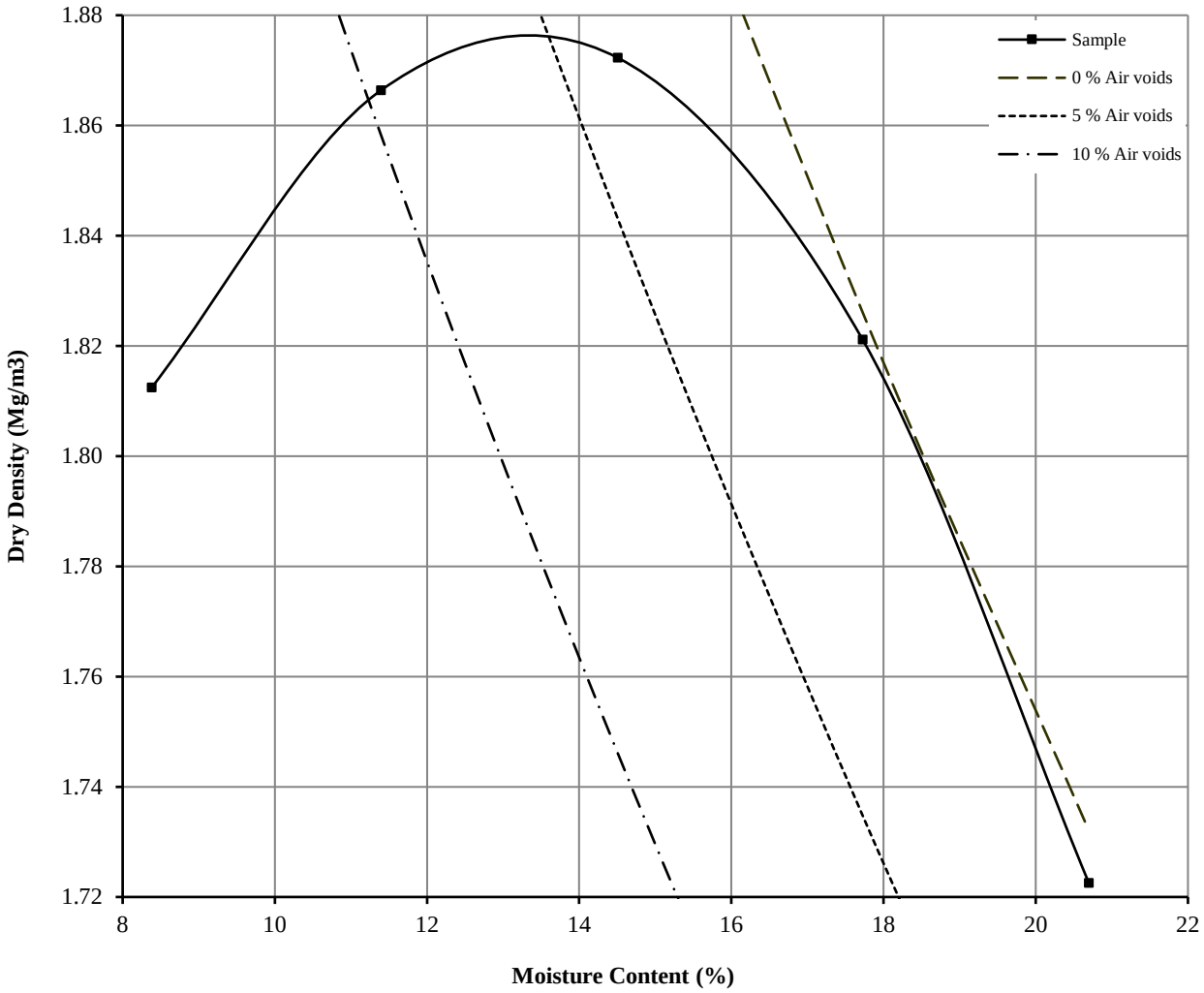
Initial Moisture Content:		19	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.71	Measured	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.84	Material Retained on 20.0 mm Test Sieve (%):		8
Optimum Moisture Content (%):		15			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract** PSL21/9802 **Client Ref** 3407

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

Hole Number:	**TP203**	**Top Depth (m) :**	**2.50**
Sample Number:	**6**	**Base Depth (m) :**	
Sample Type:	**D&B**		



Initial Moisture Content:		18	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.70	Measured	Material Retained on 37.5 mm Test Sieve (%):		17
Maximum Dry Density (Mg/m3):		1.87	Material Retained on 20.0 mm Test Sieve (%):		15
Optimum Moisture Content (%):		15			
Remarks See summary of soil descriptions					

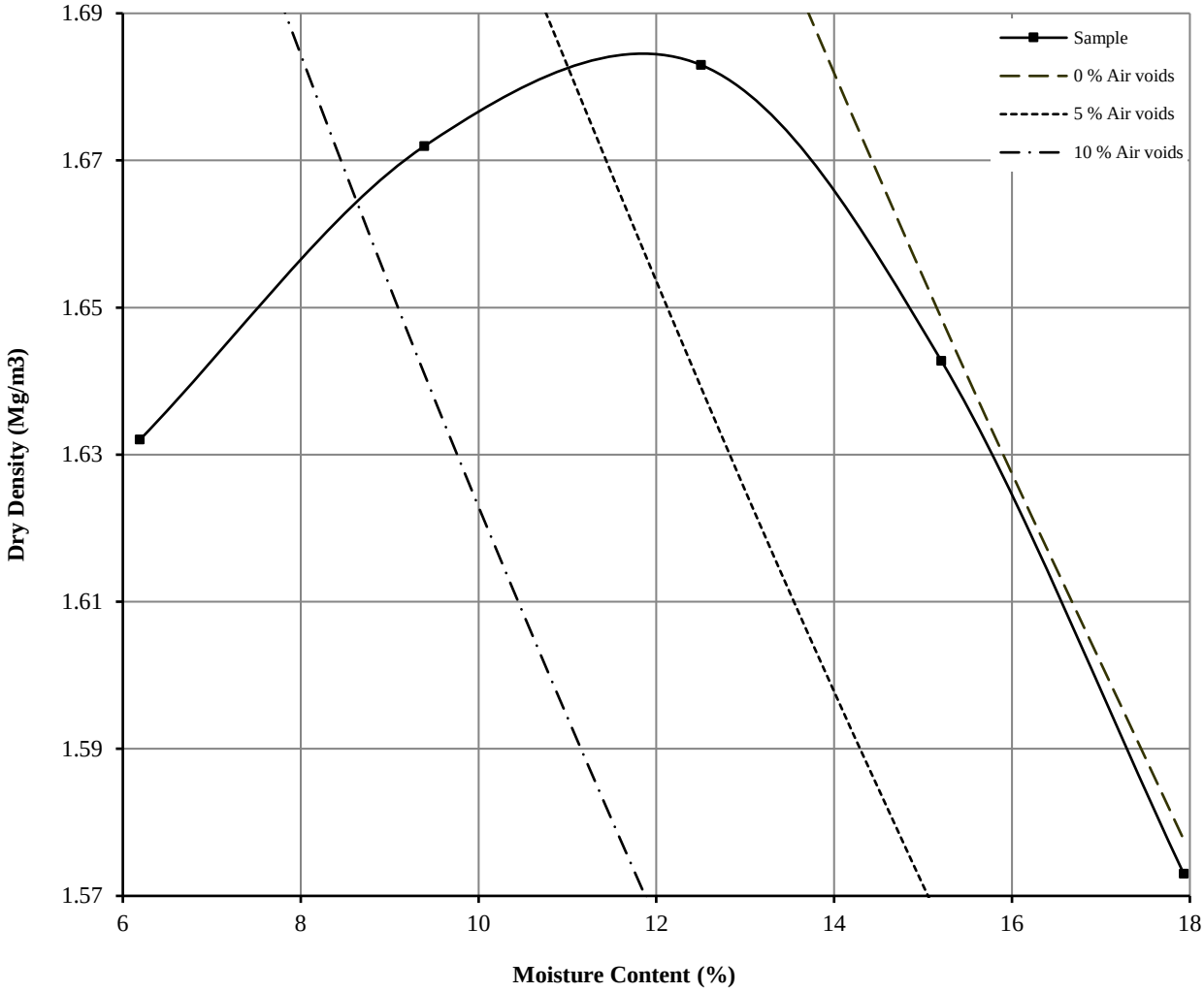
DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.6 : 1990

