

A photograph of a stream flowing over rocks, with green foliage on the banks. The text "Geoenvironmental Appraisal" is overlaid in white.

Geoenvironmental Appraisal

Land at Smithy Wood Lane, Dodworth For The Wentworth Trustees & Avant Homes Yorkshire

Report no : 1979/2B

Date : April 2021



SUMMARY OF GEO ENVIRONMENTAL ISSUES

Job No.	1979	Site area/ha	5.6
Client:	The Wentworth Trustees & Avant Homes Yorkshire	NGR	SE 322 043
Site:	Smithy Wood Lane, Dodworth	Nearest postcode:	S75 3QW

The site is located off Smithy Wood Lane, approximately 2km south west of Barnsley, and currently comprises two parcels of agricultural land of approximately 1.0 hectare and 4.4 hectares west and east of Smithy Wood Lane respectively. The site appears to have remained largely undeveloped throughout its history with the exception of an infilled reservoir in the south west of the western parcel.

Lithos were commissioned by Wentworth & Avant to provide a geoenvironmental appraisal of the site, which it is understood is to be redeveloped with traditional 2-storey domestic dwellings. Lithos' investigation included a review of the site's history and environmental setting, and a ground investigation comprising 50 trial pits, 3 trial trenches and 56 rotary open-hole probe holes.

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

Issue	Remarks
Made ground	Made Ground was only encountered within the vicinity of a former reservoir (from surface to 0.7m in TP04) and locally elsewhere. Encountered as a gravelly clay with brick and occasional small pieces of wood (Made Ground Topsoil).
Natural ground	Topsoil (typically 300mm thick) was encountered in all trial pits (apart from TP04) as a gravelly clay. Underlying natural strata comprised Cohesive Residual Soils (typically a firm/stiff gravelly Clay) to depths of between 0.7m and 3.0m over Granular Residual Soils (clayey and sandy Gravel) to a maximum depth of 3.0m. Middle Coal Measures bedrock (Sandstone, Siltstone & Mudstone) was encountered from depths of between 0.1m and 2.9m. Coal, associated with the Lidgett, Haigh Moor and Swallow Wood seams was encountered as clayey Gravel and Gravel in 10 of 18 trial pits in the eastern parcel and 1 of 8 trial pits in the western parcel.
Contamination	Testing suggests that the topsoil is chemically suitable for re-use.
Mining & quarrying	Site lies in a High Risk Area. Mine workings have been identified in the Flockton Thick seam in the north, but should be at sufficient depth not to pose a risk to surface stability. No evidence of mine workings have been identified in any other seams at shallow depth. A geophysical survey with subsequent targeted trial pitting has not identified any unrecorded shafts/bell pits.
Hazardous gas	The site is in an area where 3% to 5% of homes are estimated to be above the radon action level, and basic radon protective measures are required. Gas monitoring has been undertaken and Amber 2 protection measures are recommended in all plots.
Preparatory works	General site clearance and Topsoil strip. Some site regrade is anticipated.
Foundations	All plots should be suitable for strip foundations at: • minimum 600mm depth on weathered bedrock and granular residual soils • minimum 900mm depth on cohesive residual soil Given existing topography, some earthworks re-grade is anticipated in order to allow development, and foundation solutions should be reviewed once any digital terrain modelling has been completed.
Groundwater & excavations	Groundwater seepage/inflow were encountered in 3 trial pits between depths of 1.0m and 2.9m. Groundwater monitoring suggests a relatively shallow water table. Shallow excavation should remain stable, although some pumping may be required for deeper excavations (eg for drainage etc).
Flooding & drainage	The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. Soakaway testing was carried out within 5 trial pits, but only one test (TP15 - sandstone) was successful. Given the in-situ testing results, site topography and shallow groundwater, soakaways are not considered feasible.
Highways	Natural soils are expected to provide a CBR value of at least 3%. These values should be verified prior to, or during, road construction.

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

- There is a geological fault line crossing the north of the site. Given the presence of mine workings at around 20m to 30m depth here, reinforcement of foundations will be necessary.

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APPENDICES

Appendix A - General notes

01	Environmental setting
02	Ground investigation field work
03	Geotechnical testing
04	Contamination laboratory analysis & interpretation
05	Hazardous gas
06	Soakaways

Appendix B - Drawings

Drawing	Revision	Title
1979/101	-	Site location plan
1979/102	-	Proposed site layout
1979/103	-	Site features
1979/104	-	Site photographs
1979/105	-	Preliminary conceptual site model
1979/106A	A	Exploratory hole locations – Western parcel
1979/106B	A	Exploratory hole locations – Eastern parcel
1979/107	-	Revised conceptual site model
1979/108	A	Mining investigation findings
1979/109	-	Proposed site layout & plots requiring reinforced footings
1979/110A	-	CA Abandonment Plan NE584
1979/110B	-	CA Abandonment Plan NE469
-	-	Cross sections 1 to 3

Appendix C - Commission

Appendix D - Historical OS plans#

Appendix E- Search responses#

From	Date	Content
Landmark	07/04/2015	Environmental search data
Coal Authority	21/04/2020	Mining report

Appendix F to G - Exploratory records

Appendix F	TP01 to TP25, TP101 to TP125 & TT101 to TT103
Appendix G	PH01 to PH31 & PH101 to PH125

Appendix H - Chemical test results

Appendix I- Contaminated land assessment for selection of water supply pipes

Appendix J - Geotechnical test results

Appendix K - Soakaway test results

Appendix L- 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 ISO 9001 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 should 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.

This report assumes that ground levels will not change significantly from those existing at present and that houses will be of two storey construction. If this is not to be the case, then some modification to this report may be required.

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.

GEO ENVIRONMENTAL APPRAISAL
of land at
SMITHY WOOD LANE, DODWORTH

1 INTRODUCTION

1.1 The commission and brief

- 1.1.1 Lithos Consulting Limited were commissioned by The Wentworth Trustees & Avant Homes Yorkshire to carry out a geoenvironmental appraisal of land at Smithy Wood Lane, Dodworth.
- 1.1.2 This document is a revision of the Geoenvironmental Appraisal (Report 1979/2A) issued by Lithos in February 2021; Report 1979/2A is now superseded. This document now includes the findings of a supplementary investigation to remove uncertainties regarding shallow mine workings and to target anomalies identified by a geophysical survey. The only significant revisions to 1979/2A having been made in Sections 1.2, 6, 7 & 13.2, and to Drawings 1979/106A, 106B & 108, with the addition of Drawing 1979/102.
- 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 50 trial pits, 3 trial trenches and 56 probe holes
 - Assessment of the geotechnical properties of the near surface deposits to enable provision of foundation and highway recommendations
 - A qualitative assessment of contamination risks
 - Recommendations for the necessary site preparatory works
- 1.1.4 Primary aims of this phase of investigation were to identify salient geoenvironmental issues affecting the site to support the submission of a planning application, and also to enable prospective developers to obtain budget costs for foundations; gas protection measures; and site preparatory works.

1.2 The proposed development

- 1.2.1 It is understood that consideration is being given to redevelopment of the site with 170 no. traditional 2-storey domestic dwellings, associated gardens, POS and adoptable roads and sewers.
- 1.2.2 A site layout has been provided by Avant Homes (Drawing reference Draft Layout SK02, dated October 2020) which is reproduced as Drawing 1979/2 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
- Soakaways

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.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site's location is shown on Drawing 1979/101 presented in Appendix B to this report. Site details are summarised in the table below.

Detail	Remarks
Location	2km south west of Bamsley town centre
NGR	SE322 043
Approximate area	5.9ha (14.6 acres)
Known services	Underground sewer crossing the eastern parcel. Low Pressure gas and underground BT shown within Smithy Wood Lane in between the two parcels.

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on 13th March 2020. The site comprises two parcels of land either side of Smithy Wood Lane, which runs north-west to south-east between the two. Key features of each parcel are described below.

Western Parcel

2.2.2 The western parcel is roughly triangular in shape and approximately 1.4 hectares in size, forming the northern portion of a larger arable field. At the time of the investigation, this field was cropped with wheat.

2.2.3 This parcel can be accessed via a locked 5-bar iron gate at the southern end of Smithy Wood Lane, after which it becomes a track/footpath.

2.2.4 The topography is slightly undulating with a slope down to the south east (c. 1 in 13). A steeper slope (c. 1 in 9) is present directly south of the parcel's southern boundary.

2.2.5 The western boundary of the parcel comprises the wooden garden fences of existing residential properties.

- 2.2.6 The north eastern boundary comprises post & wire fencing with sparse hedgerows and mature trees along its length. Smithy Wood Lane runs parallel to this boundary with residential properties beyond.
- 2.2.7 There is no physical southern boundary; this parcel is part of a larger open field which continues to the south.
- 2.2.8 In the centre of the southern boundary, a significant proportion of brick, glass, and slate was noted on the ground.

Eastern Parcel

- 2.2.9 The eastern parcel is an irregular pentagon with an area of approximately 4.5 ha. At the time of the walkover and intrusive works, the field was covered in rough grass. It is understood to be used for silage.
- 2.2.10 This parcel can be accessed off Calver Close via an unsecured entrance.
- 2.2.11 The topography is undulating, but with a general fall to the south (c. 1 in 15).
- 2.2.12 The north western boundary comprises wooden garden fences of existing residential properties on Calver Close.
- 2.2.13 The western third of the northern boundary is open and a public footpath runs south from an entrance in the boundary. The remaining two thirds of the boundary comprise garden fences of the residences on Rockingham Road.
- 2.2.14 The north eastern boundary comprises post & wire fencing with sparse hedgerows and mature trees along its length.
- 2.2.15 The eastern boundary comprises garden fences of properties on Gilroyd Lane.
- 2.2.16 The south eastern boundary comprises dense hedgerows and mature trees. The Trans Pennine Trail (footpath) runs parallel to the boundary.
- 2.2.17 The south western boundary comprises sparse hedgerows and mature trees with Smithy Wood Lane (track) running parallel.
- 2.2.18 In the centre of the south eastern boundary, a small pond (c. 30cm deep) of foul smelling water was noted where there was a break in slope.
- 2.2.19 Existing salient features, at the time of the walkover are presented on Drawing 1979/103 in Appendix B to this report and summarised in the table below.

Entire Site

Feature	Remarks
Current Access	Off Smithy Wood Lane (western parcel) and Calver Close (eastern parcel)
Topography	Gently sloping to the south (c. 1 in 15) in the eastern parcel Sloping to the south east (c. 1 in 13) in the western parcel
Approximate areas	1.4 ha – Arable farmland with wheat crop (western parcel) 4.5 ha – Grassed field used for silage (eastern parcel)
Surrounding land uses	North – Play park and housing (Rockingham Road & Calver Close). East – Housing (Gilroyd Lane), with open fields and M1 motorway beyond South – Trans Pennine Trail with open fields & industrial facilities beyond West – Housing (Intake Crescent) with open fields beyond

- 2.2.20 A selection of site photographs is included on Drawing 1979/104.

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	Westem parcel	Eastem parcel	Sumounding land
1855	Part of a large open field.	Separated into 5 open fields.	A sandstone quarry is shown c. 100m west of the westem parcel. Railway lines runs along the south eastem boundary of the eastem parcel.
1892	A reservoir is shown along the southem boundary. Sumounding embankments suggest a raised feature.	No significant changes.	Two coke ovens are shown c. 50m south of the eastem parcel associated with the Stafford Collieries .
1906			Another coke oven is added to the Stafford Collieries . A shaft is shown c. 100m south-west. A reservoir is shown c. 200m south of the site.
1931	No significant changes.	Separated into 3 open fields.	The coke ovens are now labelled as 'old coke ovens'.
1948		No significant changes.	The land directly west of the westem parcel has been developed and the sandstone quarry infilled.
1956	The reservoir in the westem parcel is no longer shown.		Stafford Collieries shown as 'disused',
1962			Much of the railway is now dismantled.
1970			No significant changes.
1985	No significant changes.	Becomes one field.	Entire railway labelled as dismantled. Residential dwellings constructed to the north.
1993		No significant changes.	No significant changes.

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. Extracts from the response received from Landmark, and responses from 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 SE 30 SW) BGS shaft log - (Strafford Main Colliery – 3216,0412) BGS Memoir 87	Drift – None recorded Soil – Coal Measures, mostly Sandstone; undivided mudstone/siltstone likely on eastern boundary. Haigh Moor Rock (sandstone) in the east. Shallowest coal seam - Lidgett Coal outcrops immediately south of the site, dipping below the site. Haigh Moor and Swallow Wood seams outcrop in the eastern parcel. Flockton Thin anticipated beyond the fault line in the far north-east (further details in Section 4.3). Strata Dip – around 5° north east Faults – Champany Hill Fault, running roughly east-west (downthrow to south) crossing the far north-east.
Mining	Coal Authority BGS Maps	This site is located within a Coal Mining Development High Risk Area. Further details in Section 4.3 below.
Quarrying	Historical OS plans	Historical sandstone quarry located 100m west of site, no known quarries at the site
Radon	Public Health England	The site lies in an area where between 3% and 5% of homes are estimated to be above the action level. Further details in Section 11.5.
Hydrogeology	Environment Agency Envirocheck Report	Source Protection Zone? None. Aquifer - Secondary A (Soil). Groundwater abstraction? 160m south – Silkstone Mine shaft, Strafford Colliery, Bamsley. Operated by the Coal Authority. Soil leaching potential - Low. Pollution incidents? None of significance to site.
Hydrology		Nearest watercourse(s) – Dodworth Dyke from Source to River Dove, 220m south of site. Water quality – Ecologically and Chemically Good. Pollution incidents? None of significance to site. Abstractions? None of significance to site. Discharge consents? None of significance to site.
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
Location not supplied	432283, 404078 (185m south east)	Types of waste deposited: unknown.	Landmark Environment Agency
Land adjacent to former Stafford Colliery	432289, 404077 (193m south)	Deposited waste included Inert and Household waste Current land use: Industrial estate	
Stafford Colliery, Gilroyd Lane	432350, 404050 (217m south)	Authorised waste: Construction/demolition waste, soil, subsoil & rubble. Licence lapsed: 1 st August 1987	
Location not supplied	432424, 404063 (226m south east)	Types of waste deposited: unknown.	
Gilroyd Lane	432426, 404063 (227m south east)	Deposited waste included Inert and Commercial waste Current land use: Industrial estate	

4.2.2 The historical and recorded landfill sites listed above are likely associated with one another judging by the close proximity.

4.2.3 Historical plans indicate a reservoir on site which was backfilled in the 1950s; it is unknown what the reservoir was backfilled with.

4.2.4 Two historical recorded landfill sites are located within 250m of the site's boundary. A former sandstone quarry is also shown on historical plans around 70m to the west, backfilled circa 1894.

4.3 Coal & mining

4.3.1 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 (and Sections 7.8 & 13.2) provides the necessary mining risk assessment required by the proposed planning application.

4.3.2 This site is located within a Coal Mining Development **High Risk Area** - an area with specific mining legacy risks to the surface, including mine entries; shallow coal workings etc).

Mining history (general)

4.3.3 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).

4.3.4 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.

4.3.5 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.

- 4.3.6 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.
- 4.3.7 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.
- 4.3.8 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 benches or banks. The major axis of the galleries was generally up the dip although strike working was not uncommon.
- 4.3.9 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.
- 4.3.10 Usually, the length of the stall extended for up to 10m but some were extremely attenuated, occasionally running uninterrupted 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 width was a result of robbing.
- 4.3.11 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.
- 4.3.12 From the late 18th century onwards, **packing** of mine workings 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.
- 4.3.13 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.

- 4.3.14 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 cored boreholes).

Geological fault & shallow coal seams

- 4.3.15 Geological maps indicate the **Champany Hill Fault**, crossing the far north east of the eastern parcel. Therefore, in terms of coal risk, the site can be split into two areas; the Main fault block forming the majority of site, and the Northern fault block in the far north east of the eastern parcel.
- 4.3.16 Based on the line of the fault taken from the BGS plan, only around 200m² of the site lies within the northern fault block. However, abandonment plans (see below) show the line of the Champany Hill fault c. 40m further south-west, bringing around 1,900m² of the site into the northern fault block (see Drawing 1979/110A). The abandonment plans record the line of the fault below ground, and this difference may therefore be due to the fault plane dipping, rather than being vertical.
- 4.3.17 Geological maps suggest that 3 coal seams underlie the **main fault block** at shallow depth, all dipping to the north east. These are the:
- **Swallow Wood** Coal (0.6m to 1.6m thick) outcropping in the north east of the eastern parcel
 - **Haigh Moor** Coal (1.0m to 2.2m thick) outcropping in the centre of the eastern parcel, at c. 16m below the Swallow Wood
 - **Thin** (unnamed) coal c. 8m beneath the Haigh Moor, and c. 24m below the Swallow Wood
 - **Lidgett** Coal (0.5m to 1.3m thick) outcropping around 20m to the south of the site, dipping below the site, at c. 48m below the Swallow Wood
- 4.3.18 In addition to the above, abandonment plans (see below) show the main fault block to be underlain by the Flockton Thick seam, but at >70m depth.
- 4.3.19 Geological maps suggest that two coal seams underlie the **northern fault block** at shallow depth, both dipping to the north east. These are the:
- **Flockton Thick** coal (0.8m to 2.9m thick)
 - **Flockton Thin** coal (0.3m to 1.9m thick) 28m beneath the Flockton Thick.
- 4.3.20 Approximate outcrops of the above seams, together with additional geological features, are shown on Drawing 1979/103.
- 4.3.21 The geological plan and BGS Memoir show extensive coal workings in the surrounding area including shafts, adits and open cast works.
- 4.3.22 Given dip and topography, the Lidgett seam is expected to underlie the western parcel and the south of the eastern parcel at shallow depth (<10m). The Haigh Moor Coal is expected to underlie the north-eastern half of the eastern parcel at shallow depth (<5m, becoming deeper to the north east). The Swallow Wood coal is expected to underlie the north-eastern corner of the eastern parcel at shallow depth (<5m).
- 4.3.23 It should be noted that seam outcrops plotted on geological maps have been known to be inaccurate by distances in excess of 100m.