Hole Number: TP205 **Top Depth (m) :** 1.60

Sample Number: 4 **Base Depth (m) :**

Sample Type: D&B

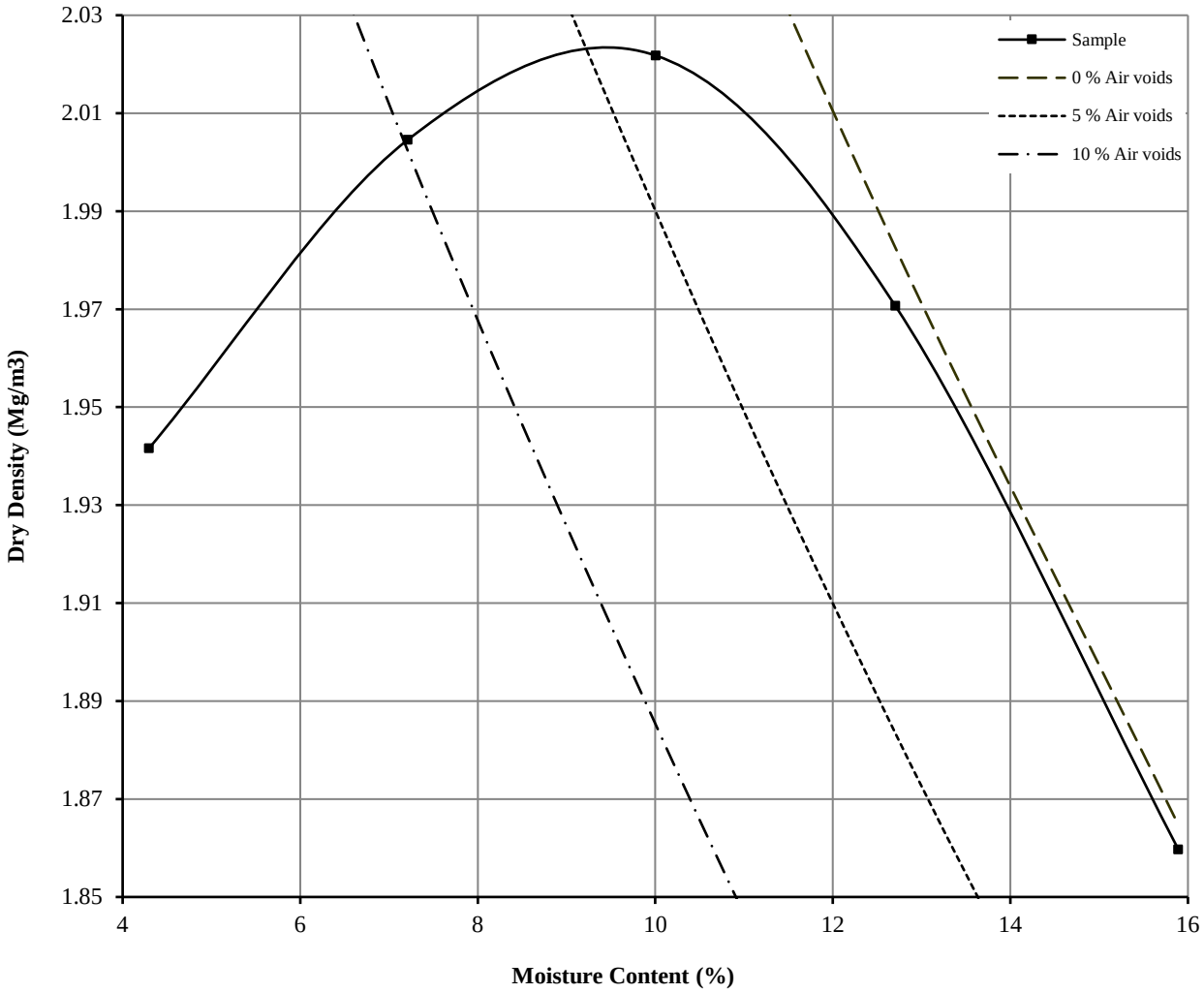


Initial Moisture Content:		9.4	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.20	Measured	Material Retained on 37.5 mm Test Sieve (%):		3
Maximum Dry Density (Mg/m3):		1.68	Material Retained on 20.0 mm Test Sieve (%):		15
Optimum Moisture Content (%):		13			
Remarks See summary of soil descriptions					

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.6 : 1990

Hole Number:	**TP207**	**Top Depth (m) :**	**1.40**
Sample Number:	**3**	**Base Depth (m) :**	
Sample Type:	**D&B**		



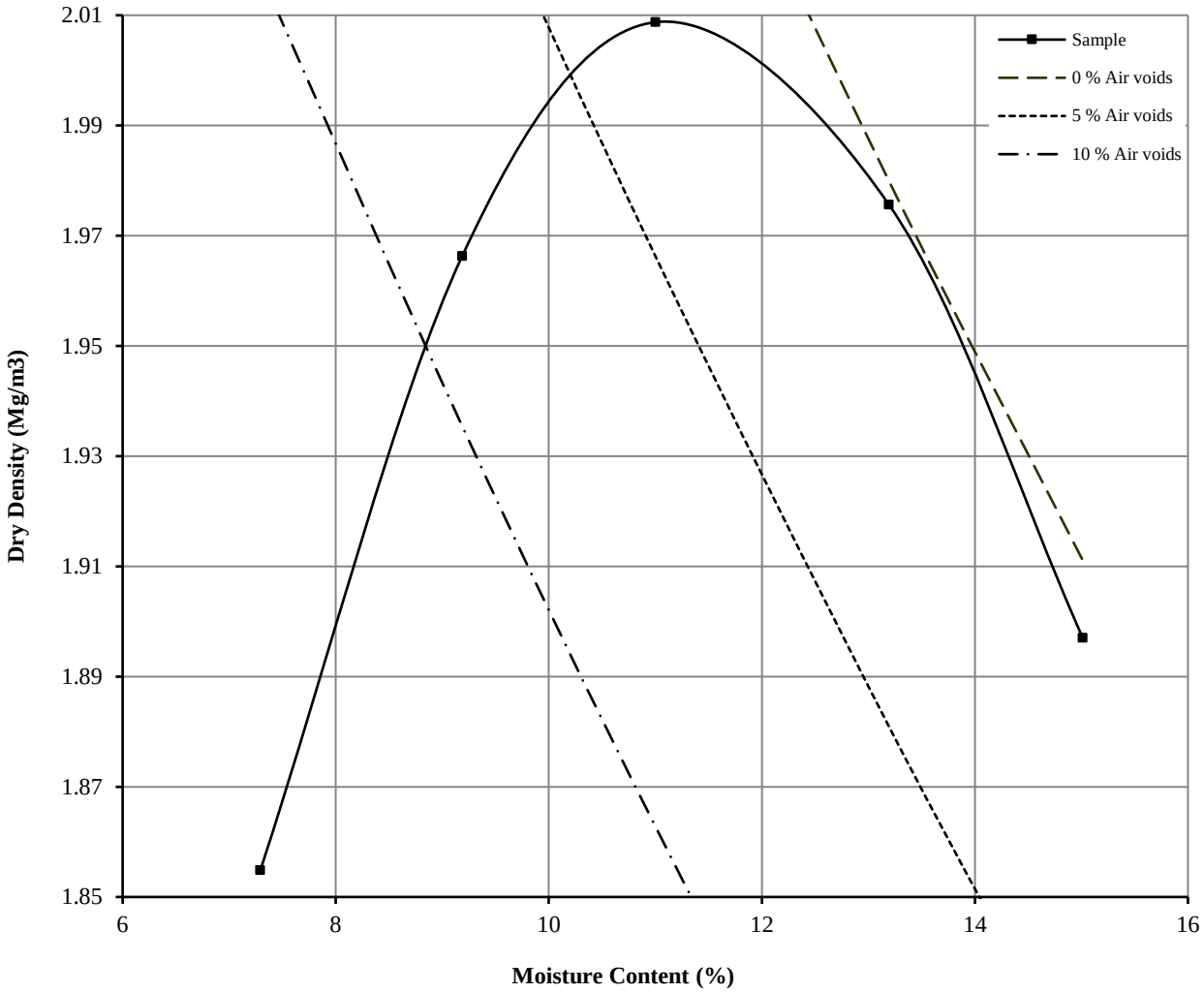
Initial Moisture Content:		13	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.65	Measured	Material Retained on 37.5 mm Test Sieve (%):		9
Maximum Dry Density (Mg/m3):		2.02	Material Retained on 20.0 mm Test Sieve (%):		7
Optimum Moisture Content (%):		10			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract** PSL21/9802 **Client Ref** 3407