4.3.24 The CA **mining report** states that:

- *The property is within the zone of influence from workings in 5 seams at shallow to 270m depth and last worked in 1971. The shallowest seam named to have been worked is the Flockton Thick (at 10m and 72m depth beneath the site). All other recorded workings are at >74m depth.*
- *The property is not in the likely zone of influence of any present underground coal workings.*
- *There are no known mine entries within, or within 100 metres of, the boundary of the property.*
- *Unrecorded shallow workings are probably present beneath the site.*
- *The Authority is not aware of any evidence of damage arising due to geological faults or other lines of weakness that have been affected by coal mining.*
- *The property is not within 800 metres of the boundary of an opencast site for which the Coal Authority is determining whether to grant a licence to remove coal by opencast methods.*
- *There is no record of a mine gas emission requiring action by the Coal Authority on, or within 500m boundary of the property.*
- *The property is not in an area for which a notice of entitlement to withdraw support has been published.*

4.3.25 A damage notice or claim for alleged subsidence damage was made in November 2000 for fields to the west of Smithy Wood Lane and in July 1999 for fields OS 1333, 0028, 2427, 2020 and 1517. However, the claims were rejected.

4.3.26 Further claims at 32 Calver Close and Saville Hall Farm were also rejected.

4.3.27 The CA do not hold any records for workings in the Lidgett, Swallow Wood or Haigh Moor seams, all of which are anticipated to underlie the site at shallow depth.

4.3.28 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 mine workings beneath the site for which the Coal Authority have no records. Indeed, the CA report states that unrecorded shallow workings are probable.

4.3.29 **Abandonment plans** have been obtained from the CA relating to mining in the Flockton Thick seam (Refs. NE584 and NE469). These plans indicate that the northern fault block was worked between 1902 and 1908 from Rosehill Colliery. No depths of the workings beneath the northern fault block are shown on the plan, but it is likely that these are the recorded workings in the Flockton Thick at around 10m, as mentioned in the CA report.

4.3.30 The same plan shows workings in the main fault block, underlying the west of the site. These workings are also in the Flockton Thick, with annotations indicating mining dates of between March and September 1950. Topographic levels to the base of these workings are shown, which, when converted, indicate levels of between 25mAOD and 27mAOD. When compared to current ground levels in this area (between 104mAOD and 111mAOD), this indicates the workings are at c. 80m depth. Therefore, these workings are most probably the 'recorded workings' in the Flockton Thick at 72m mentioned in the CA report.

4.3.31 At such depth, these should not pose any significant risk of subsidence at the site's surface.

4.3.32 Based on all the data reviewed, risks to surface stability have been identified in the northern fault block (recorded shallow workings in the Flockton Thick), and in the main fault block (probable (unrecorded) workings in the Lidgett, Haigh Moor and Swallow Wood).

4.3.33 Therefore, additional intrusive investigation is required in order to:

- Investigate the depth, thickness and presence of any workings in the Lidgett, Haigh Moor and Swallow Wood seams in the main fault block
- Confirm the depth to workings within the Flockton Thick in the northern fault block
- Provide greater clarity on the area of the site which lies within the northern fault block (and is therefore at risk from workings in the Flockton Thick)

4.4 Mineral safeguarded areas

4.4.1 The site is underlain by multiple seams of shallow coal and might therefore be considered by the Local Authority to lie within a Mineral Safeguarding Area (MSA). The next shallowest seam, the Joan Coal, is likely to be too deep (>45m) to warrant extraction by opencast methods.

4.4.2 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.

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

4.4.4 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 mineral 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.

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

4.4.6 As a consequence of the NPPF, and the presence of coal beneath the site, the Local Authority may require Avant 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

5 GROUND INVESTIGATION DESIGN

5.1 Anticipated ground conditions & potential issues

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

Anticipated condition	Remarks
Made ground	Possible made ground within footprint of former reservoir (likely a raised feature)
Natural soils	Topsoil (300mm) over shallow residual soils (gravelly clay and/or clayey gravel)
Bedrock	Coal Measures sandstone anticipated at shallow depth
Mine workings	Possible unrecorded workings in the Lidgett, Haigh Moor, Swallow Wood coals, and known workings in the Flockton Thick Coal at shallow depth beneath the site
Groundwater	Anticipated at depth within bedrock

- 5.1.2 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. former reservoir 2. farming activities	1. made ground – inorganic, organic, hazardous gas migration 2. leaks/spillages
Potential off-site contamination sources	1. landfills and backfilled quarry 2. surrounding former industrial uses	1. migration of gas 2. airborne contaminants
Potential geotechnical hazards	1. shallow coal workings	1. known, and possible unrecorded, workings of the Lidgett, Haigh Moor, Swallow Wood and Flockton Thin Coal
Other potential constraints	1. underground utilities	1. Underground sewer in eastern parcel. Underground gas, and power under Smithy Wood Lane.

5.2 Preliminary conceptual site model

- 5.2.1 A preliminary conceptual site model, presented as Drawing 1979/105 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 5.1 inclusive of this report.
- 5.2.2 Historical plans show that the site has been occupied by arable farmland which is not considered likely to have caused significant ground contamination. Nonetheless, activities such as slurry spreading, the discharge of chemicals to ground, and unregulated burial have all occurred on farmland. Potential pollutants associated with farming activity might include any of the following:

Agricultural activity	Potential contaminant
Sewage farming, slurry spreading	Methane, metals, nitrate, oxygen depletion
Plant & animal protection	Pesticides & herbicides
Soil conditioners	Metals, sulphates, PAH
Equipment maintenance	Hydrocarbons, metals
Levelling of reservoir	Methane, metals, PAH etc
Naturally occurring contaminants	Arsenic, metals

5.2.3 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 these have not been included within the proposed sampling suite.

5.2.4 Historical plans show the presence of a former reservoir that should be targeted during ground investigation.

5.3 Ground investigation design & strategy

5.3.1 The preliminary conceptual site model was used as a basis for design of an appropriate ground investigation in 2020, the scope of which is summarised below.

Exploratory holes	Purpose
20 Trial Pits	To determine the general nature of soils underlying the site, including the: - Nature, distribution and thickness of shallow soils, including any made ground - Suitability of the ground for founding structures and highways
Five Trial Pits	To determine whether soakaways could be utilised for storm water drainage
2 trial trenches	To determine the extent and nature of made ground associated with the former reservoir
30 Probe holes	To check for the presence of voids or broken ground associated with possible unrecorded shallow mine workings. To install monitoring wells across the site in order to monitor for hazardous gas and determine groundwater levels.

5.3.2 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 5.2 above. Additional exploratory locations might be scheduled by the site engineer in light of the ground conditions actually encountered.

5.3.3 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.

5.3.4 In light of residual uncertainties regarding the possibility of shallow mine workings, supplementary investigation was commissioned by Avant in March 2021, comprising:

Exploratory holes	Purpose
Geophysical survey	To check for old bell pits, given the very shallow depth to the Lidgett, Haigh Moor and Swallow Wood coals. To locate the line of the Champany Hill Fault.
15 Probe holes	To check for the presence of voids or broken ground associated with possible unrecorded shallow mine workings. To allow recovery of spot cores through potentially packed mine workings.
Trial Pits	To check any features identified by the geophysics.
Trial trenches	To search for the geological fault (again following geophysics)

6 FIELDWORK

6.1 Objectives

6.1.1 The original investigation strategy is outlined in Section 5.3 above.

6.2 Scope of works

6.2.1 Fieldwork was initially supervised by Lithos between 15th & 16th April and 8th to 12th June 2020.

6.2.2 Supplementary fieldwork was undertaken between 3rd & 8th March (drilling) and between 14th & 16th April (pitting) 2021.

6.2.3 In total, ground investigation comprised the exploratory holes listed below.

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	Ts 1 to 25	1.75m to 4.2m	Vane tests in cohesive soils
	Ts 101 to 125	0.5m to 1.7m	Excavated to investigate geophysical anomalies
	Ts 101 to 103	0.8m to 4.9m	Trenches to identify fault
Soakaway tests	Within Ts 15, 16, 18, 19 & 20	1.2m to 2.1m	Tests in Ts 16, 18, 19 & 20 did not reach 25% effective depth
Rotary open-hole probe holes	PHs 01 to 31	14m to 42m	Monitoring wells installed in 12 PHs
	PHs 101 to 125	11.5m to 32.5m	Spot coring undertaken in PHs 104, 108, 111 & 112

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

6.2.5 Exploratory hole logs are presented in Appendices F & G 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

6.2.6 Exploratory hole locations are shown on Drawing 1979/106 presented in Appendix B; probe hole locations in the eastern parcel have been picked-up by a surveyor and coordinates/ground levels are included on the logs. The remaining exploratory hole positions are based on data from a hand-held GPS (typically +/- 3m accuracy) and have not been surveyed in.

7 GROUND CONDITIONS

7.1 General

- 7.1.1 A complete record of strata encountered beneath the proposed development site is given on the various exploratory hole records, presented in Appendices F & G.
- 7.1.2 Typical ground conditions encountered at the site are described below in Sections 7.2 (made ground) and 7.3 (natural ground), with a summary provided in the table on pages 15 to 17.

7.2 Made ground

- 7.2.1 Made ground was only encountered in TP04 within the vicinity of a former reservoir in the western parcel from ground level to 0.7m. Material comprised a gravelly clay containing bricks and pieces of wood (**Made Ground Topsoil**).
- 7.2.2 Elsewhere, Made Ground Topsoil was encountered locally to shallow depth typically associated with field drains.

7.3 Natural ground

- 7.3.1 Natural ground was encountered in all of the exploratory holes, and typically comprised:
- **Topsoil:** clayey, friable topsoil was identified across the site to a typical depth of 300mm.
 - **Cohesive Residual Soils:** Encountered in the majority of trial pits as typically a firm/stiff gravelly Clay to depths of between 0.7m to 3.0m.
 - **Granular Residual Soils:** Typically encountered below Cohesive Residual Soils as a sandy/clayey Gravel to a maximum depth of 3.0m.
 - **Coal:** The Lidgett, Haigh Moor and Swallow Wood seams were encountered as a clayey Gravel in 10 of the 18 pits in the eastern parcel and 1 of 8 pits in the western parcel.
 - **Middle Coal Measures Bedrock:** Comprising Sandstone, Siltstone & Mudstone, encountered in all of the trial pits in the eastern parcel and 4 of the 8 pits in the western parcel from depths of between 0.4m and 3.6m (average 2.3m).

7.4 Fault investigation

- 7.4.1 Following a geophysical survey undertaken by Phase Site Investigations, 3 trial trenches were excavated in the far northeast of the eastern parcel where the **Champany Hill Fault** is mapped.
- 7.4.2 None of the trenches conclusively identified evidence of the fault although TTs 101 & 103 encountered a shallow coal seam which appeared to thin/terminate towards the south. In addition, a notable colour change in the shallow residual soils was noted in TT103 with dark weathered carbonaceous mudstone in the north and lighter coloured mudstone in the south.
- 7.4.3 These could be the result of faulting, either directly associated with the Champany Hill Fault, or a smaller subsidiary fault away from the main fault line. Alternatively, the thinning out of the coal may be natural variation.



Summary of Ground Conditions

Parcel	Hole ID	Final Depth (m)	Depth to Base (mbgl)				Depth to rockhead (m)	Bedrock encountered	Penetration into rock (m)	Remarks	
			Made Ground (m)	Topsoil	Cohesive Residual Soils	Granular Residual Soils					Coal
W	TP01	1.85	-	0.35	0.8	1.75	-	1.75	Siltstone	0.1	-
W	TP02	3.1	-	0.35	2.0	3.1	-	-	-	-	-
W	TP03	3.2	-	0.4	1.7	3.2	-	-	-	-	-
W	TP04	3.5	0.7	-	2.4	3.5	1.6	-	-	-	Groundwater seepage at 1.0m
W	TP05	3.4	-	0.35	2.3	3.4	-	-	-	-	-
W	TP06	1.75	-	0.4	-	-	-	0.4	Sandstone	1.35	-
E	TP07	3.4	-	0.2	2.6	-	-	2.6	Siltstone	0.8	-
E	TP08	3.8	-	0.3	1.2	2.5	-	2.5	Siltstone	1.3	-
E	TP09	3.4	-	0.3	1.8	2.7	2.9	2.9	Mudstone and Siltstone	0.5	-
E	TP10	3.9	-	0.4	1.6	2.9	3.4	2.9	Siltstone	1.0	-
E	TP11	3.9	-	0.3	1.8	2.8	3.4	2.8	Siltstone and Mudstone	1.1	-
E	TP12	3.2	-	0.25	2.2	-	2.5	2.5	Mudstone and Siltstone	0.7	-
E	TP13	3.9	-	0.25	3.0	3.3	3.5	3.5	Mudstone and Siltstone	0.4	-
E	TP14	3.9	-	0.25	2.3	2.9	1.15	2.9	Siltstone	1.0	-
W	TP15	2.2	-	0.3	1.6	1.8	-	1.8	Sandstone	0.4	-
W	TP16	2.9	-	0.3	1.6	0.5	-	1.6	Mudstone	1.3	-
E	TP17	2.0	-	0.25	0.7	-	-	0.7	Sandstone	1.3	Groundwater at 1.8m
E	TP18	3.3	-	0.3	1.8	-	2.6	1.8	Mudstone	1.5	-
E	TP19	3.4	-	0.3	2.1	3.0	-	3.0	Siltstone	0.4	-
E	TP20	3.8	-	0.3	2.0	2.3	3.6	3.6	Siltstone and mudstone	0.2	-
E	TP21	4.1	-	0.35	2.0	-	-	2.0	Siltstone and mudstone	2.1	-
E	TP22	4.2	-	0.25	2.1	2.7	1.3	2.7	Siltstone	1.5	-



Parcel	Hole ID	Final Depth (m)	Depth to Base (mbgl)					Depth to rockhead (m)	Bedrock encountered	Penetration into rock (m)	Remarks
			Made Ground (m)	Topsoil	Cohesive Residual Soils	Granular Residual Soils	Coal				
E	TP23	3.5	-	0.3	1.8	2.6	-	2.6	Sandstone	0.9	-
E	TP24	4.1	-	0.25	2.3	-	3.5	2.3	Mudstone	1.8	Groundwater seepage at 2.9m
E	TP25	3.0	-	0.3	1.3	2.0	-	2.0	Sandstone	1.0	-

Summary of Ground Conditions (geophysical anomalies)

Parcel	Hole ID	Final Depth	Depth to Base of Made Ground	Depth to Base (mbgl)					Depth to rockhead (Middle Coal Measures) (m)	Bedrock encountered	Remarks
				Made Ground Topsoil	Topsoil	Cohesive Residual Soils	Granular Residual Soils	Coal			
E	TP101	1.7	-	-	0.2	>1.7	-	-	-	-	Old electric cable with earthing plate identified
E	TP102	1.1	-	-	0.2	-	>1.1	-	-	-	
E	TP103	1.1	-	-	0.3	>1.1	-	-	-	-	
E	TP104	1.1	-	-	0.3	>1.1	-	-	-	-	Outcrop of weathered coal identified
E	TP105	1.2	-	-	0.2	>1.2	-	-	-	-	
E	TP106	1.1	-	-	0.3	>1.1	-	-	-	-	Ironstone cobbles present in residual soil
E	TP107	1.0	-	-	0.3	>1.0	-	-	-	-	Reworked ground to 0.6m depth in northeast corner
E	TP108	1.6	-	-	0.2	1.0, then >1.6	1.3	-	-	-	Possible old gate post (rotting timber with metal) identified
E	TP109	1.3	0.3	0.3	-	>1.3	-	-	-	-	Trench with limestone backfill and plastic land drain between 0.3m and 0.6m
E	TP110	1.6	-	-	0.3	>1.6	-	-	-	-	Terracotta land drains at 0.4m
E	TP111	1.3	-	-	0.3	>1.3	-	-	-	-	
E	TP112	0.9	-	-	0.3	>0.9	-	-	-	-	Ironstone cobbles present in residual soil
E	TP113	1.2	-	-	0.3	>1.2	-	-	-	-	10cm bed of weathered coal in residual soil
E	TP114	0.9	-	-	0.2	>.9	-	-	-	-	Sheet of metal (0.6m x 0.6m) at 0.4m depth
E	TP115	1.4	0.4	0.4	-	>1.4	-	-	-	-	Terracotta land drain at 0.6m and stone drain/culvert at 1.0m



Parcel	Hole ID	Final Depth	Depth to Base of Made Ground	Depth to Base (mbgl)					Depth to rockhead (Middle Coal Measures) (m)	Bedrock encountered	Remarks
				Made Ground Topsoil	Topsoil	Cohesive Residual Soils	Granular Residual Soils	Coal			
E	TP116	0.5	-	-	0.3	>0.5	-	-	-	-	Manhole cover (0.6m x 0.6m) at 0.5m depth
E	TP117	0.9	-	-	0.3	>0.9	-	-	-	-	
E	TP118	0.9	-	-	0.3	>0.9	-	-	-	-	
E	TP119	0.8	-	-	0.3	>0.8	-	-	-	-	
W	TP120	1.2	-	-	0.3	>1.2	0.8	-	-	-	
W	TP121	1.1	-	-	0.3	>1.1	-	-	-	-	
W	TP122	0.8	-	-	0.2	>0.8	0.7	-	-	-	Band of rusted metal at 0.3m depth
W	TP123	0.8	-	-	0.3	>0.8	-	-	-	-	Trench with ash & clinker backfill (rare metal, brick) and terracotta land drain between 0.3m and 0.6m
W	TP124	0.9	-	-	0.2	>0.9	-	-	-	-	1.4m wide circle of dark grey clay at base of topsoil (c. 10cm thick) - possible old hollow
W	TP125	1.0	-	-	0.2	>1.0	-	-	-	-	
E	TT101(N)	0.8	-	-	0.2	>0.8	-	-	-	-	
E	TT101(CN)	3.4	-	-	0.2	2.2, then >3.4	2.8	-	-	-	
E	TT101(CS)	4.2	-	-	0.2	2.0, then >4.2	3.9	-	-	-	Bed of weathered coal appears to terminate/thin out
E	TT101(S)	4.2	-	-	0.2	2.5	3.4	-	3.4	Mudstone	
E	TT102(N)	3.0	-	-	0.3	2	2.7	-	2.7	Mudstone	
E	TT102(CN)	3.0	-	-	0.3	1.5	2.7	-	2.7	Mudstone	
E	TT102(CS)	3.9	-	-	0.3	1.6	2.8	-	2.8	Mudstone	Ironstone nodule (0.8m wide & 1.0m thick) at 1.8m
E	TT102(S)	3.8	-	-	0.3	1.4	2.7	-	2.7	Mudstone	
E	TT103(N)	3.5	-	-	0.3	2.0, then 3.3	3	>3.5	-	-	
E	TT103(CN)	4.4	-	-	0.3	2.2, then 3.7	3.4	4.2	-	-	
E	TT103(CS)	4.9	-	-	0.3	2.8, then >4.9	4.4	4.8	-	-	
E	TT103(S)	4.7	-	-	0.3	3.8	>4.7	-	-	-	

7.5 Stability

7.5.1 Stability of excavations within the trial pits was generally good.

7.6 Visual & olfactory evidence of organic contamination

7.6.1 There was no evidence of significant organic contamination during the site investigation.

7.7 Groundwater

7.7.1 Groundwater was encountered as seepages in 3 of the 25 trial pits between depths of 1.0m and 2.9m.

7.7.2 Groundwater levels have been recorded in the monitoring wells as part of the gas monitoring on 9 visits between June and December 2020; results are summarised below.

Hole ID	Response zone (depth range & strata)	Groundwater body	Range of standing water level	
			m bgl	m AoD [#]
PH01A	3.0 – 6.0m (Mudstone, Siltstone & Coal)	Deep (solid)	3.5 – 5.9	96.1 – 93.7
PH03A	2.0 – 4.0m (Mudstone & Siltstone)		0.7 – 2.4	95.0 – 95.5
PH05A	2.5 – 5.5m (Mudstone, Siltstone & Coal)		5.2 – Dry	91.9 – >91.5
PH06A	2.0 – 4.0m (Mudstone & Siltstone)		3.0 – 4.1	95.5 – 94.3
PH08A	2.0 – 4.0m (Mudstone & Siltstone)		3.4 – 5.5	86.2 – 84.1
PH10A	3.0 – 6.0m (Mudstone & Siltstone)		2.4 – 6.0	89.9 – 86.3
PH11A	3.0 – 6.0m (Mudstone & Siltstone)		2.9 – 4.0	90.2 – 89.1
PH17A	2.0 – 4.0m (Mudstone & Siltstone)		3.4 – Dry	89.4 – >88.8
PH20A	2.0 – 4.0m (Mudstone & Siltstone)		3.5 – Dry	93.4 – >92.8
PH21A	3.0 – 6.0m (Mudstone & Siltstone)		1.0 – Dry	94.3 – >89.3
PH29A	2.0 – 4.0m (Sandstone)		0.1 – 4.0	112.4 – 108.4
PH30A	2.0 – 4.0m (Sandstone)		2.1 – 3.9	102.5 – 100.7

[#] estimate from topo survey data

7.7.3 Dip data to date suggests a shallow watertable. After an initial dip to record standing water level, the wells were bailed-out to establish an approximate rate of **recharge** during visit 1. Findings were:-

- PH03A: removal of 7 litres resulted in lowering the water level by 2.01m (from 1.25m to 3.26m bgl) within the plain casing above the response zone, and within the response zone. Recharge was slow; the water level recovered to 3.03m after 53 minutes. (Note: In a 50mm diameter well pipe there is approximately 2 litres of water per metre of water column).
- PH10A: removal of 14 litres resulted in lowering the water level by 1.96m (from 2.58m to 4.54m bgl) within the plain casing above the response zone, and within the response zone. Recharge was slow; the water level recovered to 2.81m after 68 minutes.
- PH21A: removal of 20 litres resulted in lowering the water level by 1.29m (from 2.34m to 3.63m bgl) within the plain casing above the response zone, and within the response zone. Recharge was slow; the water level recovered to 3.11m after 37 minutes.
- PH29A: removal of 9 litres resulted in lowering the water level by 3.05m (from 0.65m to 3.70m bgl) within the plain casing above the response zone, and within the response zone. Recharge was slow; the water level recovered to 1.85m after 37 minutes.

- 7.7.4 It is apparent from the above that permeability of the ground is quite low. Groundwater levels are considered to be reflective of the true water table (rather than "trapped" waters associated with drilling or surface water run-off) and appear to flow generally from north-west to south-east, broadly in line with topography.
- 7.7.5 These results should be of interest to the drainage designer, and groundworker (especially if/where deep excavation is required).

7.8 Mining investigation

Shallow workings (rotary probe holes)

- 7.8.1 It is clear from the desk study that the site is likely to be underlain by shallow mine workings associated with the Flockton Thick Coal in the northern fault block, and possibly unrecorded mine workings in the Lidgett, Haigh Moor and Swallow Wood seams across the main fault block.
- 7.8.2 The conjectured outcrops according to the BGS and CA of the Lidgett, Haigh Moor & Swallow Wood seams are shown on Drawing 1979/103 in Appendix B to this report.
- 7.8.3 Consequently, a mining investigation has been undertaken, comprising the drilling of 56 rotary open-hole probe holes. The findings of the investigation are summarised on pages 22 to 25.
- 7.8.4 A further 12 probe holes were taken to shallow depth to enable the installation of gas monitoring wells.

Main Fault block

- 7.8.5 Analysing the data obtained from the mining investigation probe holes that were advanced through the **Lidgett Coal**, it is apparent that:
- The Lidgett Coal underlies the entire main fault block (majority of the site) and is shallowest in the south west and deepest in the north east.
 - The seam is between 0.2m and 1.2m thick.
 - None of the holes advanced through the Lidgett seam encountered evidence of workings.
 - In PH14 the Lidgett coal was encountered as 0.7m and 0.4m of coal separated by a mudstone and siltstone parting. This could be indicative of the Flockton Thick seam (as opposed to the Lidgett), which is discussed further below.
 - The thickness of competent (rock) cover is typically less than 10 times seam thickness in the western parcel and south/west of the eastern parcel.
 - As the coal dips to the east, the thickness of competent cover for the majority of the site is greater than 10 times seam thickness.
- 7.8.6 Analysing the data obtained from probe holes advanced through the **Haigh Moor Coal**, it is apparent that:
- Haigh Moor coal underlies about 3.2 ha of the site, outcropping northeast, approximately 75m further southwest than that shown on BGS plans.
 - None of the 40 holes advanced through the Haigh Moor seam encountered evidence of workings.
 - The Haigh Moor seam is between 0.1m and 1.2m thick.
 - The thickness of competent (rock) cover is typically less than 10 times seam thickness in the centre of the eastern parcel, and greater than 10 times thickness towards the north east.

- 7.8.7 Analysing the data from probeholes advanced through the **Swallow Wood Coal**, it is apparent that:
- Swallow Wood coal underlies about 1.5 ha of the site in the north east of the eastern parcel, outcropping approximately 85m further south west than that shown on BGS and CA plans.
 - None of the 17 holes advanced through the Swallow Wood seam encountered evidence of workings.
 - The Swallow Wood seam is between 0.05m and 0.6m thick.
 - The thickness of competent (rock) cover above the Swallow Wood seam is always less than 10 times seam thickness.
- 7.8.8 Given the number of probeholes drilled, and the absence of any evidence of voids or broken ground, it is considered highly unlikely that the site is underlain by shallow mine workings in the Lidgett, Haigh Moor and Swallow Wood seams.
- 7.8.9 In general, the coal encountered looked to be of poor quality, and was sometimes "replaced" with dark mudstone & coal traces/bands, indicating possible localised 'washing out' of the seams. This may be the reason for a lack of workings in these seams.
- 7.8.10 In the south-east of the eastern parcel, PHs 8, 10 & 11 encountered 'soft' and often damp/wet, poor quality coal/dark mudstone with coal traces at depths of 13.0-13.3m (PH08), 10.5-11.1m (PH10) and 6.5-7.0m (PH11). Such material could be indicative of 'packed workings' or 'goaf packing' (see Section 4.3). Consequently, supplementary rotary coring was undertaken in the south-east to recover core samples.
- 7.8.11 The rotary coring typically yielded poor recovery. While this may be indicative of packed workings, it is more likely due to the extremely weathered nature of the rock/coal which was simply 'washed away' during coring (drilling flush was noted to turn black with coal fragments during drilling). No erratic or irregular penetration was noted during coring and flush returns were maintained throughout indicating an absence of mine workings.
- 7.8.12 The presence of very shallow groundwater (typically shallower than the coal seams) may be an additional line of evidence to support the absence of mine workings in the Swallow Wood, Haigh Moor and Lidgett coal seams.

Northern Fault block

- 7.8.13 Based on probehole findings, the line of the Champany Hill Fault is possibly around 10m to 20m further south than shown on the CA abandonment plans (see Drawing 1979/108). Whilst it is reasonable to assume that PHs 18, 19 & 20 lie within the northern fault block, there is some uncertainty with regards to PHs 14 and 23.
- 7.8.14 This uncertainty is in part due to the fact that the Flockton Thick in the northern fault block and Lidgett Coal in the main fault block are of similar thicknesses and lie at similar depths.
- 7.8.15 With regards to the **Flockton Thick** Coal, the mining investigation indicates:
- The seam underlies an area of between 0.2 and 0.4ha and is between 0.9m and 1.1m thick. The only exception is PH14 which encountered a seam split between two leaves totalling 2m thickness (including a mudstone parting). This could be either the Flockton Thick or the Lidgett seam (depending on where the fault line runs).
 - Two holes advanced through the Flockton Thick seam encountered evidence of workings, as was expected given the abandonment plans (see Section 4.3.29). A void (c. 1.1m thick) was encountered in PH18 from 27.3m and broken ground was encountered in PH20 from 27.0m to 27.9m.
 - The Flockton thick was encountered as 'dark grey mudstone with some coal' in PH19.

- Contrary to the CA report (which stated workings in this seam at 10m), the depth to the workings is >20m. This is possibly due to the lack of depth data on CA abandonment plans for this area (meaning the CA information is estimated only). Assuming a maximum seam thickness of 1.1m, competent (rock) cover is greater than 23 times seam thickness. Indeed, even if a conservative value is used for seam thickness (2.0m, as encountered in PH14), competent cover would still be greater than 12 times seam thickness in all boreholes where it was encountered.

7.8.16 PH19 did not encounter evidence of mine workings nor a coal seam which could be indicative of 'packed workings' (goaf packing).

7.8.17 A 0.7m thick coal seam 20m to 22m above the Flockton Thick in PHs 18 & 19 is likely the **Joan Coal**. This mining investigation indicates:

- The seam underlies an area of approximately 0.19 ha in the far north east of site and is between 0.6m and 0.7m thick.
- Neither of the holes advanced through the Joan coal encountered evidence of workings.
- The thickness of competent (rock) cover above the Joan seam ranges between 7.9 and 11 times seam thickness.

7.8.18 Updated outcrops of the Lidgett, Haigh Moor and Swallow Wood coal seams, along with a possible line of the Champany Hill Fault (based on the mining investigation) are shown on Drawing 1979/108.

Unrecorded mine entries

7.8.19 Given the presence of shallow coal seams it is considered possible that unrecorded "shallow" shafts (possibly bell pits) may be present at this site. Consequently, Phase Site Investigations carried out a magnetic and electromagnetic (EM) survey to identify possible mine entries.

7.8.20 In total, Phase identified 38 anomalies that were considered to be possible backfilled shaft/bell pits. Of these, 11 were identified as metal covers used to secure gas monitoring wells, with an additional location identified as a recently excavated manhole cover.

7.8.21 Lithos subsequently excavated 25 trial pits, each covering an area of c. 3.5m by 3.5m around the remaining anomalies. No unrecorded mine shafts have been encountered with the majority of pits identifying shallow fragments of metal, land drains etc.

7.9 Revised conceptual ground model (ground conditions)

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

- The strength, nature and depth of underlying natural strata
- The presence of localised made ground associated with a backfilled reservoir
- The absence of shallow workings

7.9.2 Further refinement of the Conceptual Site Model is presented in Section 10.2 where the results of laboratory testing for contaminants have been considered.

SUMMARY OF ROTARY PROBEHOLE DRILLING

MAIN FAULTBLOCK

Hole Final depth (m) Depth to Rockhead (m)			Lidgett Coal				Haigh Moor Coal				Swallow Wood Coal				Remarks
			Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	
PH01	19.0	1.3	17.0	No	1.2	13.1	6.0	No	1.2	3.9	Beyond outcrop of coal				-
PH02	18.0	2.9	12.6	No	1.2	8.1	Beyond outcrop of coal								-
PH03	33.0	1.5	10.1	No	1.2	7.2									-
PH04	14.0	1.0	11.0	No	1.2	8.3									-
PH05	21.5	1.2	18.0	No	1.2	14.0	3.7	No	1.2	2.1					-
PH06	24.0	1.2	18.9	No	1.2	14.8	8.9	No	1.2	6.4					-
PH07	18.0	1.5	12.8	No	1.2	9.4	3.0	No	1.2	1.3					-
PH08	21.0	1.5	13.3	No	1.2	9.8	-	-	-	-	Beyond outcrop of coal				Soft and damp poor quality coal with clay 13.0m to 13.3m. Dark grey organic mudstone 2.7m to 3.5m
PH09	33.0	1.5	18.5	No	1.2	14.2	-	-	-	-					Organic mudstone 8.8m to 9.5m
PH10	27.0	1.9	21.7	No	1.2	16.5	-	-	-	-					Soft black organic MST with some coal 10.5m to 11.1m
PH11	24.0	1.8	18.2	No	1.2	13.7	7.0	No	1.2	4.3					Coal flash 3.6m to 3.7m. Soft, damp poor quality coal 6.5m to 7.0m
PH12	33.0	2.5	25.3	No	1.2	19.0	16.1	No	1.2	11.3	-	-	-	-	Organic mudstone with some coal 6.0m to 6.1m
PH13	30.0	2.3	25.0	No	1.2	18.9	16.0	No	1.2	11.4	6.0	No	0.6	2.3	-
PH14	35.0	2.0	31.0	No	2.0*	14.5	-	-	-	-	9.6	No	0.6	4.5	Dark grey organic mudstone 22.5m to 24.5m

Hole	Final depth (m)	Depth to Rockhead (m)	Lidgett Coal				Haigh Moor Coal				Swallow Wood Coal				Remarks
			Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	
PH15	30.0	2.0	26.2	No	1.2	20.2	17.7	No	1.2	13.1	-	-	-	-	Flash of coal 8.1m to 8.2m
PH16	27.0	2.0	23.3	No	1.2	17.8	13.3	No	1.2	9.4	2.2	No	0.6	0.8	-
PH17	27.0	2.2	22.9	No	1.2	17.3	15.0	No	1.2	10.7	4.7	No	0.6	1.9	Organic mudstone with rare coal 14.3m to 15m
PH21	30.0	2.3	26.3	No	1.2	20.0	-	-	-	-	9.5	No	0.6	3.9	Black organic mudstone 18.2m to 18.3m
PH22	36.0	2.2	31.6	No	1.2	24.5	-	-	-	-	10.2	No	0.6	4.4	-
PH23	32.0	2.0	27.6	No	1.2	21.3	-	-	-	-	10.5	No	0.6	-	Dark grey organic mudstone interbedded throughout borehole.
PH24	31.0	2.5	27.5	No	1.2	20.8	-	-	-	-	-	-	-	-	Flash of coal 16.9m to 17m. Dark grey organic mudstone 6.9m to 7.5m & 13.5m to 14.2m
PH25	36.0	2.4	27.5	No	1.2	20.9	-	-	-	-	4.6	No	0.6	1.7	Flashes of coal at 7.5m to 7.6m & 17.2m to 17.3m
PH26	30.0	0.5	1.1	No	1.2	0.5	Beyond outcrop of coal								-
PH27	36.0	2.5	4.4	No	1.2	1.6									-
PH28	15.0	1.2	9.5	No	1.2	6.9									-
PH29	18.0	1.5	11.7	No	1.2	8.5									-
PH30	15.0	1.5	9.1	No	1.2	6.3									-
PH31	18.0	2.0	13.1	No	1.2	9.3									Thin coal 2.9m to 3.2m
PH101	14.5	1.4	11.4	No	1.2	8.3	2.0	No	1.2	0.5	Beyond outcrop of coal				-
PH102	16.0	1.5	13.5	No	1.2	10.0	4.3	No	1.2	2.3					Wet poor quality coal 12.8m to 13.5m
PH103	16.0	1.5	15.0	No	1.2	11.3	2.1	No	1.2	0.5					-
PH104	15.0	1.0	13.5	No	1.2	10.4	4.4	No	1.2	2.8					-

Hole	Final depth (m)	Depth to Rockhead (m)	Lidgett Coal				Haigh Moor Coal				Swallow Wood Coal				Remarks
			Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	
PH105	20.5	1.5	18.7	No	1.2	14.3	10.5	No	1.2	7.5					-
PH106	20.5	1.6	17.6	No	1.2	13.3	6.7	No	1.2	4.3					Flash of coal at 4.3m
PH107	24.0	1.6	-	-	-	-	-	-	-	-					Dark grey mudstone 10.6m to 11.1m, coal traces in mudstone from 21.0m
PH108	12.0	1.4	Beyond base of hole				10.7	No	1.2	7.8					-
PH109	20.5	1.3	19.5	No	1.2	15.2	-	-	-	-					Dark grey mudstone 4.9m to 5.1m & 8.0m to 8.1m
PH110	32.5	1.1	31.4	No	1.2	25.3	-	-	-	-	9.8	No	0.6	8.4	Dark grey mudstone 16.8m to 16.9m & 20.0m to 20.2m
PH111	16.0	1.0	Beyond base of hole				-	-	-	-	-	-	-	-	Dark grey mudstone 7.3m to 7.5m & 14.4m to 14.5m
PH112	20.5	1.6	18.6	No	1.2	14.2	7.7	No	1.2	5.1	Beyond outcrop of coal				Flash of coal at 4.5m
PH113	29.5	1.4	26.3	No	1.2	20.8	-	-	-	-	-	-	-	-	Dark grey mudstone 5.0m to 5.2m & 15.0m to 15.1m
PH114	26.5	1.2	23.6	No	1.2	18.7	-	-	-	-	7.2	No	0.6	5.5	Flash of coal at 4.0m and dark grey mudstone 16.5m to 17.0m
PH115	32.5	1.3	28.4	No	1.2	22.6	19.0	No	1.2	14.8	7.7	No	0.6	5.5	Flash of coal at 4.6m and dark grey mudstone with coal bands 14.9m to 15.8m
PH116	26.5	1.3	-	-	-	-	-	-	-	-	1.5	No	0.6	0.7	Dark grey mudstone 11.2m to 11.5m & 20.4m to 21.2m (with coal bands)
PH117	14.5	1.6	-	-	-	-	Beyond outcrop of coal								Dark grey mudstone 7.0m to 7.8m
PH118	14.5	1.6	10.7	No	1.2	7.6									-

Hole	Final depth (m)	Depth to Rockhead (m)	Lidgett Coal				Haigh Moor Coal				Swallow Wood Coal				Remarks
			Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	
PH119	11.5	1.0	9.2	No	1.2	6.8									-
PH120	11.5	1.0	8.0	No	1.2	5.8									-
PH121	23.5	1.8	-	-	-	-	8.2	No	1.2	5.3	Beyond outcrop of coal				Dark grey mudstone 18.0m to 19.0m
PH122	20.5	1.5	-	-	-	-	-	-	-	-					Dark grey mudstone 7.1m to 8.1m & 18.0m to 19.1m
PH123	20.5	1.4	17.3	No	1.2	13.3	6.1	No	1.2	3.9					-
PH124	22.0	1.6	14.5	No	1.2	10.8	2.4	No	1.2	0.7					-
PH125	23.5	1.7	22.2	No	1.2	17.1	7.9	No	1.2	5.2					-

* Coal encountered in two leaves split by a mudstone parting, totalling 2m thickness – possibly the Flockton Thick seam

NORTHERN FAULT BLOCK

Hole	Final depth (m)	Depth to Rockhead (m)	Joan Coal				Flockton Thick Coal				Remarks
			Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	Depth to base (m)	Evidence of workings	Maximum thickness of seam (m)	Cover ratio*	
PH18	33.0	2.0	7.5	No	0.6	9.2	28.4	Yes	1.1	13.2	Void
PH19	42.0	2.5	10.2	No	0.7	11.0	-	-	-	-	Black carbonaceous Mudstone with some coal at 31.9m
PH20	31.0	2.0	-	-	-	-	27.9	Yes	1.1	13.0	Broken ground at 27.0m.