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.6 : 1990

Hole Number:	**TP208**	**Top Depth (m) :**	**1.70**
Sample Number:	**4**	**Base Depth (m) :**	
Sample Type:	**D&B**		

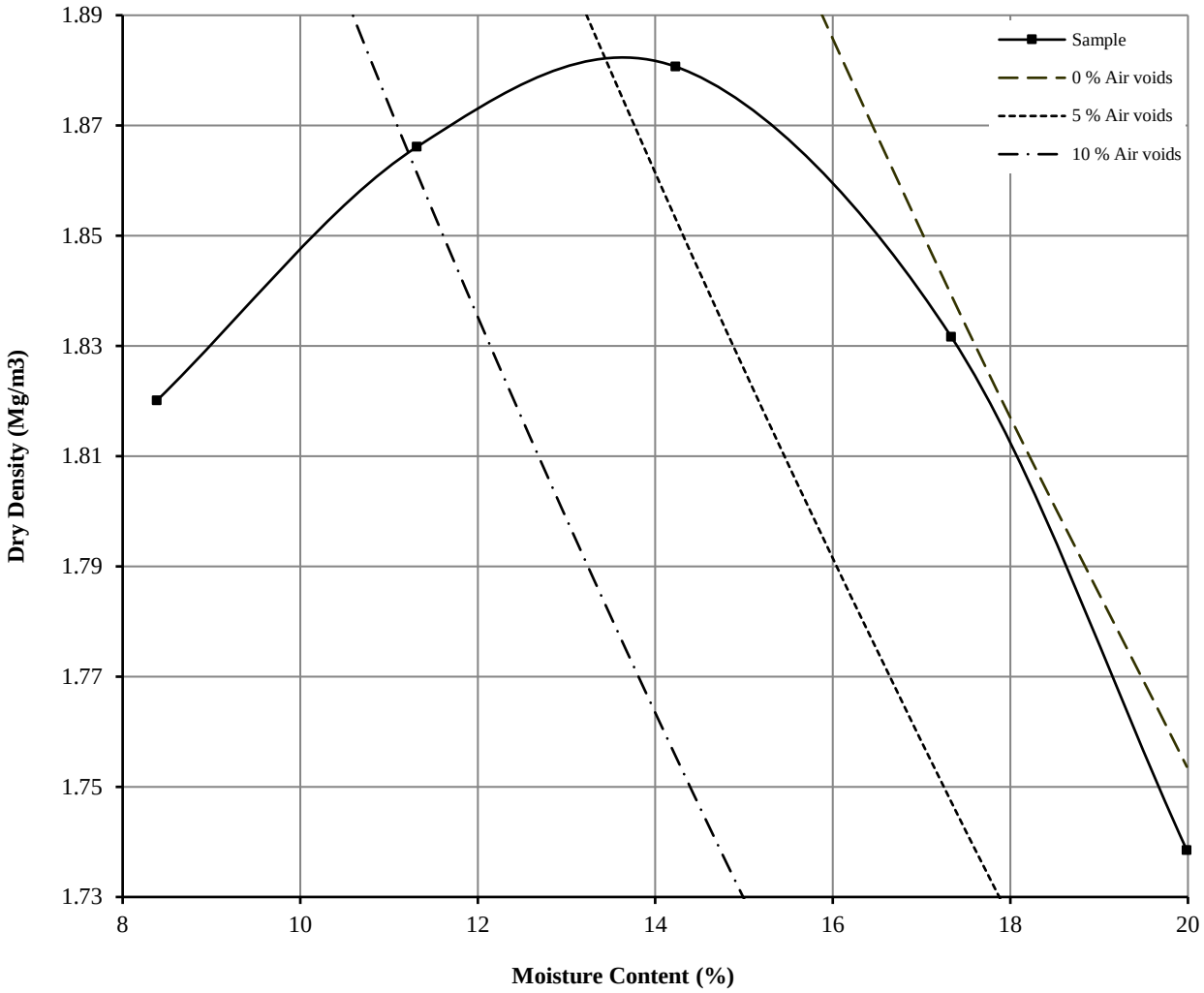


Initial Moisture Content:		15	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.68	Measured	Material Retained on 37.5 mm Test Sieve (%):		6
Maximum Dry Density (Mg/m3):		2.01	Material Retained on 20.0 mm Test Sieve (%):		17
Optimum Moisture Content (%):		11			
Remarks See summary of soil descriptions					

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.5 : 1990

Hole Number:	**TP209**	**Top Depth (m) :**	**1.00**
Sample Number:	**3**	**Base Depth (m) :**	
Sample Type:	**D&B**		



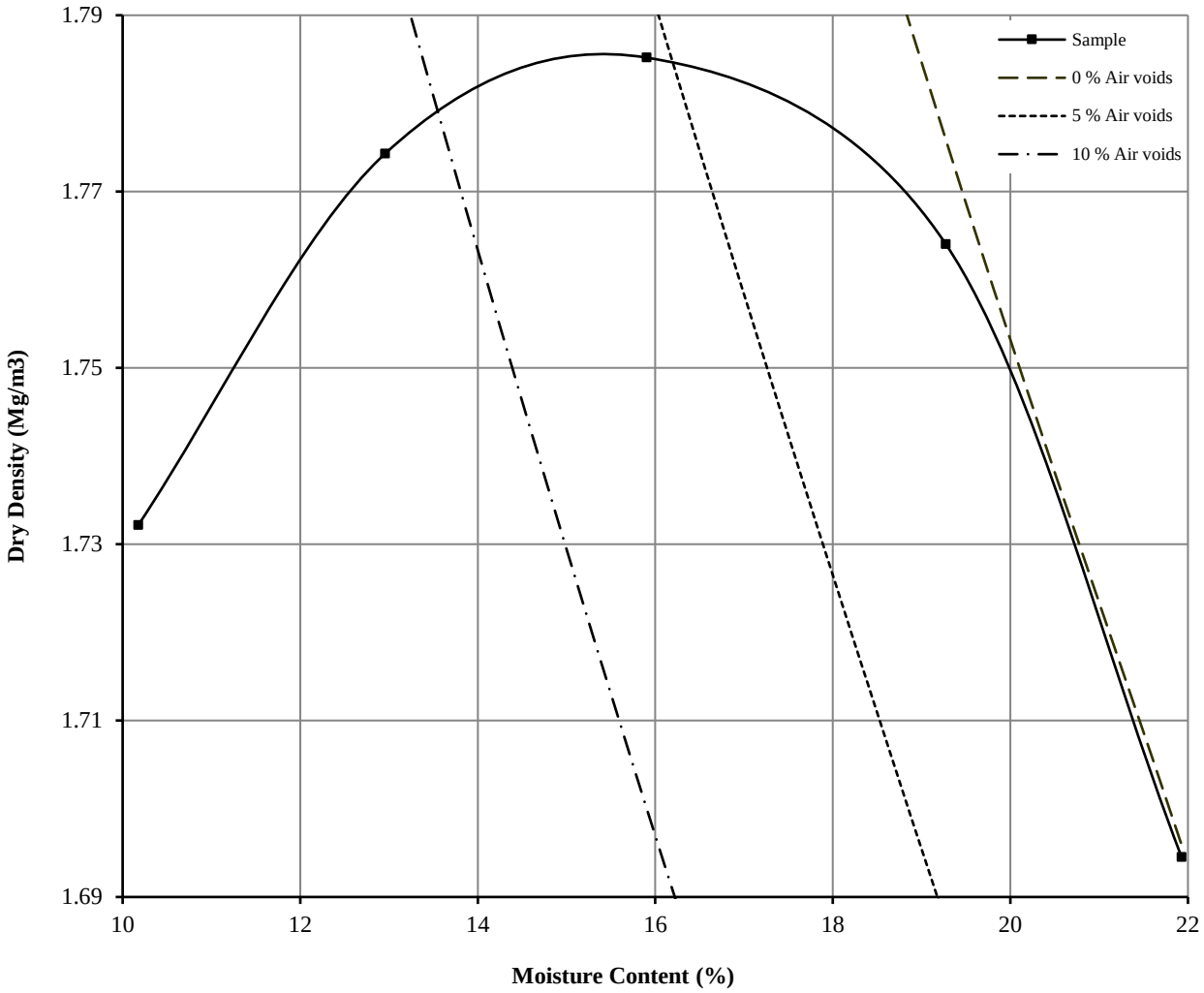
Initial Moisture Content:		17	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.70	Measured	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.88	Material Retained on 20.0 mm Test Sieve (%):		0
Optimum Moisture Content (%):		14			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract** PSL21/9802 **Client Ref** 3407