8 SOAKAWAY TEST RESULTS

8.1 UK Guidance

- 8.1.1 General notes about soakaways, including their location, design, and Lithos' test methodology are presented in Appendix A.
- 8.1.2 UK guidance does not explicitly state that soakaways cannot be constructed in made ground, but such construction is not generally considered good practice. There may be a risk of settlement caused by wash out of fine soil particles if soakaway waters are allowed to infiltrate into made ground. Furthermore, UK guidance does state that the soakaways should not be built where the presence of contamination could result in pollution of groundwater.
- 8.1.3 Given watertable depth and topography it is considered possible that springs will appear down-gradient.
- 8.1.4 CIRIA C753:2015¹ recommends that soakaways should not be constructed 'in ground where the watertable reaches a level within 1m below the base of the soakaway at any time of the year'.
- 8.1.5 BRE Digest 365 "Soakaway Design" advises that each soakaway pit should be filled and allowed to drain three times to near empty on the same or consecutive days.

8.2 Field tests

- 8.2.1 Soakaway tests were carried out within 5 trial pits in general accordance with BRE Digest 365² "Soakaway Design". The locations of the soakaways are shown on Drawing 1979/106 presented in Appendix B to this report.
- 8.2.2 Infiltration rates for each soakaway test have been calculated (where possible) in accordance with BRE Digest 365. This design takes into account time for the water level to fall from 75% to 25% of its effective depth. The effective depth is the difference between the starting water level and the soakaway pit base depth.
- 8.2.3 Where the water level did not fall to 25% effective depth within 3 hours the test was not considered suitable for calculation of an infiltration rate; this was the case for **unsuccessful** tests in TPs 16, 18, 19 and 20.
- 8.2.4 Three filling cycles were undertaken in TP15.
- 8.2.5 Calculated infiltration rates for the successful tests in TP15 are summarised in the table below, and copies of the associated calculations are presented in Appendix K to this report.

Soakaway	Stratum	Infiltration rate (m/s)	Remarks
TP15, Test 1	Cohesive Residual Soil (0.3-1.6m) Granular Residual Soil (1.6-1.8m) Weathered sandstone (1.8-2.2m)	7.11x10 ⁻⁵	-
TP15, Test 2		1.81x10 ⁻⁵	-
TP15, Test 3		1.70x10 ⁻⁵	-

¹ CIRIA C753. The SUDS Manual (2015).

² BRE Digest 365. Soakaway Design (1991).

8.3 Discussion & conclusions

- 8.3.1 Soakaways are generally only considered likely to provide a suitable drainage solution for the discharge of surface water run-off where vast majority of tests yield reasonable infiltration rates, which is not the case at this site.
- 8.3.2 In conclusion, given the results of the in-situ testing, groundwater levels and topography, soakaways are unlikely to provide a suitable drainage solution for the discharge of surface water run-off at the site; and therefore there may be a need for surface water balancing.
- 8.3.3 Drainage solutions are discussed further in Section 13.7.

9 CONTAMINATION (ANALYSIS)

9.1 General

- 9.1.1 The site has been formerly used as agricultural fields.
- 9.1.2 The site's former usage is considered unlikely to have given rise to any significant ground contamination. Furthermore, no significant made ground was encountered during the ground investigation. However, samples of topsoil have been recovered in order to confirm its suitability for re-use. Made ground encountered in TP04 has also been scheduled for testing.
- 9.1.3 An assessment of potential contaminants associated with the former uses has been undertaken; see Section 5.2.
- 9.1.4 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 CIEA default conceptual site model (CSM) used for generating SGVs, but amended, where appropriate, to be more specific to redevelopment within the planning process.
- 9.1.5 Where available, Category 4 Screening Levels (C4SL) have also been referenced.
- 9.1.6 Generic Note 04 in Appendix A provides further details with respect to current guidance and the interpretation of analytical data.

9.2 Testing schedule

- 9.2.1 Based on the above assessment, Lithos submitted a test schedule (summarised in the table below) to a UKAS accredited laboratory. Account has also been taken of visual and olfactory evidence recorded during the ground investigation.

Type of sample	No. of samples	Determinands
Made ground topsoil	1	pH, water soluble born, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID
Topsoil	11	TOC, Speciated Polycyclic Aromatic Hydrocarbons (PAH)

9.3 Soil contamination results

- 9.3.1 The soil contamination test results are summarised in the tables on page 29.
- 9.3.2 Laboratory test certificates as received from the laboratory are presented in Appendix I to this report.

Inorganic determinands

- 9.3.3 Of the 12 samples of analysed for inorganic parameters, all can be classified as uncontaminated.
- 9.3.4 The 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 the proposed end-uses).

Asbestos

- 9.3.5 No asbestos fibres were identified in any of the samples screened.

Organic determinands

- 9.3.6 This site is essentially greenfield and therefore for organic compounds, the Tier 1 Values 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 will be placed in gardens/landscaped areas (Lithos Scenario A).
- 9.3.7 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.
- 9.3.8 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.
- 9.3.9 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?
Top soil/made ground to top soil	4%	No

Polycyclic Aromatic Hydrocarbons (PAH)

- 9.3.10 There are numerous PAH compounds. The USEPA identified 16 PAHs that are considered to represent the most problematic in terms of toxicology, fate and behaviour. The UK have also focused on these 16 and these are included in the laboratory report where speciated PAH analysis has been scheduled.
- 9.3.11 Speciated PAH analysis has been undertaken in order to determine concentrations of the key "marker" compounds: benzo(a)pyrene (considered the most toxic of the PAHs); and naphthalene (the most mobile and volatile of the PAHs).
- 9.3.12 Speciated analysis has confirmed the absence of significant concentrations of both benzo(a)pyrene and naphthalene in the soils beneath this site.

Summary of degree of soils contamination

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.														Asbestos ID.
			pH	As ∞	B ~	Cd ∞	Cr x	Cu ♣ \$	Pb ∞	Hg *	Ni	Se	Zn \$	% TOC	PAH		
				B(a)P ∞	Naphthalene												
				37	5	26	3000	200	200	169	127	350	200		5	8	
TP01	0.2	Topsoil	8.4	24	0.5	0.3	17	33	63	0.1	18	0.5	93	3.2	0.2	< 0.1	N.D.
TP03	0.3	Topsoil	7.1	19	1.3	0.5	20	37	62	0.2	26	0.5	120	4.3	0.4	0.1	N.D.
TP05	0.3	Topsoil	7.6	13	0.8	0.3	16	27	44	0.1	16	0.3	91	4.6	0.1	< 0.1	N.D.
TP07	0.2	Topsoil	6.6	13	0.8	0.3	21	25	36	0.1	20	0.4	85	2.9	< 0.1	< 0.1	N.D.
TP09	0.2	Topsoil	7.3	18	0.7	0.3	20	26	62	0.1	19	0.3	91	4.1	< 0.1	< 0.1	N.D.
TP13	0.2	Topsoil	6.5	20	1.2	0.4	21	34	61	0.1	22	0.6	97	5.4	< 0.1	< 0.1	N.D.
TP16	0.2	Topsoil	6.7	21	0.7	0.4	20	32	58	0.1	20	0.4	110	3.8	0.3	< 0.1	N.D.
TP18	0.2	Topsoil	6.8	13	0.5	0.3	16	26	37	0.2	20	0.5	81	4.0	< 0.1	< 0.1	N.D.
TP20	0.2	Topsoil	6.3	18	0.9	0.3	21	35	59	0.2	22	0.5	92	4.9	< 0.1	< 0.1	N.D.
TP22	0.2	Topsoil	6.6	20	0.9	0.4	20	34	64	0.2	21	0.5	93	3.7	< 0.1	< 0.1	N.D.
TP25	0.2	Topsoil	5.4	13	< 0.4	0.2	19	24	38	0.1	24	0.4	120	3.3	0.2	0.4	N.D.
TP04	0.5	Made Ground Topsoil	7.1	24	0.8	0.6	21	59	130	0.3	30	0.4	200	4.5	2.5	0.2	N.D.

Key		Source of guidance trigger level	
36	Parameter tested for and found to be in excess of Tier 1 value.	With the exception of those annotated with one of the symbols below (∞, \$, ~), all Soil Screening Values in brackets above have been derived using CLEA v1.06.	
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.	∞	Category 4 Screening Level – SP1010, December 2013 (CLAIRe/Defra).
	Parameter not tested for.	\$	MAFF Code of Practice for Agricultural Practice for the Protection of Soil, 1998.
♣	Tier 1 Value is pH dependent.	~	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.
x	Assumes Cr III. If demonstrated Cr VI Tier 1 would be 21mg/kg.		
ND	No fibres detected (asbestos screen)	*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.

10 CONTAMINATION (QUALITATIVE RISK ASSESSMENT)

10.1 Topsoil

- 10.1.1 Topsoil, typically 300mm thick underlies the entire site. Testing suggests this material is chemically suitable for re-use.
- 10.1.2 Given the nature of the topsoil present on this site it would be expected to be suitable to support plant growth. However, no testing in accordance with BS3882:2015 Specification for Topsoil (N-P-K, clay content etc) has been undertaken to date.

10.2 Revised conceptual ground model (contamination)

- 10.2.1 No plausible contaminant linkages have been identified.

10.3 Waste classification

- 10.3.1 Some excess arisings (topsoil & subsoil) may be generated by excavations for foundations, sewers etc. If these are intended for retention and reuse on the site, they would be classed as clean naturally occurring soils and would not be considered waste, under the Waste Framework Directive.
- 10.3.2 Off-site disposal of surplus clean naturally occurring soils to land fill is not recommended. In accordance with the CLAIRE Code of Practice³ any excess natural soil arisings should be suitable for Direct Transfer to another development site, for use either as clean cover material, or bulk fill for use, without the need for waste legislation to be applied.

11 HAZARDOUS GAS

11.1 General

- 11.1.1 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
Off-site land fills (land adjacent to former Stafford Colliery)	Human health	Asphyxiation & explosion	Lateral migration, ingress & accumulation	Low: land fills are at considerable distance from site (>180m).
	Buildings	Explosion		
Shallow mine workings	Human health	Asphyxiation & explosion	Vertical migration, ingress & accumulation	Low: workings are at significant depth.
	Buildings	Explosion		

- 11.1.2 Given the above gas monitoring wells have been installed in 12 boreholes across the site. Details of the installations are given on the exploratory hole logs presented in Appendix G to this the report.
- 11.1.3 The generation potential of the gas source was initially considered to be Low. Consequently, in accordance with CIRIA Report C665, given the proposed residential end use, 9 visits have been scheduled over a 6-month period.

³ The Definition of Waste: Development Industry Code of Practice. CLAIRE, 2011.

11.2 Scope of works

11.2.1 A standard procedure was followed, in accordance with CIRIA guidance:

- Ambient oxygen concentration
- 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)

11.3 Monitoring results

11.3.1 Gas monitoring is now complete, and results are summarised below.

Well	Response zone	Range of methane concentrations (% v/v)	Range of carbon dioxide concentrations (% v/v)	Range of steady flow rates (litre/hour)
PH01A	3.0 – 6.0m (Mudstone, Siltstone & Coal)	0.0 – 0.0	1.4 – 3.5	0.0 – 4.8
PH03A	2.0 – 4.0m (Mudstone & Siltstone)	0.0 – 0.0	0.1 – 4.8	13.5 – 20.8
PH05A	2.5 – 5.5m (Mudstone, Siltstone & Coal)	0.0 – 0.0	0.9 – 3.8	6.8 – 17.0
PH06A	2.0 – 4.0m (Mudstone & Siltstone)	0.0 – 0.0	0.7 – 3.1	9.3 – 15.2
PH08A	2.0 – 4.0m (Mudstone & Siltstone)	0.0 – 0.0	1.6 – 6.6	3.6 – 11.0
PH10A	3.0 – 6.0m (Mudstone & Siltstone)	0.0 – 0.0	0.1 – 1.7	18.9 – 21.3
PH11A	3.0 – 6.0m (Mudstone & Siltstone)	0.0 – 0.0	0.4 – 2.3	0.1– 6.1
PH17A	2.0 – 4.0m (Mudstone & Siltstone)	0.0 – 0.0	0.1 – 1.4	18.4 – 21.0
PH20A	2.0 – 4.0m (Mudstone & Siltstone)	0.0 – 0.0	0.0 – 7.5	0.8 – 16.6
PH21A	3.0 – 6.0m (Mudstone & Siltstone)	0.0 – 0.0	0.0 – 8.0	2.6 – 20.3
PH29A	2.0 – 4.0m (Sandstone)	0.0 – 0.0	0.0 – 0.1	19.6 – 21.6
PH30A	2.0 – 4.0m (Sandstone)	0.0 – 0.0	0.0 – 0.6	17.7 – 20.0

Note: Atmospheric pressures varied between 1025mb and 979mb.

11.3.2 In accordance with the DEIR approach, a default value of 0.1 litres/hour has been used in the absence of any recorded flows; i.e. the limit of detection of the flow rate equipment.

11.3.3 During 3 of the 9 monitoring visits, atmospheric pressure was falling, including 1 visit where the pressure was below 1000mb. Plots of atmospheric pressure versus time, with the monitoring visits indicated, are included in Appendix L.

11.4 Discussion

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

11.4.2 The proposed residential development comprises low rise residential housing. Consequently, the gas regime has been characterised in accordance with the Situation B (traffic light) methodology outlined in CIRIA Report C665.

11.4.3 Based on worst-case (peak) gas concentrations and steady flows, Gas Screening Values (GSVs) for methane and carbon dioxide are **0.00** and **7.23** respectively. The carbon dioxide GSV of 7.23 equates to a Red gas regime (traffic light) for this site.

- 11.4.4 Significantly depleted oxygen readings have been detected in the majority of boreholes on all visits (often less than 10%, reaching as low as 0%). No methane was detected in any of the visits, and carbon dioxide concentrations were below the Amber 1 threshold of 5% on all visits with the exception of PHs 08A and 20A (maximum recorded of 8%).
- 11.4.5 Flow readings were highly variable, with peak readings reaching up to c.120 litres per hour, but usually decreasing to <10ltr/hr (often 0.0ltr/hr) during monitoring (around 10 minutes per borehole). A number of significantly higher positive steady flows were recorded (up to 90.4ltr/hr in PH11A on visit 8) during visits 8 and 9. During visits 8 and 9, flows were noted by the engineer as still decreasing albeit it very slowly (c. 0.1ltr/hr every 10 seconds).
- 11.4.6 It is considered likely that flow readings would have continued to decrease to values in line with those typically recorded across the remainder of the monitoring period (typically less than 10ltr/hr, but a maximum of 23.1 in PH11A on visit 1). Assuming a worst-case scenario of 23.1ltr/hr, the GSV for carbon dioxide would be 1.85, equating to an Amber 1 regime.
- 11.4.7 However, irrespective of the uncertainty in true range of steady flows, the depleted oxygen concentrations indicate the potential for 'blackdamp'. Blackdamp is characterized by low oxygen and high nitrogen. In shallow coal workings the gases are predominantly carbon dioxide. Carbon dioxide is produced by the bacterial degradation of the organic matter in coal residues. This bacterial action uses oxygen and produces carbon dioxide. Monitoring data which shows this reduction of oxygen (replaced by nitrogen), indicates a high rate of bacterial action in the mine workings and therefore the possibility of increasing concentrations of carbon dioxide in the future.
- 11.4.8 Furthermore, where mine workings are flooded (permanently or temporarily) the carbon dioxide dissolves into groundwater, meaning it may not be detected during monitoring at the surface.
- 11.4.9 The main source of gas at this site is deep mine workings. These are most likely flooded given their depth but are also likely to be affected by changes in groundwater levels. This is supported by the presence of shallow groundwater which clearly fluctuates throughout the monitoring period. Given the above, a precautionary approach to gas protection is recommended, in order to future-proof the development to changes in the ground gas regime (for example, if sites nearby are grouted and/or longer-term changes in groundwater levels). Therefore, it is recommended that a classification of **Amber 2** is applied.

Scope of protection measures

- 11.4.10 Based on the site characterisation (Traffic Light) discussed above, the proposed foundation solution, and with reference to the gas protection “scoring” system outlined in BS8485:2015+A1:2019, Lithos consider that the following protective measures should be incorporated in all new dwellings:

Traffic light classification and “score” req’d by BS8485#	Floorslab (BS8485 “score”)	Protective measures	
		Sub-floor ventilation (BS8485 “score”)	Membrane
			Type (BS8485 “score”)
Amber2 4.5	<i>Select one from:</i> i. Block & Beam – (0). ii. Reinforced ground bearing slab – (0.5). iii. Reinforced, cast in-situ suspended slab (with minimal and suitably sealed service penetrations & joints) – (1.5). iv. Reinforced ground bearing raft (with limited service penetrations cast into slab). Note: the venting area through any downstand beam should be 3 times greater than that provided by the side ventilation (airbricks) – (1.5).	<i>Select one from:</i> Passive sub-floor ventilation; venting layer could be: i. A min. 150mm clear void (2.5), or ii. A proprietary void former providing an equivalent clear void depth of 60mm; see Section B7 in BS8485 (2.5). Min. ventilation = 2,000 mm ² /m run of external wall (via airbricks on each of 2 opposite sides), with 100mm pipes at 1.3m centres or honeycombing of any sub-floor sleeper walls.	Gas resistant membrane meeting all of the following criteria: • sufficiently impervious to the gases with a methane gas transmission rate <40.0 m³/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floorslab); • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); • capable, after installation, of providing a complete barrier to the entry of the relevant gas; • a minimum 0.4 mm thickness (1600g polyethylene) reinforced membrane (virgin polymer) and • verified in accordance with CIRIA C735[∞] (2.0)

Scores are broadly based on those outlined in BS8485:2015+A1:2019 (for Characteristic Situations 2 & 3, and Building Type A).

* Modified from BS8485:2015+A1:2019 by Lithos. Monitoring data has also been reviewed using Wilson & Card methodology and found to be Characteristic Situation 2; consequently a lapped/sealed membrane & ventilation are recommended.

[∞] In accordance with CIRIA C735, a Verification Plan should be prepared which outlines the activities (inspection and testing), the relevant personnel, and the type of records to be collected. Gas membranes need to be visually inspected to establish possible damage. For Amber2 sites inspection & verification should be carried out by an independent third party. However, whilst conflicts of interest in verification should be avoided, the Developer's staff on site could undertake inspection & verification on Amber1 sites. In all circumstances, the verifier should be competent, experienced and suitably trained.

Note NHBC guidance only requires membranes to be fitted by a specialist contractor, and be fully certified, on Amber2 sites. However, BS8485 is considered to ‘outrank’ NHBC guidance, and it would be prudent to comply with this Standard and CIRIA C735. Furthermore, (YALPAG) local authorities have issued guidance requiring a detailed verification method statement in advance of the construction phase. This should address how gas measures will be installed and what verification information will be provided to demonstrate that installation has been carried out in accordance with the appropriate guidance.

1. A combination of two or more of the three types of protection measures (slab, ventilation & membrane) should be used to achieve the BS8485 score.
2. The membrane should always be lapped and sealed in accordance with BRE\Environment Agency Report BR 414 (2001) – “Protective Measures for housing on gas-contaminated land”. The membrane should be **continuous** across internal walls & the cavity, and there should be a **cavity tray** in external walls.
3. In all cases there should be minimum penetration of floorslab by **services**; any penetrations should be suitably sealed.
4. **Integral garages** with occupied rooms above, or direct access through a doorway from the garage to the house, should be provided with the same protective measures as the rest of the dwelling. Buildings with basement car parks (with ventilation in accordance with Building Regulations) may not require gas resistant membranes.
5. Check manufacturer's specification if **hydrocarbon** vapours are present; hydrocarbons will degrade some membrane materials.
6. If **radon** is the only gas of concern, adopt Green\CS2 protection for basic radon measures (but sub-floor ventilation not essential), and protection as per Amber2 for full radon measures.

Workmanship & certification

- 11.4.11 This site has been classified as Amber 2. Consequently, independent certification that the protective gas measures have been installed correctly is required to enable finaling of plots under the CML initiative (Certification is a Red item).
- 11.4.12 In order to ensure the effectiveness of gas protective measures, workmanship should be carried out by appropriately trained and qualified personnel.
- 11.4.13 In accordance with recent YALPAG guidance⁴, a detailed verification method statement should be issued to Bamsley Council in advance of the construction phase. This should address how the gas protection measures will be installed and what verification information will be provided to demonstrate the installation has been carried out in accordance with the appropriate guidance. As a minimum the report should include (but not be limited to):
- A summary of the gas risk assessment.
 - The gas protection measures proposed and confirmation they will meet the gas protection requirements for the life time of the development.
 - Technical drawings showing how the gas protection measures will be incorporated.
 - Formal qualifications/experience/training of the person carrying out the installation.
 - Formal qualifications/experience/training of the person carrying out the verification.
 - Clear demonstration of the independence of the person carrying out the verification.
 - The manufacturer's specification of the gas protection membrane to be used.
 - Full details of what the verification process will comprise and at what stage verification will be carried out.
 - Details of how any non-conformance will be dealt with.
 - Details of the number of plots to be validated.
 - Timeline of when during the build, each of the gas protection measures will be installed.
 - Details of management measures proposed to ensure how damage to the membrane will be prevented prior to the floor being installed, post installation.
 - Details of how all site personnel (including follow-on trades) will be made aware of the presence of the membrane and that damage to the membrane must be prevented.
 - Details of the extent of overlap and method of sealing.
- 11.4.14 BRE\Environment Agency Report BR 414 (2001) – "Protective Measures for housing on gas-contaminated land" provides a practical guide to good practice for the detailing and construction of passive soil gas protection measures for new residential development. Of particular relevance are a list of 'Watchpoints', which offer practical information for installation and buildability.
- 11.4.15 In addition to the plot-specific measures, in order to future proof the development, the developer could consider implementation of gas measures within street furniture (vent trenches etc) to help mitigate gas risks further.

Notes for designers & architects

- 11.4.16 Designers\Architects should be made aware of the importance of gas protection measures, and their house designs should take account of potential constraints associated with Building Regulations (most notably those relating to access thresholds, noise and insulation), flood mitigation measures, and utility providers (external meter boxes may have to be located away from air bricks) etc.

⁴ Verification Requirements For Gas Protection Systems - Technical Guidance for Developers, Landowners and Consultants. Yorkshire and Lincolnshire Pollution Advisory Group, December 2016.

11.5 Radon

- 11.5.1 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.
- 11.5.2 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.
- 11.5.3 The Public Health England UK radon map and the Landmark report indicate that the site is in an area where between 3% and 5% of homes are estimated to be above the action level, and basic radon protection measures are required in new dwellings.
- 11.5.4 In accordance with BRE211:2015⁵, basic radon measures simply comprise a barrier (membrane) laid within the floor construction, which is linked to a damp-proof course (DPC) within the walls of the building. The DPC to cavity walls should be in the form of a cavity tray to prevent radon entering the building through the cavity. Sealing of joints in the barrier and sealing around service penetrations are also required. A 1200-gauge polythene membrane should suffice, and sub-floor ventilation is not essential.
- 11.5.5 However, a building site is a harsh environment and barriers can easily become damaged during construction by operatives or equipment moving across or working over a completed section of barrier. As a consequence, where there is a risk of puncturing the membrane, stronger materials such as thicker or reinforced polyethylene sheet should be considered and it should be ensured that the membrane is well protected with sand or lean mix concrete before advancing construction.
- 11.5.6 BRE211:2015 highlights the importance of good practice and workmanship to ensure radon membranes are installed to a high standard and suggests regular supervision and inspection. Whilst there are no specific statutory requirements to inspect radon barriers, BRE and Lithos strongly recommend a programme of inspections.
- 11.5.7 It is not deemed necessary to inspect each barrier before it is covered but Lithos would suggest the first plot is inspected and 1 in 20 plots thereafter.

⁵ BRE Report BR211, 2007: "Radon: guidance on protective measures for new buildings"

12 GEOTECHNICAL TESTING

12.1 General

12.1.1 A total of 30 samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.

12.1.2 The geotechnical laboratory test results are presented in Appendix J to this report.

12.2 Atterberg limits

12.2.1 The plasticity indices of 12 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
Cohesive Residual Soil	12	11-33 (22)	18-38 (25)^	Medium

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

^ One sample yielded a result on non-plastic

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

12.2.2 For the purpose of foundation design, it is recommended that all cohesive soils be regarded as being of **medium** shrinkability.

12.3 Soluble sulphate and pH

12.3.1 In accordance with BRE Special Digest 1:2005, this site has been classified as greenfield with a mobile groundwater regime.

12.3.2 It is envisaged foundations will extend to depths of about 1m through natural strata and samples taken from this depth range have been submitted for pH and water-soluble sulphate (2:1 soil/water extract).

12.3.3 The highest water-soluble sulphate concentration and the lowest pH value for each soil type analysed are shown in the table below.

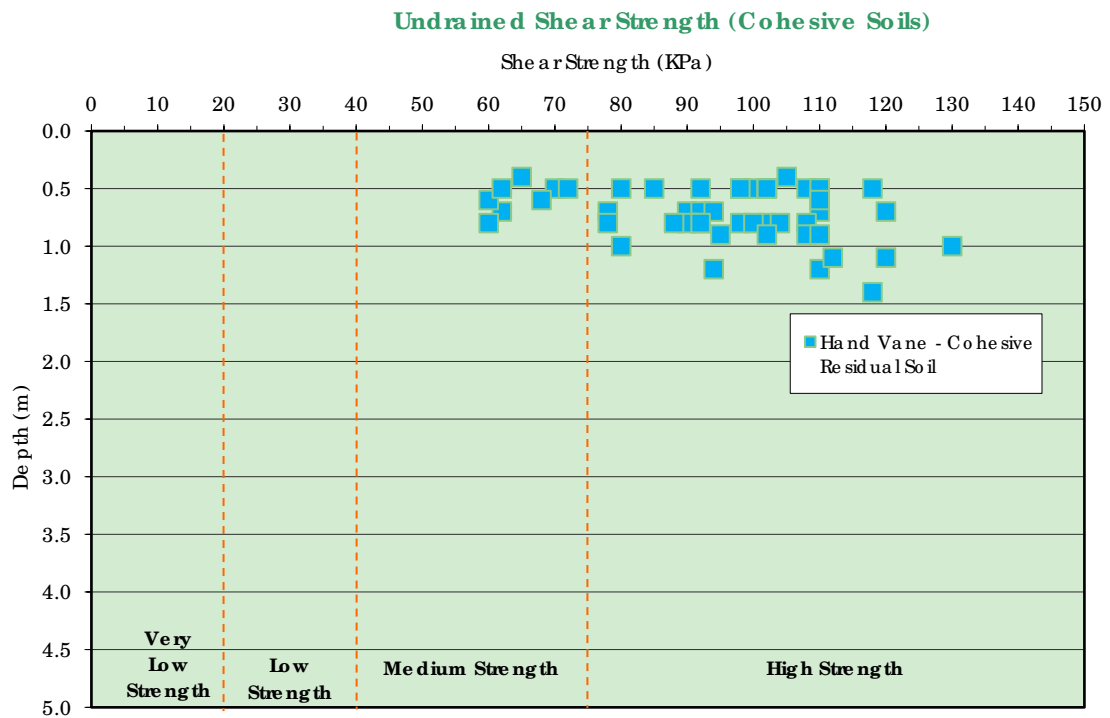
Soil type	No. samples tested	Lowest pH value	Highest soluble sulphate concentration (mg/l)
Cohesive Residual Soil	7	5.1	86
Granular Residual Soil	5	6.4	67
Coal	5	4.8	31
Mudstone	1	4.6	28

12.3.4 Given the low pH values recorded, additional testing (for chloride, magnesium and nitrate) was scheduled on 4 samples; all concentrations were all below 10mg/l and are therefore not considered significant.

12.3.5 At this stage, in accordance with Tables C1 and C2 of SD1, sub-surface concrete should be Design Sulphate Class **DS-1**, with the site allocated an AC EC Classification of **AC-2z**.

Hand shear vane testing

- 12.3.6 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.
- 12.3.7 The results are summarised within the plot below and illustrate a linear increase in undrained shear strength (S_u) with depth within the Cohesive Residual Soils. Below approximately 0.5m depth S_u is typically greater than 60kPa. The majority of readings lie within the high strength (>75kPa) range.
- 12.3.8 The plot below provides a summary of undrained shear strengths.



13 GEO TECHNICAL ISSUES

13.1 Conceptual site model

- 13.1.1 The site is underlain by medium and high strength clay (Cohesive Residual Soils) typically grading into sandy/clayey gravel (Granular Residual Soils), with bedrock below at depths of between 0.4m and 3.6m (average 2.3m).
- 13.1.2 Localised made ground was encountered in the west within the vicinity of a former reservoir, but only to very limited depth (0.6m).

13.2 Mining & quarrying

- 13.2.1 There are no known quarries on, or within 50m of the site.
- 13.2.2 This site is located within a Coal Mining Development High Risk Area.
- 13.2.3 In relation to coal mining, the site is split into two areas by the Champany Hill Fault; the main fault block (majority of site), and the northern fault block (far north-east).
- 13.2.4 Evidence of workings within the Flockton Thick seam (c. 1.1m thick) have been encountered beneath the northern fault block. These workings are considered to be at sufficient depth (>25m) so as to not pose any significant risk of subsidence at the site's surface.
- 13.2.5 Beneath the main fault block, no evidence of workings was encountered in any of the three seams which lie at shallow depth (Lidgett, Haigh Moor and Swallow Wood). In addition, the coal was generally of poor quality, suggesting perhaps that it was not worth working.
- 13.2.6 Consequently, it is considered unlikely that the site is underlain by shallow mine workings in the Lidgett, Haigh Moor and Swallow Wood seams.
- 13.2.7 It was considered possible that unrecorded "shallow" shafts (possibly bell pits) may be present at this site, and therefore a geophysical survey has been undertaken. Subsequent trial pitting targeting identified anomalies encountered no such mining features.
- 13.2.8 However, it should be noted that the geophysical survey may have missed such features if there is an insufficient contrast between shaft backfill and the surrounding ground. Based on the above, and the absence of any shallow mine workings, the presence of unrecorded shafts is considered highly unlikely but cannot be entirely discounted.

13.3 Site regrade

- 13.3.1 Given the undulating nature of the site, some earthworks regrade will be required to create level development platforms (i.e. cut and fill earthworks). This may also necessitate the use of retaining walls and possibly some underbuild & tanking.
- 13.3.2 Natural ground underlying this site is often clayey, therefore consideration should be given to the implication of undertaking earthworks in poor/wet weather when the ground surface is likely to become difficult to cross with heavy machinery.
- 13.3.3 Wherever possible, Lithos recommend that excavated soils are retained on site. However, if this is not possible the comments in Section 10.3 should apply.

13.4 Foundation recommendations

General

- 13.4.1 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.
- 13.4.2 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 the Developer should consider implications for the foundation recommendations outlined below.
- 13.4.3 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.
- 13.4.4 Sub-surface concrete in contact with natural ground should be Design Sulphate Class DS-1, with the site allocated an AEC Classification of AC-2z.

Strip/ trench fill footings

- 13.4.5 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for all two or three storey houses constructed at the site. Footings will be founded in medium/high strength clay, or the underlying granular residual soils/competent bedrock.
- 13.4.6 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.
- 13.4.7 Foundations will be required to be placed below a line drawn up at 45° from the base of any service or similar excavation.
- 13.4.8 Overdeepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.4.
- 13.4.9 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 a low water/cement ratio as possible).
- 13.4.10 Avant 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

- 13.4.11 Clay classification tests suggest that natural cohesive soils at the site should be regarded as being of medium shrinkability. A minimum founding depth of 900mm is therefore recommended for all soils on the site where strip footings are proposed.
- 13.4.12 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.
- 13.4.13 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that up to 20% of the site may be affected by trees.
- 13.4.14 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.
- 13.4.15 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)
- 13.4.16 It would therefore be prudent to prepare a detailed foundation schedule and seek approval from NHBC in order to determine likely foundation abnormalities.
- 13.4.17 A safe bearing capacity of around 160kPa, 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
 - An undrained shear strength of 60kPa for the firm clay (typical minimum recorded on site)
- 13.4.18 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

- 13.4.19 Where foundations are deepened (for example due to tree influence), excavations may encounter granular soils (or bedrock) at, or before the minimum required founding depth in clay. Indeed, locally, clay might be absent (for example, in the vicinity of TP06). Where this is the case, the foundations can be cast within the granular soils/bedrock, subject to a minimum founding depth of 450mm.
- 13.4.20 The granular residual soil is assumed to have a relative density of at least medium dense (in accordance with BS5930:2015).
- 13.4.21 A safe bearing capacity of around 160kPa, 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 0.45m
 - An angle of shearing resistance of $\phi=33^\circ$ for the granular deposits

- 13.4.22 Assuming the foundation geometry detailed above minimal settlements would be anticipated. However, further advice should be sought from the Structural Engineer responsible for foundation design.
- 13.4.23 In accordance with NHBC Standards, a minimum founding depth of 450mm (due to potential frost susceptibility) is required in granular soils. 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).
- 13.4.24 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.
- 13.4.25 Where ground level is being raised, it would be prudent to proof roll the exposed granular soils after stripping to soil (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).
- 13.4.26 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

- 13.4.27 The Coal Measures bedrock is generally considered to have a safe bearing capacity of at least 300kPa and minimal settlements would be anticipated.
- 13.4.28 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 overdeepening of foundations.
- 13.4.29 In places bedrock at the site comprises sandstone, siltstone and mudstone which can be excavated using a backhoe excavator and will be recovered as a tabular gravel. Where in-situ bedrock 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 lithorelics of mudstone) is likely to be a shrinkable soil; Mudstone is not.

Coal

- 13.4.30 Some excavations for foundations in may come into contact with coal. Care should be taken not to unnecessarily overdeepen foundations, in order to minimise the chance of encountering coal.
- 13.4.31 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.
- 13.4.32 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).

Geological fault

- 13.4.33 Drawing 1979/103 shows the approximate line of the Champany Hill Fault according to the CA and BGS plans.
- 13.4.34 It should be noted that the line of a fault on a geological map is often very approximate, and it may be inaccurate by 10m or more.
- 13.4.35 Three trial trenches were excavated in the far northeast of the eastern parcel where the geophysical survey yielded some evidence of the line of the Champany Hill Fault.
- 13.4.36 None of the trenches conclusively identified evidence of the fault although TTs 101 & 103 encountered a shallow coal seam which appeared to thin/terminate towards the south. In addition, a notable colour change in the shallow residual soils was noted in TT103.
- 13.4.37 Further advice should be sought if a significant weak zone is encountered (e.g. ground comprising loose, broken or soft 'gouge' material) during the excavation of footings. If associated with the fault, the weak zone is likely to form a fairly continuous 'linear belt', rather than a localised 'pocket', and be anything from a few centimetres to a few metres in width.
- 13.4.38 In accordance with NHBC requirements, all plots within 25m of its assumed line will require reinforcement comprising one layer of B385 mesh placed 75mm above the base of the footing. However, given uncertainty regarding the fault's location, and the presence of mine workings at around 20-30m depth north of the fault within the Flockton Thick seam, it is recommended that the footings of all plots within 40m of the assumed line are reinforced; see Drawing 1979/109.

13.5 Designated concrete mixes

- 13.5.1 Designated mixes are considered in BRE Special Digest SD1 and BS 8500 -1:2015+A1:2016. 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.
- 13.5.2 Consequently, Avant should seek advice from their appointed Structural Engineer.

13.6 Excavations

- 13.6.1 Groundwater should be controlled in accordance with CIRIA report 113 "Control of Groundwater for Temporary Works".
- 13.6.2 Based on the groundwater monitoring results, in excavations of greater than around 1.0m, some water seepage/s/inflows might occur which necessitate pumping (especially in wetter months of the year).
- 13.6.3 Excavations 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.
- 13.6.4 Bedrock was encountered in the majority of exploratory holes, especially in the eastern parcel. Based on the exploratory hole logs, excavation greater than 2.5m is likely to prove difficult across about 15% 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.