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.5 : 1990

Hole Number:	**TP212**	**Top Depth (m) :**	**0.80**
Sample Number:	**1**	**Base Depth (m) :**	
Sample Type:	**D&B**		



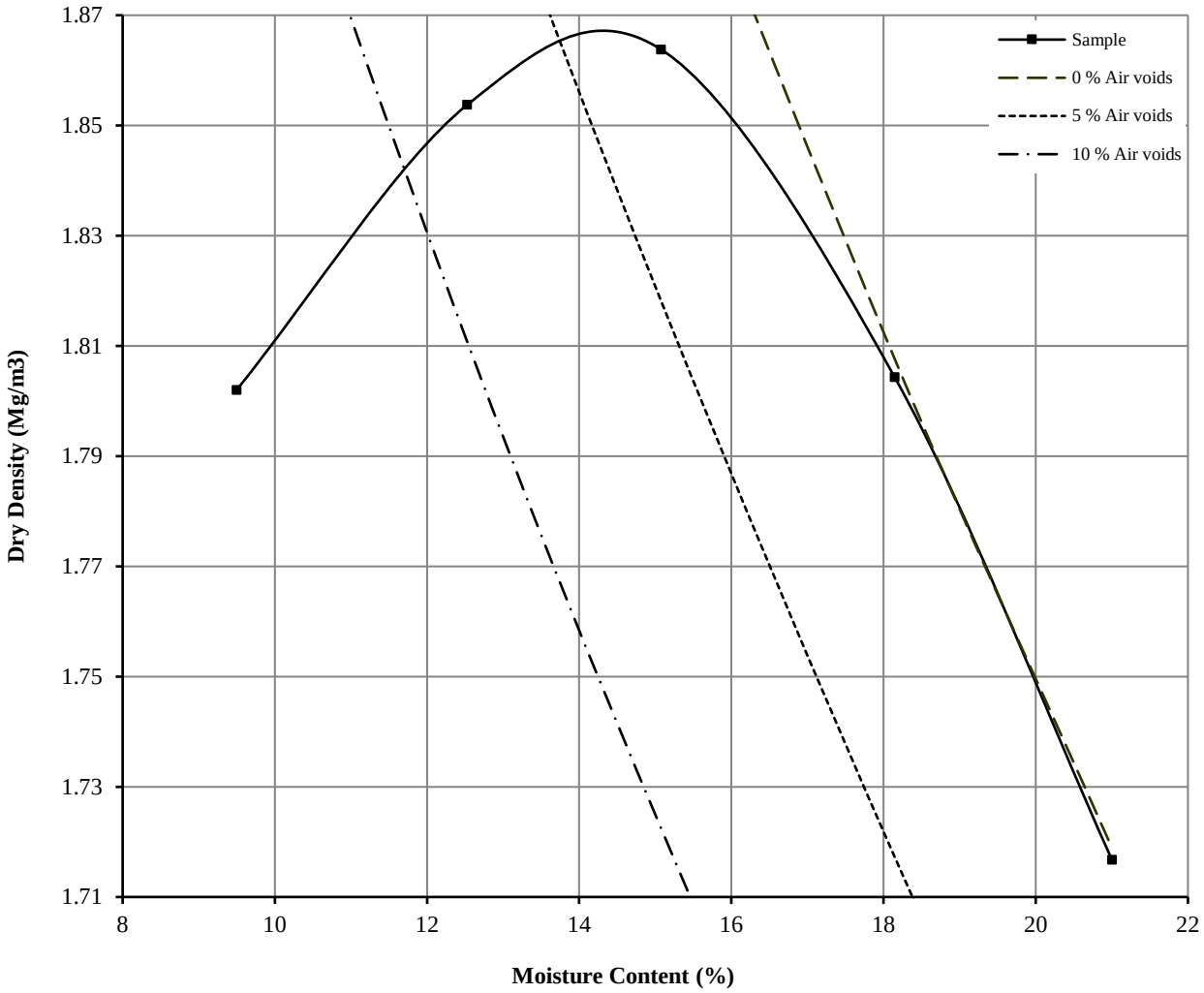
Initial Moisture Content:		19	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.70	Measured	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.79	Material Retained on 20.0 mm Test Sieve (%):		3
Optimum Moisture Content (%):		16			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract** PSL21/9802 **Client Ref** 3407

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

Hole Number:	**TT201SE**	**Top Depth (m) :**	**1.20**
Sample Number:	**2**	**Base Depth (m) :**	
Sample Type:	**D&B**		



Initial Moisture Content:		15	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.69	Measured	Material Retained on 37.5 mm Test Sieve (%):		21
Maximum Dry Density (Mg/m3):		1.86	Material Retained on 20.0 mm Test Sieve (%):		8
Optimum Moisture Content (%):		15			
Remarks See summary of soil descriptions					

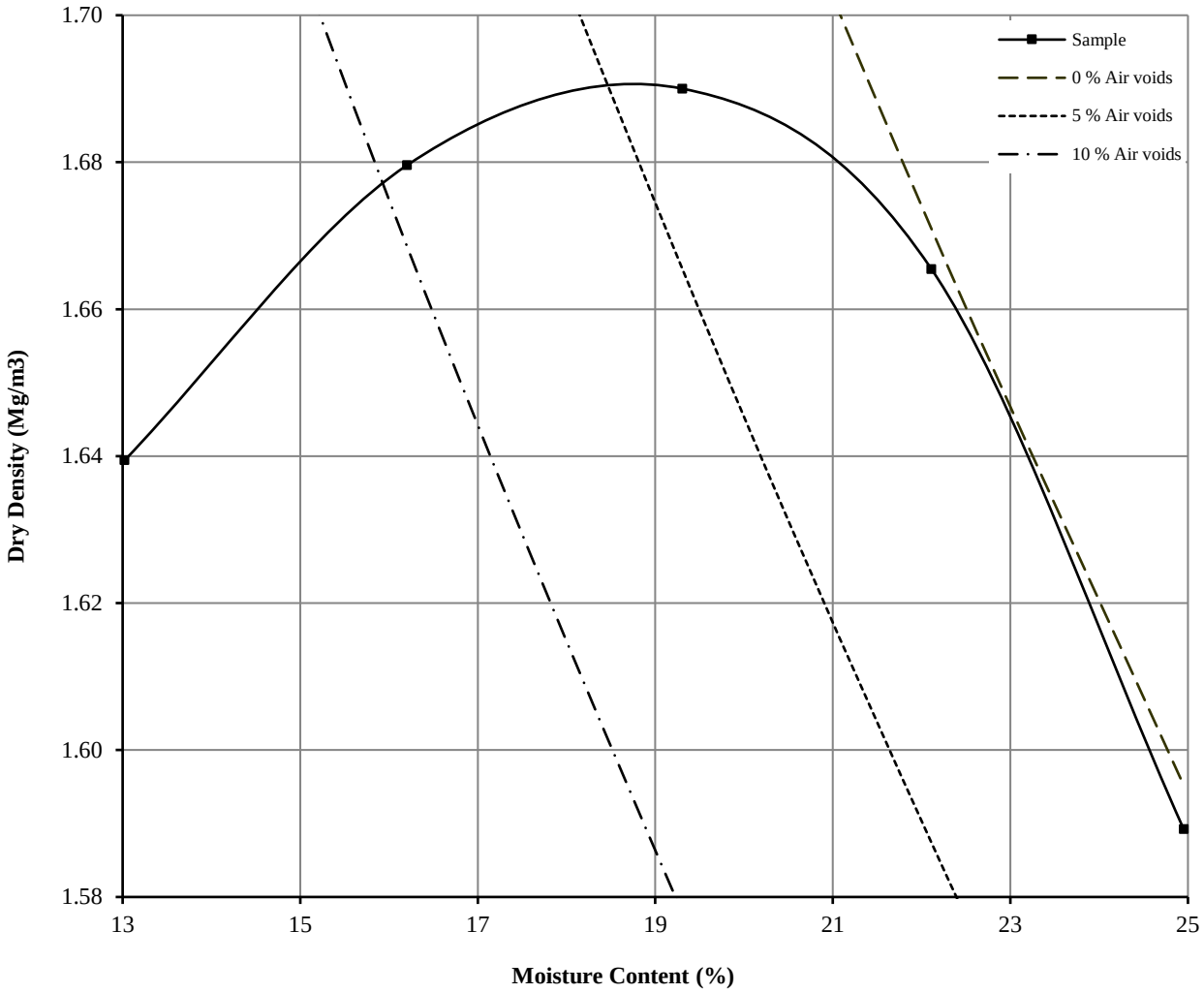
DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.5 : 1990

Hole Number: TT205SE **Top Depth (m) :** 1.00

Sample Number: 2 **Base Depth (m) :**

Sample Type: D&B



Initial Moisture Content:		25	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.65	Measured	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.69	Material Retained on 20.0 mm Test Sieve (%):		0
Optimum Moisture Content (%):		19			
Remarks See summary of soil descriptions					

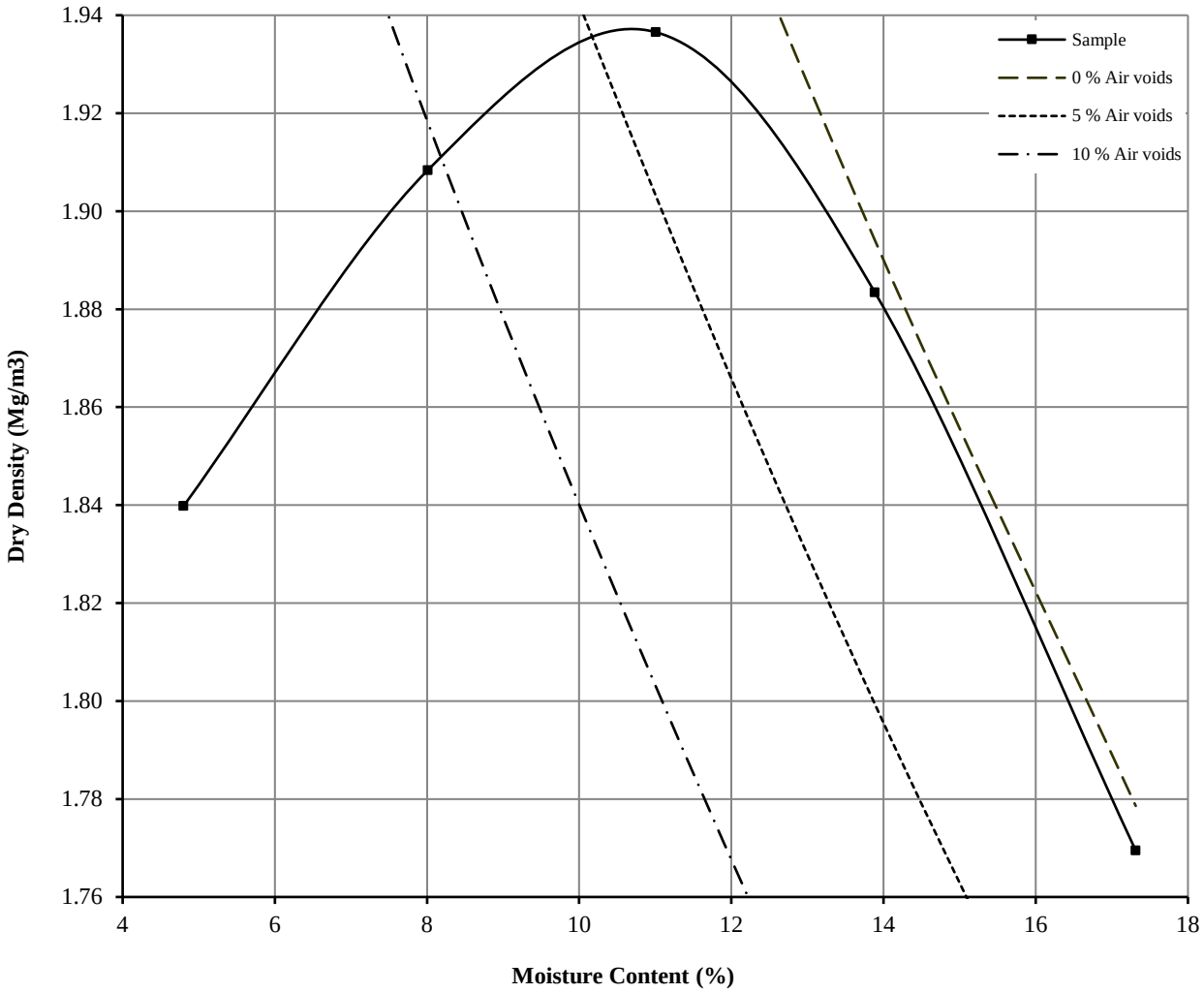
DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.6 : 1990

Hole Number: TT206C **Top Depth (m) :** 0.80

Sample Number: 3 **Base Depth (m) :**

Sample Type: D&B

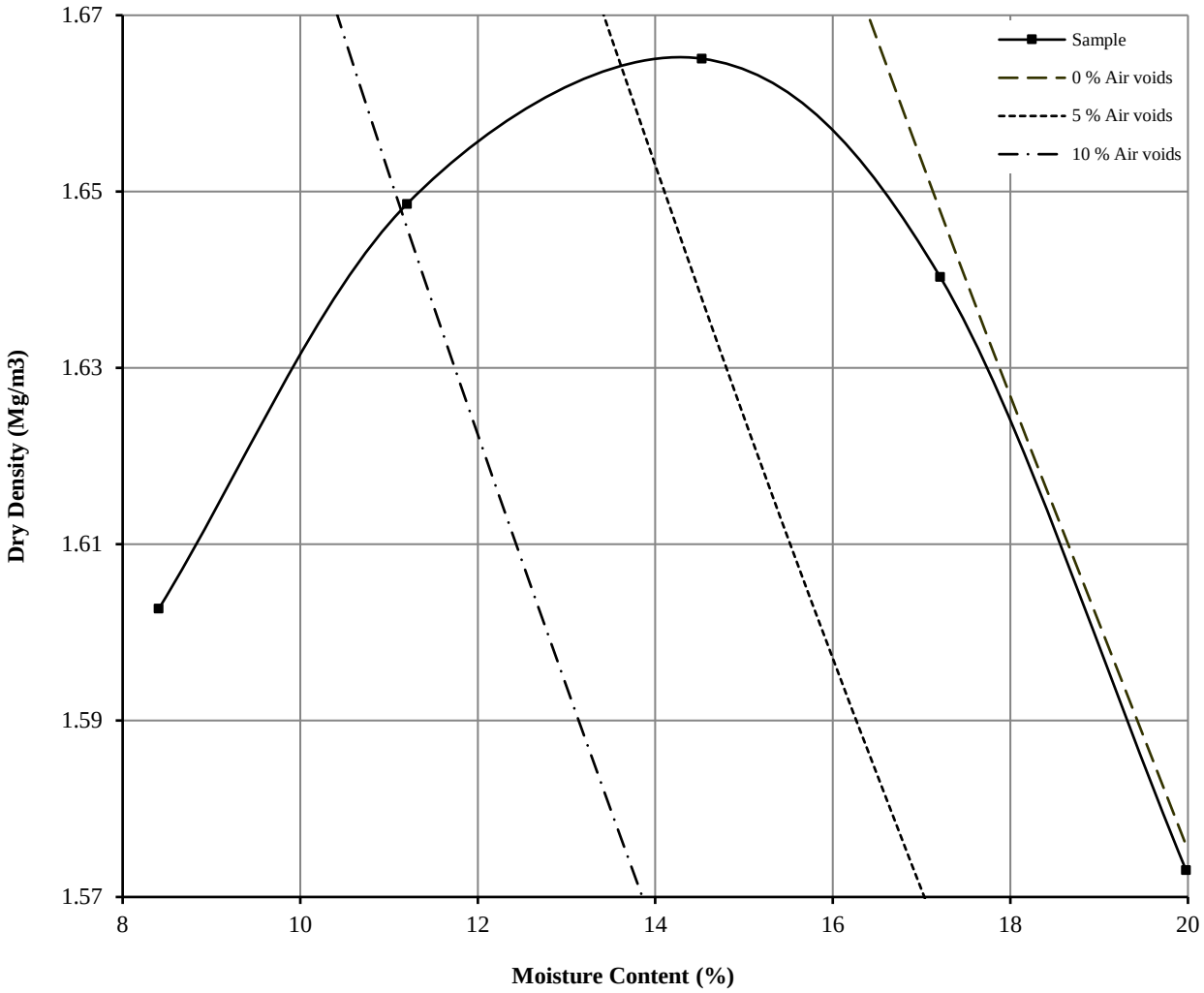


Initial Moisture Content:		14	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.57	Measured	Material Retained on 37.5 mm Test Sieve (%):		6
Maximum Dry Density (Mg/m3):		1.94	Material Retained on 20.0 mm Test Sieve (%):		4
Optimum Moisture Content (%):		11			
Remarks See summary of soil descriptions					