13.7 Drainage

- 13.7.1 Based on the results of the in-situ testing, topography and groundwater levels, 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.
- 13.7.2 Whilst the site does not lend itself to the adoption of discrete soakaways, ground may have the capacity to absorb surface water run-off, and systems which spread infiltration over a wider area (e.g. an infiltration basin, swales and/or pervious paving) may provide the best solution.
- 13.7.3 Alternative SUDS options (see CIRIA C753:2015 for further details) include:
- Swales – linear grassed features in which surface water can be stored or conveyed.
 - Pervious Pavements – provide a surface suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate into subsurface storage, with subsequent 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.
- 13.7.4 Yorkshire Water have published a guide⁶ for developers and designers outlining their design requirements for surface water attenuation assets.
- 13.7.5 With respect to detention basins, which should normally be dry, watertable 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.
- 13.7.6 Ground conditions must be suitable to allow free drainage from the detention basin all year round by having regard to groundwater levels, and impermeable liners are not to be used.
- 13.7.7 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.
- 13.7.8 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.
- 13.7.9 The guide also discusses required access to flow control chambers, large diameter (i.e. >900mm) surface water storage pipes, and surface water storage tanks.

⁶ Design Requirements for Surface Water Attenuation Assets, February 2017.

13.8 Highways

- 13.8.1 The natural soils present at shallow depth are predominantly cohesive. Based on visual inspection of the natural materials and the recorded plasticity indices at the site, published tables⁷ indicate that the cohesive residual soils would be expected to provide a CBR value of at least 4%. This should be verified prior to or during construction.
- 13.8.2 Where localised made ground is present it 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.

13.9 External works

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

14 REDEVELOPMENT ISSUES

14.1 General

- 14.1.1 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.
- 14.1.2 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.
- 14.1.3 If unanticipated ground is encountered during the construction phase, the Contractor should immediately seek further advice from the Engineer.

14.2 Good practice guidance

- 14.2.1 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 C502 'Environmental Good Practice on Site'
 - EA Pollution Prevention Guidelines⁸:
 - PPG 6 - Working at construction and demolition sites
 - PPG 2 - Above ground oil storage tank
 - PPG 7 - The safe operation of refuelling facilities.
 - PPG 21 - Incident Response Planning

⁷ Interim Advice Note 73/06 Revision 1 (2009), Chapter 5. Characterisation of Materials Design Guidance for Road Pavement Foundations - Draft HD25

⁸ Whilst this has formally been withdrawn it can still be accessed via the EA archives and provides useful information on managing risks.

14.3 New utilities

- 14.3.1 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.
- 14.3.2 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.
- 14.3.3 It is recommended that trenches for services including site drainage and water supply are cut oversize in order to isolate pipe materials from potential contaminants and to enable maintenance to be conducted in "clean" material.
- 14.3.4 This site is greenfield, and no previous or current usage of the site or its immediate surroundings is likely to have resulted in ground contamination. Furthermore, no significant made ground was encountered in any of the exploratory holes during the ground investigation.
- 14.3.5 Consequently, the use of 'standard' polyethylene water supply pipes should be acceptable, although Avant should consult Yorkshire Water at the earliest opportunity to confirm this.
- 14.3.6 This site investigation has enabled completion of Yorkshire Water's Contaminated Land Assessment Form, a copy of which is included in Appendix I.

14.4 Health & safety issues - construction workers

- 14.4.1 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.
- 14.4.2 Before site operations are started, the necessary COSHH statements and Health & Safety Plan should be drafted in accordance with the CDM regulations.
- 14.4.3 Localised made ground was encountered in the vicinity of a historical reservoir, but no elevated concentrations of contaminants have been identified.
- 14.4.4 However, simple precautionary measures are recommended to protect the health and safety of site personnel i.e. good personal hygiene and basic personal protective equipment.
- 14.4.5 General guidance on these matters is given in the Health & Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land".

14.5 Shallow coal in garden areas

- 14.5.1 Whilst there is no explicit guidance in NHBC Standards, liaison with NHBC suggests the instance 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.
- 14.5.2 Based on the findings of this investigation, and depending on final levels, this could be an issue for about 20% of the total site area.
- 14.5.3 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.
- 14.5.4 As with foundation arisings, the developer will need to contact the Coal Authority to dig or carry away excavated (incidental) coal.

14.6 Potential development constraints

- 14.6.1 Some 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.
- 14.6.2 The underground sewer presents 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 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

15.1 General

- 15.1.1 The site is located off Smithy Wood Lane, approximately 0.6km southeast of Dodworth, and currently comprises of two open fields. No former development is shown on historical OS plans, apart from a historical reservoir on the western parcel.
- 15.1.2 It is understood that consideration is being given to redevelopment of the site with traditional 2-storey domestic dwellings, associated gardens, POS and adoptable roads and sewers.
- 15.1.3 Made ground was encountered in the western parcel, associated with a historical reservoir.
- 15.1.4 Natural ground comprises medium and high strength clay (Cohesive Residual Soils) typically grading into sandy/clayey gravel (Granular Residual Soils), with bedrock (Mudstone, Siltstone and Sandstone), below at depths of between 0.4m and 3.6m (average 2.3m).
- 15.1.5 Coal or weathered coal was encountered in trial pits and during the intrusive mining investigation.

15.2 Mining

- 15.2.1 This site is located within a Coal Mining Development High Risk Area, and is underlain by known workings associated with the Flockton Thick Coal and possibly also unrecorded shallow workings in the Swallow Wood, Haigh Moor and Lidgett seams. Consequently, an intrusive mining investigation has been undertaken, comprising the drilling of 56 rotary probe holes.
- 15.2.2 Evidence of workings within the Flockton Thick seam have been encountered beneath the northern fault block. These workings are considered to be at sufficient depth so as to not pose any significant risk of subsidence at the site's surface.
- 15.2.3 Beneath the main fault block, no evidence of workings was encountered in any of the three seams which lie at shallow depth beneath the site (Lidgett, Haigh Moor and Swallow Wood). In addition, the coal was generally of poor quality, suggesting perhaps that it was not worth working. Consequently, it is considered unlikely that the site is underlain by shallow mine workings in the Lidgett, Haigh Moor and Swallow Wood seams.
- 15.2.4 A geophysical survey with subsequent trial pitting has not identified any unrecorded shafts/bell pits.

15.3 Hazardous gas

- 15.3.1 The site is in an area where 3% to 5% of homes are estimated to be above the radon action level, and basic radon protective measures are required.
- 15.3.2 Shallow coal and mine workings underlie the site and there are landfills within 250m of the site. Consequently, gas monitoring has been undertaken and, based on this assessment, Amber 2 protection measures are recommended in all plots.

15.4 Contamination & remediation

- 15.4.1 Whilst localised made ground was encountered in the vicinity of a historical reservoir, no elevated concentrations of contaminants for an end use that includes gardens have been identified.
- 15.4.2 Topsoil (typically 300mm thick) underlies the entire site. Testing suggests that this material is suitable for re-use.

15.5 Foundations

15.5.1 Strip footings are anticipated:

- Minimum 600mm depth in weathered bedrock and granular residual soils
- Minimum 900mm in cohesive residual soils

15.5.2 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that up to 20% of the site may be affected by trees.

15.5.3 Given existing topography, some earthworks re-grade is anticipated in order to allow development, and foundation solutions should be reviewed once any digital terrain modelling has been completed.

15.5.4 It is recommended that the footings of all plots within 40m of the assumed fault line are reinforced; see Drawing 1979/109.

15.6 Flooding

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

15.7 Drainage

15.7.1 Due to very slow infiltration rates, topography and shallow groundwater, soakaways are very unlikely to 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.

15.8 Highways

15.8.1 Based on visual inspection of the shallow natural materials and published guidance, the cohesive residual soils should provide a CBR value of at least 4%. This value should be verified prior to or during construction.

Appendix A

General Notes

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

Lithos obtain data from Landmark or Groundsure, 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 through 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 BR211¹, 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 2010². 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 Bq m⁻³ and 100 Bq m⁻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 2007³. 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 Bq m⁻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 and Target Levels should also be applied to non-domestic buildings with public occupancy exceeding 2,000 hours per year and to all schools.

Hydrogeology

Lithos obtain information from the Environment Agency (EA), 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

Lithos obtain information from the Environment Agency 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.

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.
- Cable percussive (Shell & Auger) boreholes, typically using 150mm diameter tools and casing.
- 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).
- 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.

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 stones¹ – 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).

¹ Mark Pe min. *Stone d – Sample Preparation for Soils Analysis. Ground Engineering, April 2007.*

02 - Ground investigation fieldwork

Generic notes – geoenvironmental investigations



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 4°C, until delivery to the selected laboratory.

Anticipated testing	Container(s)
Asbestos identification	500ml plastic tub
pH & metals, and non-volatile organics	500ml glass jar
Speciated TPH	500ml & 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.

Key to exploratory hole logs

Keys to logs are presented in the Appendix containing the logs. There are two Keys – Symbols & Legends and Terms & Definitions.

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:

$$I_p = I_p * (\% < 425\mu\text{m} / 100)$$

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 SO₄ 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:

- For stiff soils the effective overburden pressure*
- For firm soils "somewhat less" than the effective overburden pressure
- For soft soils "appreciably less" than the effective overburden pressure, usually 25 kPa or less
- 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 ϕ') 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 ϕ') 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 (SO₄), 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 C₆ to C₁₀). Also referred to as PRO – Petroleum Range Organics
- DRO – Diesel Range Organics (typically C₁₀ to C₂₈)
- LRO – Lubricating Oil Range Organics (typically C₂₈ to C₄₀)
- MRO – Mineral Oil Range Organics (typically C₁₈ to C₄₄)

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 C₅-C₄₀, whereas others define TPH as C₁₀-C₃₀.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictated by the nature of the source (eg 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 C₄ to C₅ 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 more than two 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 C₁₀ to C₄₀ (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 C₆ to C₈, aromatic C₁₀ to C₁₂ 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).

04 - Contamination analysis & interpretation (including WAC)

Generic notes – geoenvironmental investigations



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 Contaminated Land Report No. 11 (2004) "Model Procedures for the Management of Land Contamination". 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 and 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 and 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 (Version 1.071), Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

The approach set out in these documents represents current scientific knowledge and thinking; and includes the Contaminated Land Exposure Model (CLEAv1.06). The Environment Agency are in the process of using this updated approach to regenerate a selection of Soil Guideline Values (SGVs).

CLEA SGVs were derived for standard land use scenarios predominantly in the context of Part IIA, using a conceptual site model (CSM) defined in SR3. Lithos have incorporated amendments to the CSM used to derive SGVs, that more accurately reflect redevelopment within the planning regime; consequently, Lithos have not adopted any published SGV as a screening value.

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, where the average TOC value for a particular soil type is significantly lower than the 3.5%, evaluation of Lithos Screening Values should be undertaken and a site specific risk assessment will usually 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 four 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.
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.

04 - Contamination analysis & interpretation (including WAC)

Generic notes – geoenvironmental investigations



Lithos have assumed the source of contamination is directly below the building foundations; i.e. a depth of 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. This adjustment has been included to account for sites where made ground is re-engineered to enable new buildings to be established on raft foundations. In such situations contamination may lie directly beneath the foundation.

The Soil Screening Values referred to in this document are **not** intended to be used when considering potential risks associated with:

- Existing land uses in the context of Part IIA of the Environment Protection Act 1990;
- End uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; and
- Controlled waters.

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 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 new 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).

The Part 2A Statutory Guidance was developed on the basis that C4SLs could be used under the planning regime. However, policy responsibility for the National Planning Policy Framework falls to the Department for Communities and Local Government. 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 YAHPAC (collection of Yorkshire & Humberside local authorities) and received confirmation that they are satisfied with this approach.

With respect to **inorganic** determinands, Lithos derived Tier 1 values for the five Scenarios A to E are presented below:

Inorganic contaminant	Tier 1 assessment criteria (mg/kg) for Scenarios A to D							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			3,000		3,000	30,000	3,000	Assumes Cr is CrIII
Pb	450	200	200		310	2,330	200	C4SL adopted
Ni	130		127		127	1,700	127	Assessment of health risk only
Se	350		350		595	13,000	434	
Hg	170		169		238	3,640	199	Assumes in an inorganic compound
B			5		5	5	5	
Cu			80-200		80-200	80-200	80-200	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Zn			200		200	200	200	

With respect to **organic** determinands, Lithos derived Tier 1 values for the five Scenarios A to E are presented below:

Organic contaminant (all sourced via CLEA)	Tier 1 assessment criteria (mg/kg) for Scenarios A to D							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
Benzene	0.33	0.87	0.9	0.9	3.3	98	N/A	C4SL adopted
Toluene	610		600	3,000	2,700	5,000	N/A	Calculated value over 10,000
Ethyl Benzene	350		350	932	843	5,000	N/A	
Xylenes	240		246	327	321	5,000	N/A	
Phenol	420		412	2,400	519	5,000	N/A	
PCBs			2	8	2	38	N/A	Based on toxicity of EC7
Benzo(a)pyrene		5	5	25	5.3	76	5	C4SL adopted. Where source is not a coal tar
Naphthalene			8	9	9	1,000	12	
Gasoline Range Organics			30	34	34	5,000	45	See 3-step assessment of TPH below
Diesel Range Organics			151	156	154	5,000	219	
Lubricating Range Org			1,000	5,000	2,000	5,000	1,000	

* For residential 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 study¹

¹ SP1010 Appendix E, Provisional C4SLs for benzo(a)pyrene as a surrogate marker for PAHs, CL:AIRE 2013

04 - Contamination analysis & interpretation (including WAC)

Generic notes – geoenvironmental investigations



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.

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

Step 1 - Assessing indicator compounds

TPH fraction Indicator compound	End use specific screening value (mg/kg)			
	A: Residential no cover	B: Residential with 600mm cover	C: Residential no gardens	D: Commercial\ industrial
Benzene	0.9	0.9	3.3	98
Toluene	600	3,000	2,700	5,000
Ethyl Benzene	350	932	843	5,000
Xylenes	246	327	321	5,000
Naphthalene	8	9	9	1,000
Benzo[a]pyrene	5	25	5.3	76

Step 2 - Assessing individual TPH fractions

TPH fraction		End use specific screening value (mg/kg)			
		A: Residential no cover	B: Residential with 600mm cover	C: Residential with no gardens	D: Commercial/ industrial
Aliphatic 5-6	GRO	41	41	42	5,000 [^] per fraction
Aliphatic 6-8	GRO	125	125	125	
Aliphatic 8-10	GRO	31	31	32	
Aliphatic 10-12	DRO	151	156	154	
Aliphatic 12-16	DRO	500 [^]	500 [^]	500 [^]	
Aliphatic 16-21	DRO	1,000 [^]	5,000 [#]	1,000 [^]	
Aliphatic 21-35	LRO	1,000 [^]	5,000 [#]	1,000 [^]	
Aromatic 5-7	GRO	100	123	122	
Aromatic 7-8	GRO	30	34	34	
Aromatic 8-10	GRO	47	50	50	
Aromatic 10-12	DRO	215	287	266	
Aromatic 12-16	DRO	689	1,000 [*]	1,000 [*]	
Aromatic 16-21	DRO	1,000 [^]	5,000 [#]	1,000 [^]	
Aromatic 21-35	LRO	1,000 [^]	5,000 [#]	1,000 [^]	

* Calculated Screening Value exceeded soil saturation limit and could indicate free product, therefore calculated soil saturation limit adopted as a target

[^] Calculated Screening Value close to soil saturation limit, screening value selected by Lithos considering visual and olfactory impacts.

[#] Five times the screening value for Scenario A.

Step 3 - Assessing Cumulative Effects

$$HI = \sum_{i=1}^{15} HQ F_i = \frac{\text{Measured concentration } F_i \text{ (ug kg}^{-1}\text{)}}{SGV F_i \text{ (ug kg}^{-1}\text{)}}$$

where HI = Hazard Index
 HQ = Hazard Quotient
 F_i = Fraction i
 SGV = Soil Guideline Value

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 Soil Code” (MAFF, 1998) for copper and zinc. The CLEA SGV 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 ICRC 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 undertaken by comparing leachate or groundwater concentrations with the appropriate water quality standard. Tier 1 Screening Values have been discussed with the Environment Agency, and typically those in **bold** below are adopted.

Analyte	Source of Tier 1 Screening Value (µg/l)			
	Surface water (Abstraction for drinking) 1996	Water Supply Regulations 2000	Water Framework Directive	EA Advice
Arsenic	50	10	50	
Selenium	10	10		
Cadmium	5	5	1.5	
Chromium	50	50	32	
Copper	50	2,000	28	
Lead	50	10	7.2	
Nickel		20	20	
Zinc	3,000		125	
Boron		1,000		
Mercury	1	1	0.07	
Petroleum Hydrocarbons				10
1,1,1-Trichloroethane			100	
1,1 Dichloroethane				100
1,2-Dichloroethane		3	10	
1,1-Dichloroethene				100
Benzene		1	10	
Ethylbenzene				10
Tetrachloroethene		10	10	
Toluene			50	
Trichloroethene		10	10	
Vinyl Chloride		0.5		
Trichloromethane			2.5	
Xylenes			30	
Chloroethane				100

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**, and such waste must have been subjected to pre-treatment. 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 (eg 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 (eg 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 "*Guidance on Comparing Soil Contamination Data with a Critical Concentration - CL:AIRE and CIEH, May 2008*" 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. The CL:AIRE\CIEH document still refers to CLR 7, which suggests averaging area should reflect receptor behaviour and therefore might be a single garden, or an open area used by the local community as a play area. This approach to averaging areas is considered applicable within the context of Part IIA of the Environmental Protection Act (EPA) 1990, in terms of an existing residential development.

However, Lithos consider the concept of a single garden as an averaging area to be inappropriate with respect to brownfield redevelopment, which is regulated by the planning regime. In this context, contamination across 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; ie 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, ie contamination would normally be more pervasive and significant in granular soils than cohesive soils

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, 1999ⁱⁱⁱ

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.

A – All developments except low rise housing

(Wilson & Card, 1999)^v revised Table 28 of CIRIA 149^{iv} 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: Bore hole flow rate = volume of gas (regardless of composition) which is escaping from well (l/hr). Gas Screening Value (litre /hour) = gas concentration (%) / 100 x bore hole 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 ² (%v/v)	Gas Screening Value ^{3,4,5} (l/hr)	Typical Maximum Concentration ² (%v/v)	Gas Screening Value ^{3,4,5} (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:

- 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.
- 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.
- 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 5.63m³ has been considered.
- 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.
- 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.
- 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 of development proposals on site 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.