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.6 : 1990

Hole Number:	**TT207NW**	**Top Depth (m) :**	**2.40**
Sample Number:	**3**	**Base Depth (m) :**	
Sample Type:	**D&B**		

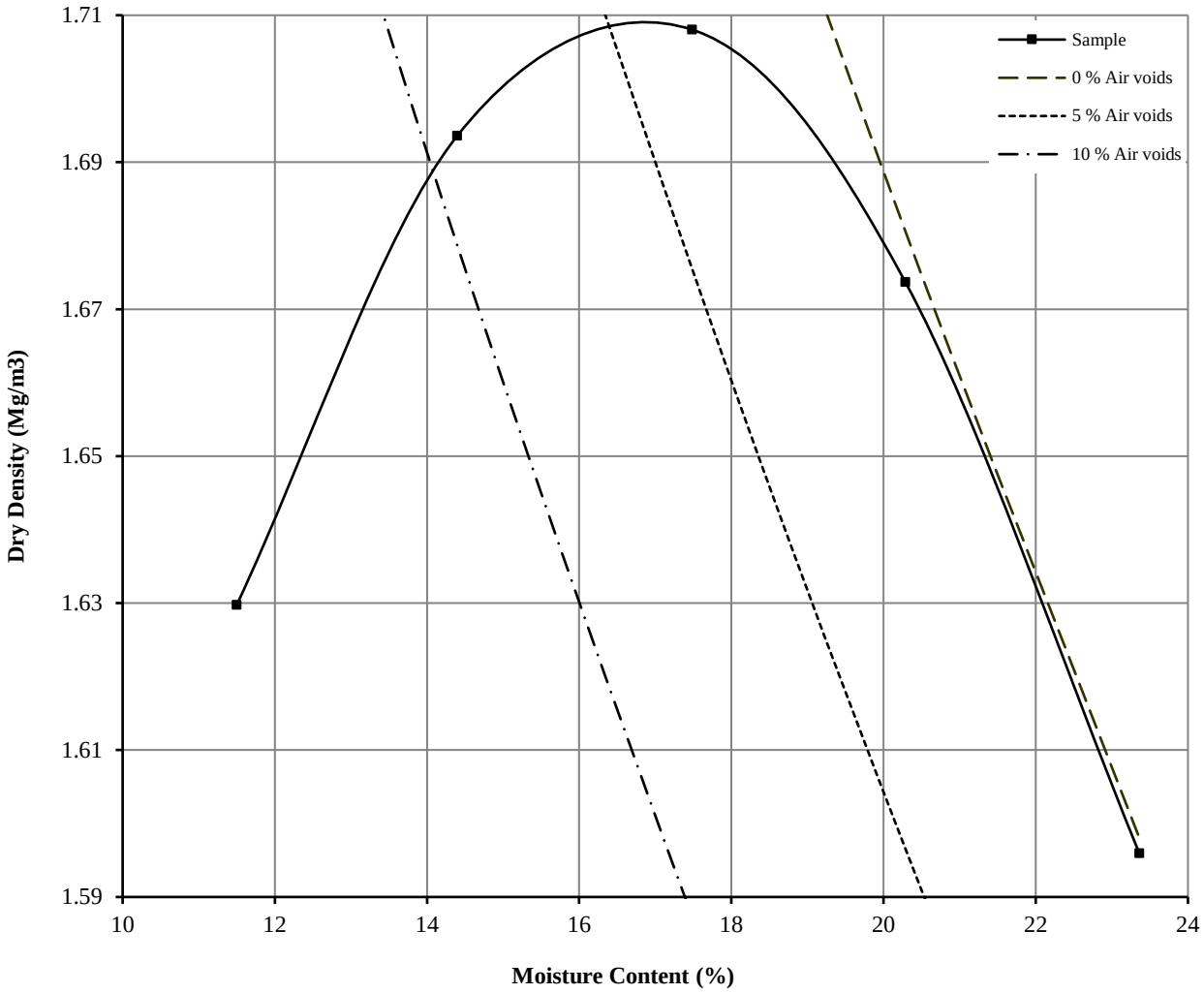


Initial Moisture Content:		15	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.30	Measured	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.67	Material Retained on 20.0 mm Test Sieve (%):		8
Optimum Moisture Content (%):		15			
Remarks See summary of soil descriptions					

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.6 : 1990

Hole Number:	**TT208SE**	**Top Depth (m) :**	**0.90**
Sample Number:	**2**	**Base Depth (m) :**	
Sample Type:	**D&B**		



Initial Moisture Content:		23	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.55	Measured	Material Retained on 37.5 mm Test Sieve (%):		9
Maximum Dry Density (Mg/m3):		1.71	Material Retained on 20.0 mm Test Sieve (%):		7
Optimum Moisture Content (%):		17			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Barugh Green**	**Contract** **PSL21/9802** **Client Ref** **3407**

2531

ANALYTICAL TEST REPORT

Contract no: 104715

Contract name: Barugh Green

Client reference: PSL21/9802

Clients name: Professional Soils Laboratory

Clients address: 5/7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 18 January 2022

Analysis started: 18 January 2022

Analysis completed: 25 January 2022

Report issued: 25 January 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

Approved by:

Rachael Burton

Reporting Team Lead

Chemtech Environmental Limited

SOILS

Lab number			104715-1	104715-2	104715-3	104715-4	104715-5	104715-6
Sample id			BH201	BH201	BH201	BH202	BH203	BH203
Depth (m)			1.00	3.00	6.00	2.00	1.00	4.00
Sample Type			D	D	D	D	D	D
Date sampled			30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Test	**Method**	**Units**						
pH	CE004 U	units	7.0	7.1	7.4	7.2	7.5	7.3
Sulphate (2:1 water soluble)	CE061 U	mg/l SO_4	131	127	133	616	43	103

Chemtech Environmental Limited

SOILS

Lab number			104715-7	104715-8	104715-9	104715-10	104715-11	104715-12
Sample id			BH203	BH204	BH204	BH205	BH205	BH205
Depth (m)			5.00	6.70	8.50	1.00	4.00	8.00
Sample Type			D	D	D	D	B	D
Date sampled			30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Test	**Method**	**Units**						
pH	CE004 U	units	7.5	7.5	7.5	7.4	7.3	7.4
Sulphate (2:1 water soluble)	CE061 U	mg/l SO_4	145	60	60	121	101	119

Chemtech Environmental Limited

SOILS

Lab number			104715-13	104715-14	104715-15	104715-16	104715-17	104715-18
Sample id			BH206	BH206	TP201	TP202	TP203	TP203
Depth (m)			4.00	6.50	0.80	1.00	0.70	1.90
Sample Type			D	D	D&B	D	D&B	D
Date sampled			30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Test	**Method**	**Units**						
pH	CE004 U	units	7.5	7.4	7.5	7.5	7.3	7.2
Sulphate (2:1 water soluble)	CE061 U	mg/l SO_4	19	107	81	94	133	206

Chemtech Environmental Limited

SOILS

Lab number			104715-19	104715-20	104715-21	104715-22	104715-23	104715-24
Sample id			TP203	TP205	TP205	TP206	TP206	TP207
Depth (m)			2.50	1.60	2.80	0.50	1.00	1.40
Sample Type			D&B	D&B	D&B	D	D&B	D&B
Date sampled			30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Test	**Method**	**Units**						
pH	CE004 U	units	7.2	5.3	6.9	7.1	6.9	6.9
Sulphate (2:1 water soluble)	CE061 U	mg/l SO_4	185	646	1005	140	673	558

Chemtech Environmental Limited

SOILS

Lab number			104715-25	104715-26	104715-27	104715-28	104715-29	104715-30
Sample id			TP207	TP208	TP208	TP209	TP210	TP210
Depth (m)			3.90	0.40	1.70	1.00	0.80	1.60
Sample Type			D&B	D&B	D&B	D&B	D	D
Date sampled			30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Test	**Method**	**Units**						
pH	CE004 U	units	7.2	7.3	7.2	7.7	7.6	8.3
Sulphate (2:1 water soluble)	CE061 U	mg/l SO_4	73	86	76	48	75	34

Chemtech Environmental Limited

SOILS

Lab number			104715-31	104715-32	104715-33	104715-34	104715-35	104715-36
Sample id			TP211	TP211	TP212	TP212	TT201SE	TT202N
Depth (m)			0.60	1.50	0.80	2.20	1.20	1.50
Sample Type			D	D	D&B	D	D&B	D
Date sampled			30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Test	**Method**	**Units**						
pH	CE004 [U]	units	8.3	6.7	7.1	7.2	7.4	7.3
Sulphate (2:1 water soluble)	CE061 [U]	mg/l SO_4	14	27	23	48	93	69

Chemtech Environmental Limited

SOILS

Lab number			104715-37	104715-38	104715-39	104715-40	104715-41	104715-42
Sample id			TT202S	TT204N	TT204S	TT205NW	TT205SE	TT206C
Depth (m)			1.40	1.40	1.20	1.80	1.00	0.80
Sample Type			D&B	D	D	D	D&B	D&B
Date sampled			30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Test	**Method**	**Units**						
pH	CE004 U	units	7.3	7.6	7.6	7.4	6.8	7.8
Sulphate (2:1 water soluble)	CE061 U	mg/l SO_4	169	147	66	95	114	55

Chemtech Environmental Limited

SOILS

Lab number			104715-43	104715-44	104715-45
Sample id			TT206SE	TT207NW	TT208SE
Depth (m)			1.00	2.40	0.90
Sample Type			D	D&B	D&B
Date sampled			30/11/2021	30/11/2021	30/11/2021
Test	**Method**	**Units**			
pH	CE004 [U]	units	7.7	7.2	7.7
Sulphate (2:1 water soluble)	CE061 [U]	mg/l SO_4	76	162	71

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE004	pH	Based on BS 1377, pH Meter	As received	U	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	U	10	mg/l SO_4

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)
104715-1	BH201	1.00	Y	All (EHT)
104715-2	BH201	3.00	Y	All (EHT)
104715-3	BH201	6.00	Y	All (EHT)
104715-4	BH202	2.00	Y	All (EHT)
104715-5	BH203	1.00	Y	All (EHT)
104715-6	BH203	4.00	Y	All (EHT)
104715-7	BH203	5.00	Y	All (EHT)
104715-8	BH204	6.70	Y	All (EHT)
104715-9	BH204	8.50	Y	All (EHT)
104715-10	BH205	1.00	Y	All (EHT)
104715-11	BH205	4.00	Y	All (EHT)
104715-12	BH205	8.00	Y	All (EHT)
104715-13	BH206	4.00	Y	All (EHT)
104715-14	BH206	6.50	Y	All (EHT)
104715-15	TP201	0.80	Y	All (EHT)
104715-16	TP202	1.00	Y	All (EHT)
104715-17	TP203	0.70	Y	All (EHT)
104715-18	TP203	1.90	Y	All (EHT)
104715-19	TP203	2.50	Y	All (EHT)
104715-20	TP205	1.60	Y	All (EHT)
104715-21	TP205	2.80	Y	All (EHT)
104715-22	TP206	0.50	Y	All (EHT)
104715-23	TP206	1.00	Y	All (EHT)
104715-24	TP207	1.40	Y	All (EHT)
104715-25	TP207	3.90	Y	All (EHT)
104715-26	TP208	0.40	Y	All (EHT)
104715-27	TP208	1.70	Y	All (EHT)
104715-28	TP209	1.00	Y	All (EHT)
104715-29	TP210	0.80	Y	All (EHT)
104715-30	TP210	1.60	Y	All (EHT)

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)
104715-31	TP211	0.60	Y	All (EHT)
104715-32	TP211	1.50	Y	All (EHT)
104715-33	TP212	0.80	Y	All (EHT)
104715-34	TP212	2.20	Y	All (EHT)
104715-35	TT201SE	1.20	Y	All (EHT)
104715-36	TT202N	1.50	Y	All (EHT)
104715-37	TT202S	1.40	Y	All (EHT)
104715-38	TT204N	1.40	Y	All (EHT)
104715-39	TT204S	1.20	Y	All (EHT)
104715-40	TT205NW	1.80	Y	All (EHT)
104715-41	TT205SE	1.00	Y	All (EHT)
104715-42	TT206C	0.80	Y	All (EHT)
104715-43	TT206SE	1.00	Y	All (EHT)
104715-44	TT207NW	2.40	Y	All (EHT)
104715-45	TT208SE	0.90	Y	All (EHT)

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 6 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.

LABORATORY REPORT

4043

Contract Number: PSL22/0875

Report Date: 21 February 2022

Client's Reference: 3407

Client Name: Lithos Consulting

For the attention of: Lewis Whiteley

Contract Title: Barugh Green

Date Received: 3/2/2022
Date Commenced: 3/2/2022
Date Completed: 21/2/2022

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:

A Watkins (Director)
R Berriman (Quality Manager)
S Royle (Laboratory Manager)
L Knight (Assistant Laboratory Manager)
S Eyre (Senior Technician)
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SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimensions (mm)		Area	D_e^2	D_e	Failure Load (P)		I_s	Corr Fac	I_{s50}	Failure Type	Remarks
				Par / Perp	W	D	(mm2)		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)		
RC201	11.40	1	A	Perp	86	42	3612	4598.94	67.82	-	6.08	1.32	1.147	1.52	Valid	
RC201	13.20	4	A	Perp	86	29	2494	3175.46	56.35	-	0.71	0.22	1.055	0.24	Valid	
RC201	14.80	6	A	Perp	86	38	3268	4160.95	64.51	-	1.43	0.34	1.121	0.39	Valid	
RC201	15.50	7	A	Perp	86	36	3096	3941.95	62.78	-	4.72	1.20	1.108	1.33	Valid	
RC201	16.50	10	A	Perp	86	38	3268	4160.95	64.51	-	3.18	0.76	1.121	0.86	Valid	
RC202	11.60	1	A	Perp	86	37	3182	4051.45	63.65	-	2.10	0.52	1.115	0.58	Valid	
RC202	12.40	3	A	Perp	86	41	3526	4489.44	67.00	-	13.55	3.02	1.141	3.44	Valid	
RC202	13.40	6	A	Perp	86	43	3698	4708.44	68.62	-	3.11	0.66	1.153	0.76	Valid	
RC202	13.90	8	A	Perp	86	40	3440	4379.94	66.18	-	0.96	0.22	1.134	0.25	Valid	
RC202	16.20	11	A	Perp	86	41	3526	4489.44	67.00	-	2.01	0.45	1.141	0.51	Valid	
RC203	9.80	1	A	Perp	86	34	2924	3722.95	61.02	-	1.21	0.33	1.094	0.36	Valid	
RC203	10.40	3	A	Perp	86	40	3440	4379.94	66.18	-	1.66	0.38	1.134	0.43	Valid	
RC203	12.70	7	A	Perp	86	39	3354	4270.45	65.35	-	0.75	0.18	1.128	0.20	Valid	
RC203	13.00	8	A	Perp	86	32	2752	3503.96	59.19	-	1.15	0.33	1.079	0.35	Valid	
RC203	13.40	9	A	Perp	86	42	3612	4598.94	67.82	-	10.07	2.19	1.147	2.51	Valid	

Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular

UKAS TESTING 4043

PSL Professional Soils Laboratory

Barugh Green

Contract No:

PSL22/0875

Client Ref:

3407

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimensions (mm)		D_e^2	D_e	Failure Load		I_s	Corr Fac	I_{s50}	Failure Type	Remarks
				Par / Perp	L	D		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)		
RC201	11.40	1	D	Par	-	86	7396	86.00	-	4.79	0.648	1.276	0.83	Valid	
RC201	13.20	4	D	Par	-	86	7396	86.00	-	0.42	0.057	1.276	0.07	Valid	
RC201	15.50	7	D	Par	-	86	7396	86.00	-	5.03	0.680	1.276	0.87	Valid	
RC201	16.50	10	D	Par	-	86	7396	86.00	-	2.69	0.364	1.276	0.46	Valid	
RC202	11.60	1	D	Par	-	86	7396	86.00	-	1.65	0.223	1.276	0.28	Valid	
RC202	12.40	3	D	Par	-	86	7396	86.00	-	12.81	1.732	1.276	2.21	Valid	
RC202	13.40	6	D	Par	-	86	7396	86.00	-	0.74	0.100	1.276	0.13	Valid	
RC202	13.90	8	D	Par	-	86	7396	86.00	-	0.28	0.038	1.276	0.05	Valid	
RC202	16.20	11	D	Par	-	86	7396	86.00	-	1.27	0.172	1.276	0.22	Valid	
RC203	9.80	1	D	Par	-	86	7396	86.00	-	0.57	0.077	1.276	0.10	Valid	
RC203	10.40	3	D	Par	-	86	7396	86.00	-	0.83	0.112	1.276	0.14	Valid	
RC203	12.70	7	D	Par	-	86	7396	86.00	-	0.33	0.045	1.276	0.06	Valid	
RC203	13.00	8	D	Par	-	86	7396	86.00	-	1.08	0.146	1.276	0.19	Valid	
RC203	13.40	9	D	Par	-	86	7396	86.00	-	8.25	1.115	1.276	1.42	Valid	

Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

UKAS TESTING 4043

PSL Professional Soils Laboratory

Barugh Green

Contract No:

PSL22/0875

Client Ref:

3407

DETERMINATION OF UNCONFINED COMPRESSIVE STRENGTH

ISRM Suggested Methods, pp 111 –116, 1981.