Background

Soakaways have been the traditional way to dispose of stormwater from buildings and paved areas remote from a public sewer or watercourse. In recent years, soakaways have been used within urban, fully-sewered areas to limit the impact on discharge of new upstream building works, and to avoid costs of sewer up-grading outside a development.

Soakaways are increasingly seen as a more widely applicable option alongside other means of stormwater control and disposal. Soakaways must store the immediate stormwater run-off and allow for its efficient infiltration into the adjacent soil. They must discharge their stored water sufficiently quickly to provide the necessary capacity to receive run-off from a subsequent storm. The time taken for discharge depends upon the soakaway shape and size, and the surrounding soil's infiltration characteristics. Soakaways can be constructed in many different forms and from a range of materials.

BRE Digest 365, DG365: 1991 describes design and construction procedures, explains how to calculate rainfall design values and soil infiltration rates, and gives design examples. Further advice is provided in **NHBC Standards Chapter 5.3** (Section 9 & Appendix F), **Building Regulations** Section 3 of Approved Document H (Drainage & Waste Disposal), and Chapter 13 of **CIRIA's SUDS Manual (C753:2015)**.

Soakaways should generally be built on land lower than or sloping away from buildings and be sited **at least 5m** from the foundations of a building.

BRE365 states that '**Groundwater should not rise to the level of the base of the soakaway** during annual variations in the water table' this is further reinforced in Chapter 13 of CIRIA C753:2015 which states that: "*A minimum distance of 1m between the base of the infiltration system and the maximum likely groundwater level should always be adopted. This is to minimise the risk of groundwater rising into the infiltration component and reducing the available storage volume, to protect the functionality of the infiltration process by ensuring a sufficient depth of unsaturated material and to protect the groundwater from any contamination in the run-off*". There may be a requirement to install groundwater monitoring wells at a site in order to monitor seasonal variations in groundwater level at least over a wet winter period.

Soakaways should **not be sited on sloping sites**, an assessment should also be made to ensure that infiltrating water will not cause a rise in groundwater levels, waterlogging of downhill areas or springs, and that slopes are not made unstable.

Made ground (and ground within 5m of deep fill) is not generally regarded as suitable for soakaways, due to the potential for inundation settlement and the leaching of contaminants.

Chalk: CIRIA C574:2002 notes that concentrated ingress of water into the chalk can initiate dissolution, particularly in low-density chalk. For this reason, soakaways should be sited well away from foundations for structures, roads or railways:-

- in areas where dissolution features are known to be prevalent, soakaways should be avoided but, if unavoidable, should be sited at least 20m away from foundations etc
- where the chalk is of low density (weak), or where density is not known, soakaways should be sited at least 10m away from foundations
- where the chalk is of medium density, or higher (moderately weak), soakaways should be sited at least 5m away from foundations

Test methodology

Lithos undertake soakaway tests in general accordance with BRE Digest 365 "Soakaway Design". The BRE Digest recommends that each soakaway pit is filled and allowed to drain three times to near empty; the three fillings to be on the same or consecutive days. However, each test can take over 2 hours to complete and therefore pits are often only filled and allowed to drain on one occasion, due to the time constraints imposed on the investigation

Three filling\drainage cycles are more important where drainage is primarily via fissures, most notably within a rock mass. Initial drainage within the rock mass may be high, as the fissures fill with water, giving the impression (if only one cycle is undertaken) that soakaways would be a suitable drainage solution. If infiltration through the matrix of the rock is low, then drainage from the test pit becomes slow as the fissures become saturated.

For non-fissile, granular soils infiltration is via the matrix, and consequently one filling\drainage cycle is generally considered sufficient. Soakaway pits are typically excavated to a depth of about 2.5m using a mechanical excavator equipped with a 0.3m wide bucket. The soakaway test pits are rapidly filled with water to the top of the test section. The fall in water level is then monitored at regular intervals.

Infiltration rates

Infiltration rates for each soakaway test are calculated (where possible) in accordance with BRE Digest 365. This design takes into account the time of emptying the soakaway pit between 25% and 75% of its effective depth. The effective depth is calculated from the starting water level to the soakaway pit base. Where the water level did not fall to 25% effective depth, the data was interpolated in order to obtain a representative infiltration rate.

Soakaway design

Soakaway design should be carried out by a suitably qualified and experienced Drainage Engineer, in accordance with BRE Digest 365 using the infiltration rates calculated from soakaway testing during a ground investigation.

It is generally assumed that soakaways become impracticable on residential developments when:

- A chamber type design requires a square pit with side length in excess of 1.8m, or an effective depth greater than 1.5m.
- A trench type design requires a length greater than about 10m, or an effective depth greater than 1.5m.

Increasing the soakaway effective depth might offer a solution, but consideration should be given to:

- Standing groundwater level
- Depth to base of permeable strata
- Cost of excavation

Soakaway percolation in some rock types is predominately via the vertical joints within the rock mass. The relatively small-scale soakaway test pits may not intercept such joints and this can result in variable test results. However, it is likely that the larger surface area of a completed soakaway within the development will intercept such joints.

Appendix B

Drawings



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Tel 01937 545330

CLIENT

THE
WENTWORTH
TRUSTEES

JOB TITLE

SMITHY WOOD
LANE

DRAWING TITLE

SITE LOCATION
PLAN

DRAWN

LT

DATE

03 07 2020

CHECKED

MT

DATE

03 07 2020

STATUS

FOR COMMENT ☐

DRAFT ☐

FOR APPROVAL ☐

FINAL ☒

SCALE

1:25,000

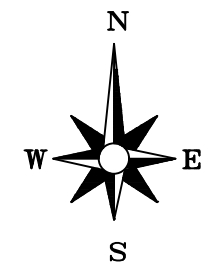
SHEET

A4

DRAWING NO.

1979/101

REVISION



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Tel 01937 545330

THE
WENTWORTH
TRUSTEES &
AVANT HOMES

SMITHY WOOD
LANE,
DODWORTH

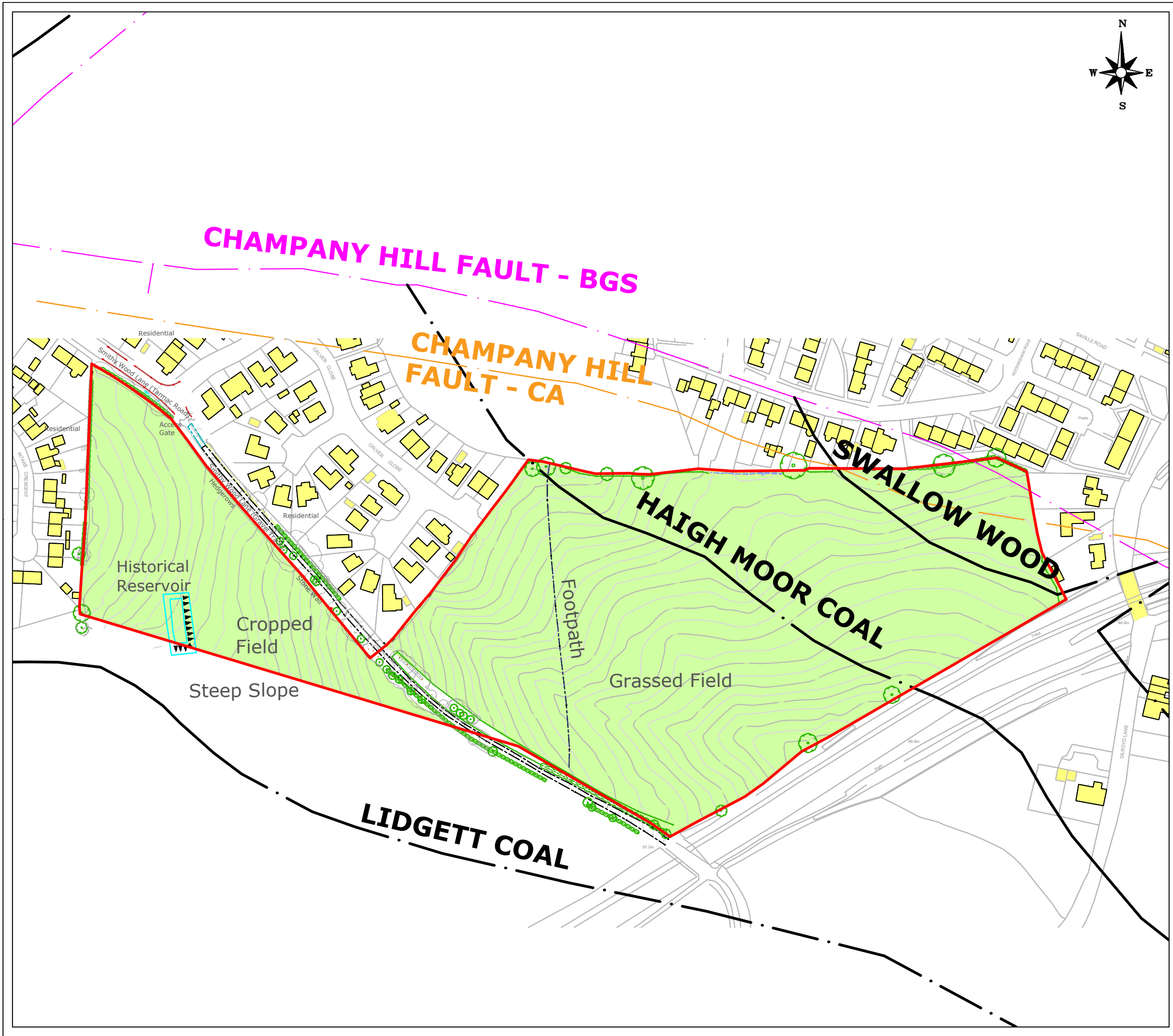
PROPOSED SITE LAYOUT

— APPROXIMATE SITE BOUNDARY

REPRODUCED FROM AVANT HOMES
DRAWING REFERENCE DRAFT LAYOUT SK02,
DATED OCTOBER 2020

REV.	DESCRIPTION	DATE

STATUS	
FOR COMMENT ☐	FOR APPROVAL ☐
DRAFT ☐	FINAL ☒
DRAWN LEW	DATE 25 03 21
APPROVED REG	DATE 25 03 21
SCALE Not to scale	SHEET A3
DRAWING NO. 1979/102	REVISION

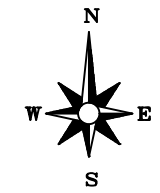


NOTES		
	TREES & HEDGES	
	GRASS & CROPPED AREAS	
	BUILDING	
	APPROXIMATE LINE OF BGS GEOLOGICAL FAULT	
	APPROXIMATE LINE OF COAL SEAM OUTCROP	
	APPROXIMATE LINE OF C.A GEOLOGICAL FAULT	
	APPROXIMATE SITE BOUNDARY	
REV.	DESCRIPTION	DATE



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CLIENT		
THE WENTWORTH TRUSTEES		
JOB TITLE		
SMITHY WOOD LANE		
DRAWING TITLE		
SITE FEATURES		
DRAWN	DATE	STATUS
LT	03 07 2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
MT	03 07 2020	DRAFT ☐
SCALE	SHEET	DRAWING NO.
1:2,000	A3	1979/103
		REVISION



NOTES

- GRASS & OVERGROWN AREAS
- APPROXIMATE SITE BOUNDARY
- LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE



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CLIENT

THE
WENTWORTH
TRUSTEES

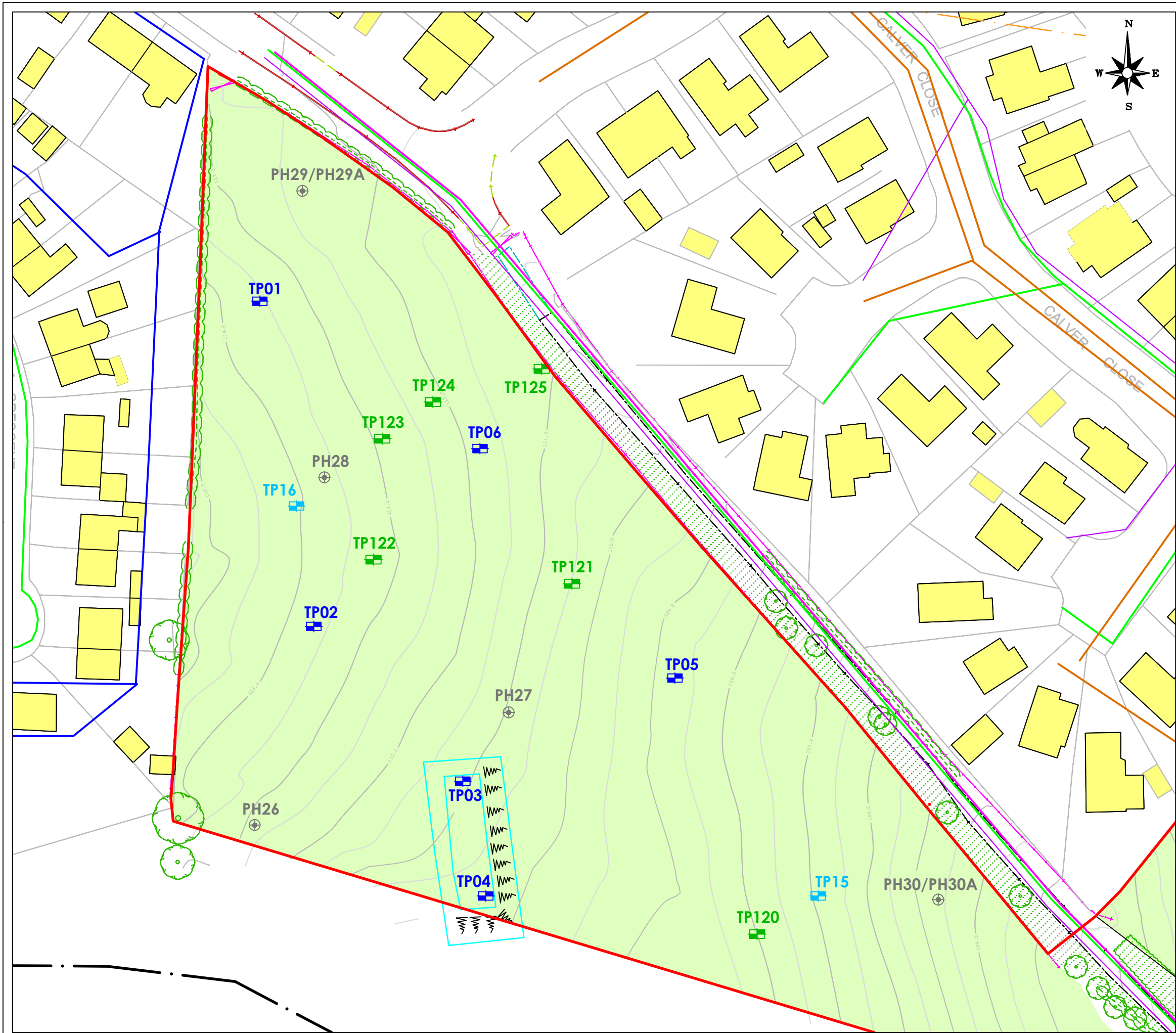
JOB TITLE

SMITHY WOOD
LANE

DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	LT	DATE	03 07 2020	STATUS	FOR COMMENT	☐	
CHECKED	MT	DATE	03 07 2020	FOR APPROVAL	DRAFT	☐	
				FINAL		☒	
SCALE	NOT TO SCALE	SHEET	A3	DRAWING NO.	1979/104	REVISION	



NOTES

- TRIAL PIT LOCATION (APR '20)
- TRIAL PIT/SOAKAWAY LOCATION (APR '20)
- TRIAL PIT LOCATION (APR '21)
- PROBEHOLE LOCATION (JUN '20)
- GRASS & OVERGROWN AREAS
- BUILDING
- LINE OF ELECTRICITY UTILITY
- LINE OF GAS UTILITY
- LINE OF WATER UTILITY
- LINE OF SEWER/DRAINAGE UTILITY
- LINE OF BT/TELECOMMS UTILITY

NOTE THAT UTILITY LOCATIONS SHOULD NOT BE RELIED UPON FOR CONSTRUCTION PURPOSES, NOR SHOULD IT BE ASSUMED THAT ALL UTILITIES BENEATH THE SITE ARE SHOWN ON THIS PLAN. THERE MAY BE UTILITIES UNKNOWN TO LITHOS. THIS DRAWING IS NOT AN ALTERNATIVE TO VISUAL INSPECTION, USE OF A CAT DETECTION TOOL AND CAREFUL EXCAVATION.