Hole Number	Sample Number	Sample Type	Top Depth (m)	Base Depth (m)	Sample Diameter (mm)	Sample Length (mm)	Height Ratio	Initial Mass (g)	Bulk Density (Mg/m)	Moisture Content (%)	Dry Density (Mg/m)	Load Failure (kN)	UCS (MPa)	Failure Mode	Date Tested	Remarks
RC201	2	UCS	11.50		86	165	1.9	2448	2.55	3.4	2.47	127.0	21.9	Brittle	18/02/22	
RC201	8	UCS	15.80		86	163	1.9	2429	2.57	3.3	2.48	129.1	22.2	Brittle	18/02/22	
RC202	7	UCS	13.60		86	165	1.9	2453	2.56	2.5	2.50	133.2	22.9	Brittle	18/02/22	
RC203	2	UCS	10.00		86	160	1.9	2392	2.57	3.0	2.50	116.4	20.0	Brittle	18/02/22	
RC203	10	UCS	13.90		86	149	1.7	2295	2.65	2.5	2.59	108.6	18.7	Brittle	18/02/22	

Professional Soils Laboratory

Barugh Green

Contract No:

PSL22/0875

Client Ref:

3407

Appendix N

Gas Monitoring Results

Prelim Visit											
Job Title:										**Job No:**	
Barugh Green										**3407**	
Client:										**Sheet :**	
Countryside Properties PLC										1 of 1	
Date:		**Arrival Time:**		**Depart Time:**		**Operator:**					
02/12/2021						Cameron Daniel					

Gas Monitoring Results:

Ambient Concentration (% Volume):	**CH_4:**	ND	**CO_2:**	ND	**O_2:**	20.4

Monitoring Point	**Groundwater level**	**Concentrations**					**Gas Flow Rates**			**Bottom of well**	**Remarks**
		Initial / Highest		**Steady concentrations**		**Lowest concn**	**Initial / Maximum**	**Steady**	**Time to fall from highest to steady**		
		CH_4	**CO_2**	**CH_4**	**CO_2**	**O_2**					
	(m) bgl	**% v/v**	**(%)**	**% v/v**	**(%)**	**(%)**	**litre/hr**	**litre/hr**	**secs**	**m**	
PH102	1.44	ND	3.0	ND	3.0	**12.6**	81.3	1.5	180.0	5.58	Flow fluctuating 1.2 to 1.5.
PH105	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Top hat slightly loose. Lid won't open.
PH106	0.72	ND	0.8	ND	0.8	**13.8**	-68.9	-4.9	180.0	5.26	Flow rising towards 0 gradually.
PH107	2.76	ND	4.1	ND	4.1	**12.5**	-38.0	-0.2	60.0	5.62	
PH110	3.79	ND	0.2	ND	0.1	20.0	ND	ND	ND	5.58	Bung not tight on arrival. Replaced and monitored.
PH115	1.94	ND	ND	ND	ND	20.1	29.0	ND	40.0	5.28	Bung not tight on arrival. Replaced and monitored.
PH121	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Well flooded. Lid missing bolt. Bung stuck.

Equipment Used:	**Next Calibration Date**
Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	22/02/2021

Key	
ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

	Site Data:			**Weather Station Data (***Station)**							**CH_4**	**CO_2**	**O_2**
	Temp (°C):			**Barometric Pressure Trend:**									
Time:	08:50	10:03	10:25								Trigger level 1	1.0	5.0	16.0
Pressure (mb):	998	1000	1001								Trigger level 2	5.0	10.0	10.0
	Weather Conditions:		Sunny / Gentle Breeze											
	Surface Ground Conditions:		Damp											

Remarks:

Visit 1											
Job Title:										**Job No:**	
Barugh Green, Barnsley										**3407**	
Client:										**Sheet :**	
Countryside Properties PLC										1 of 2	
Date:	**Arrival Time:**		**Depart Time:**		**Operator:**						
15/03/2022	08:00		12:20		Cameron Daniel						

Gas Monitoring Results:

Ambient Concentration (% Volume):	**CH_4:**	ND	**CO_2:**	ND	**O_2:**	20.6

Monitoring Point	**Groundwater level**	**Concentrations**					**Gas Flow Rates**			**Bottom of well**	**Remarks**
		Initial / Highest		**Steady concentrations**		**Lowest concn**	**Initial / Maximum**	**Steady**	**Time to fall from highest to steady**		
		CH_4	**CO_2**	**CH_4**	**CO_2**	**O_2**					
	(m) bgl	**% v/v**	**(%)**	**% v/v**	**(%)**	**(%)**	**litre/hr**	**litre/hr**	**secs**	**m**	
BH201	5.11	ND	2.6	ND	2.6	18.9	ND	ND	ND	7.47	
BH202	3.93	ND	3.3	ND	3.3	17.2	ND	ND	ND	4.86	
BH203	2.42	ND	1.7	ND	1.7	20.3	ND	ND	ND	9.04	
BH204	1.65	-	-	-	-	-	-	-	-	9.26	
BH205	-0.19	-	-	-	-	-	-	-	-	9.91	
BH206	ND	-	-	-	-	-	-	-	-	9.02	
BH207	1.14	ND	**7.9**	ND	**7.9**	**15.2**	7.1	ND	30.0	3.92	Bailed 10:50 - 10:54 to 3.43 m (12 L). Remonitored 11:37.
PH102	1.20	ND	1.7	ND	1.7	19.1	15.2	ND	30.0	5.61	Bailed 10:30 - 10:38 to 5.15 m (20 L). Remonitored 11:16.
PH105	-0.14	-	-	-	-	-	-	-	-	5.31	
PH107	2.51	-	-	-	-	-	-	-	-	5.68	Well flooded. Bung briefly removed before monitoring. Bailed 10:02 - 10:06 to 3.68 m (7 L). Remonitored 11:30.
PH108	0.80	-	-	-	-	-	-	-	-	5.23	
PH108 (Piezo)	ND	ND	1.2	ND	1.2	19.4	ND	ND	ND	0.89	
PH110	3.80	ND	**6.8**	ND	**6.8**	**15.6**	ND	ND	ND	5.62	
PH115	1.56	ND	0.8	ND	0.8	20.5	4.0	ND	15.0	4.77	Bailed 11:06 - 11:09 to 4.57 m (8 L). Remonitored 11:42.
PH122	2.57	-	-	-	-	-	-	-	-	5.73	
PH122 (Piezo)	ND	ND	0.4	ND	0.4	20.6	1.6	ND	15.0	0.88	

Equipment Used:	**Next Calibration Date**
Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	08/03/2023

Key

ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

	Site Data:			**Weather Station Data (sid - IBARNS27 Station)**							**CH_4**	**CO_2**	**O_2**
	Temp (°C):	9 to 12		**Barometric Pressure Trend:**			Falling						
Time:	09:35	11:15	12:10	00:04	05:59	09:34	11:14	12:09	13:59	Trigger level 1	1.0	5.0	16.0
Pressure (mb):	1012	1010	1009	1013	1011	1010	1009	1009	1008	Trigger level 2	5.0	10.0	10.0
	Weather Conditions:		Light cloud/ Gentle breeze										
	Surface Ground Conditions:		Wet - Damp										

Remarks: Piezo pipies installed next to PH108 and PH122.