- PUBLIC FOOTPATH
- APPROXIMATE SITE BOUNDARY

A	SUPPLEMENTARY TRIAL PITS ADDED	19 04 21
REV.	DESCRIPTION	DATE

info@lithos.co.uk
www.lithos.co.uk
Tel 01937 545330

CLIENT

THE WENTWORTH TRUSTEES & AVANT HOMES

JOB TITLE

SMITHY WOOD LANE, DODWORTH

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS - WESTERN PARCEL

DRAWN	LEW	DATE	03 07 2020	STATUS	FOR COMMENT	☐
CHECKED	REG	DATE	03 07 2020	FOR APPROVAL	DRAFT	☐
				FINAL		☒

SCALE	1:750	SHEET	A3	DRAWING NO.	1979/106A	REVISION	A
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NOTES		
	TRIAL PIT LOCATION (APR '20)	
	TRIAL PIT/SOAKAWAY LOCATION (APR '20)	
	TRIAL PIT LOCATION (APR '21)	
	PROBEHOLE LOCATION (JUN '20)	
	PROBEHOLE LOCATION (MAR '21)	
	PROBEHOLE WITH SPOT CORE LOCATION (MAR '21)	
	GRASS & OVERGROWN AREAS	
	BUILDING	
	LINE OF ELECTRICITY UTILITY	
	LINE OF GAS UTILITY	
	LINE OF WATER UTILITY	
	LINE OF SEWER/DRAINAGE UTILITY	
	LINE OF BT/TELECOMMS UTILITY	
NOTE THAT UTILITY LOCATIONS SHOULD NOT BE RELIED UPON FOR CONSTRUCTION PURPOSES, NOR SHOULD IT BE ASSUMED THAT ALL UTILITIES BENEATH THE SITE ARE SHOWN ON THIS PLAN. THERE MAY BE UTILITIES UNKNOWN TO LITHOS. THIS DRAWING IS NOT AN ALTERNATIVE TO VISUAL INSPECTION, USE OF A CAT DETECTION TOOL AND CAREFUL EXCAVATION.		
	PUBLIC FOOTPATH	
	APPROXIMATE SITE BOUNDARY	
A	SUPPLEMENTARY EXPLORATORY HOLES ADDED	19 04 2021
REV.	DESCRIPTION	DATE



info@lithos.co.uk
www.lithos.co.uk
Tel 01937 545330

CLIENT

THE
WENTWORTH
TRUSTEES &
AVANT HOMES

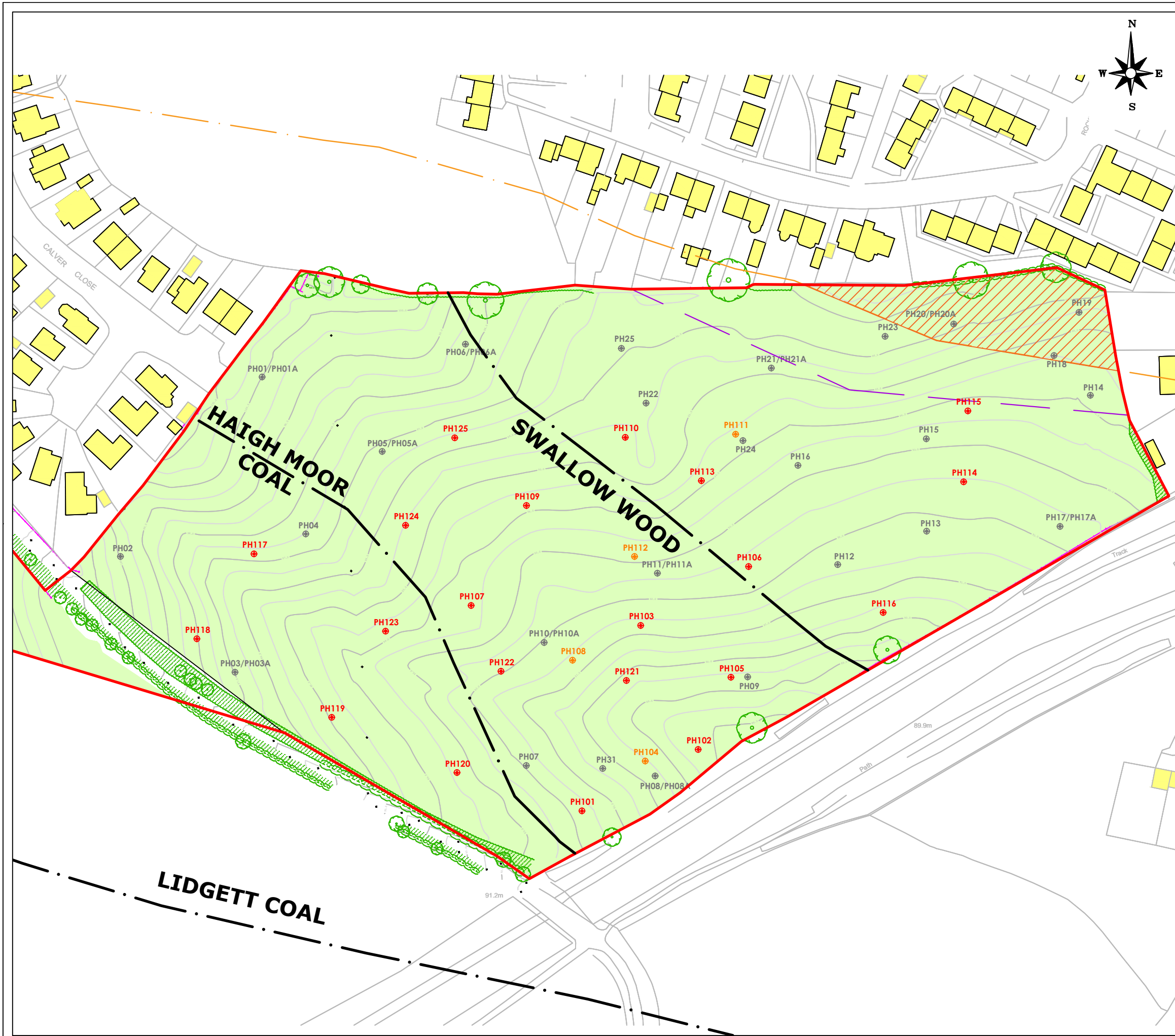
JOB TITLE

SMITHY WOOD
LANE,
DODWORTH

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS -
EASTERN PARCEL

DRAWN		DATE		STATUS	
LEW		03 07 2020		FOR COMMENT ☐	
CHECKED		DATE		FOR APPROVAL ☐	
REG		03 07 2020		DRAFT ☐	
				FINAL ☒	
SCALE		SHEET		DRAWING NO.	
1:1250		A3		1979/106B	
				REVISION	
				A	



NOTES

- PROBEHOLE LOCATION (JUN '20)
- PROBEHOLE LOCATION (MAR '21)
- PROBEHOLE WITH SPOT CORE LOCATION (MAR '21)
- GRASS & OVERGROWN AREAS
- BUILDING
- AREA OF SHALLOW WORKINGS IN FLOCKTON THICK SEAM (BASED ON ABANDONMENT PLAN)
- APPROXIMATE LINE OF COAL SEAM OUTCROP (BASED ON PH FINDINGS)
- APPROXIMATE LINE OF GEOLOGICAL FAULT (BASED ON ABANDONMENT PLAN)
- POSSIBLE ALTERNATIVE LINE OF GEOLOGICAL FAULT (BASED ON PH FINDINGS)
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE
A	SUPPLEMENTARY PROBEHOLES ADDED	19 04 2021



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www.lithos.co.uk
Tel 01937 545330

CLIENT

THE WENTWORTH TRUSTEES & AVANT HOMES

JOB TITLE

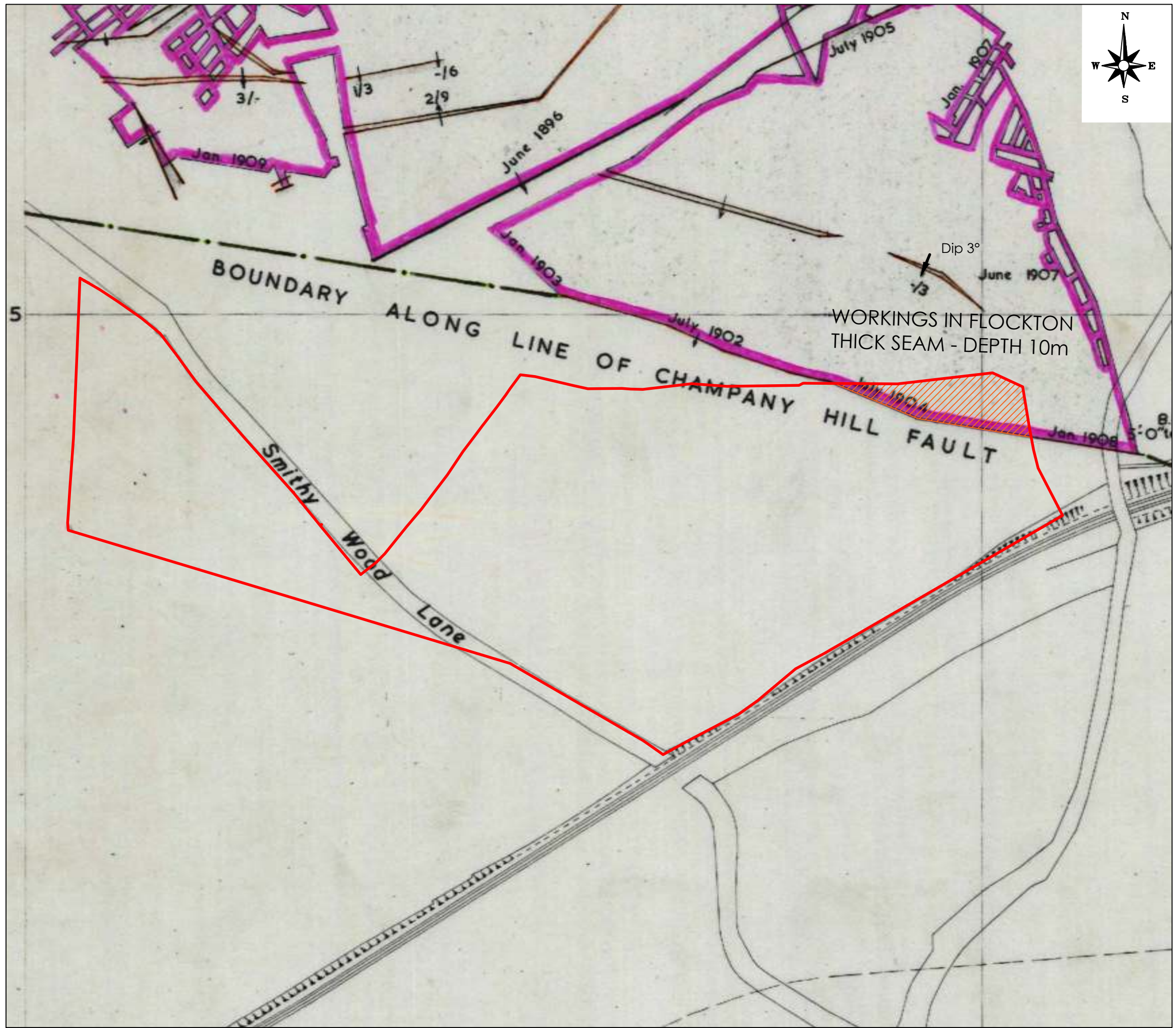
SMITHY WOOD LANE, DODWORTH

DRAWING TITLE

COAL SEAM OUTCROP ACCORDING TO SI

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CHECKED	REG	DATE	03 07 2020	FOR APPROVAL	DRAFT	☐
				FINAL	☒	

SCALE	1:1250	SHEET	A3	DRAWING NO.	1979/108	REVISION	A
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NOTES

- APPROXIMATE SITE BOUNDARY
- AREA OF SHALLOW WORKINGS IN FLOCKTON THICK SEAM

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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www.lithos.co.uk

Tel 01937 545330

CLIENT

THE WENTWORTH TRUSTEES

JOB TITLE

SMITHY WOOD LANE

DRAWING TITLE

CA ABANDONMENT PLAN NE584

DRAWN	LT	DATE	03 07 2020	STATUS	FOR COMMENT	☐
CHECKED	MT	DATE	03 07 2020	FOR APPROVAL	DRAFT	☐
SCALE	1:2000	SHEET	A3	DRAWING NO.	1979/I10A	REVISION



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THE
WENTWORTH
TRUSTEES &
AVANT HOMES

SMITHY WOOD
LANE,
DODWORTH

PROPOSED SITE LAYOUT &
PLOTS REQUIRING
REINFORCED FOOTINGS

NOTES		
— APPROXIMATE SITE BOUNDARY		
REPRODUCED FROM AVANT HOMES DRAWING REFERENCE DRAFT LAYOUT SK02, DATED OCTOBER 2020		
⊠ REINFORCED FOOTINGS REQUIRED		
REV.	DESCRIPTION	DATE

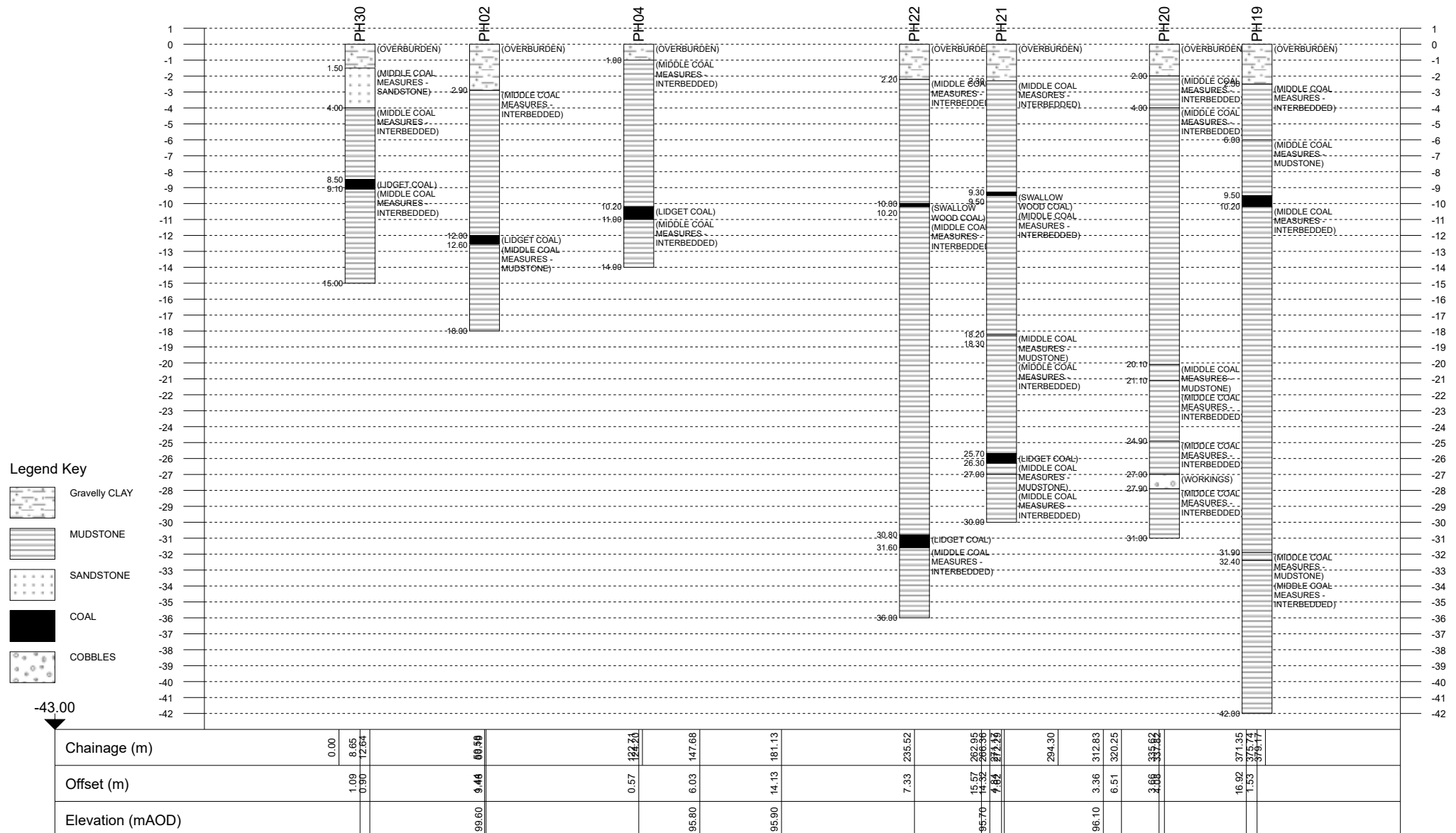
STATUS		FOR COMMENT ☐	FOR APPROVAL ☐	DRAFT ☐	FINAL ☒
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APPROVED	REG	DATE	25 03 21		
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DRAWING NO.	1979/109	REVISION			

Title: Section line 1

Vertical Scale: 1:337

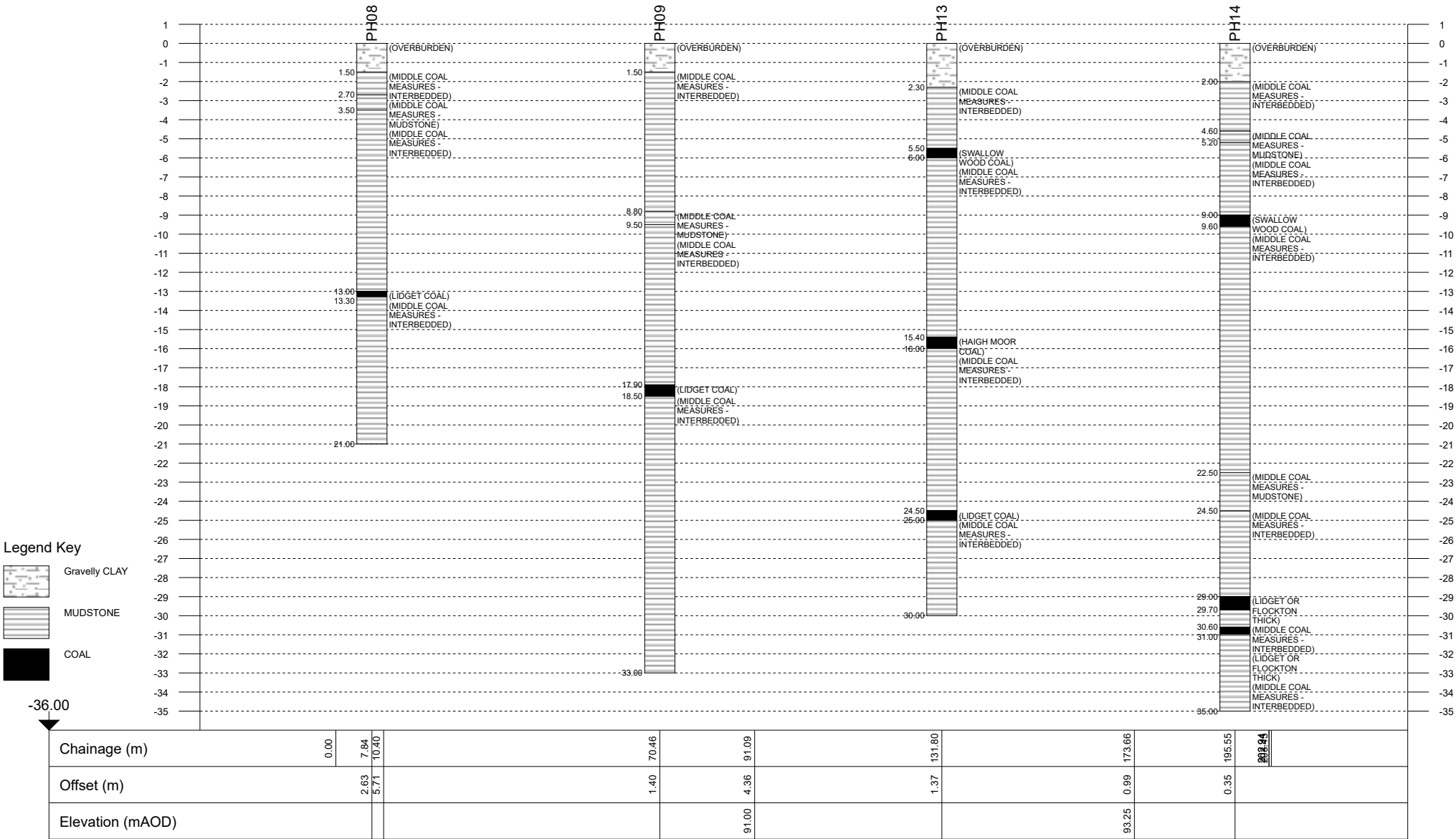
Horizontal Scale: 1:2197

Engineer: LT



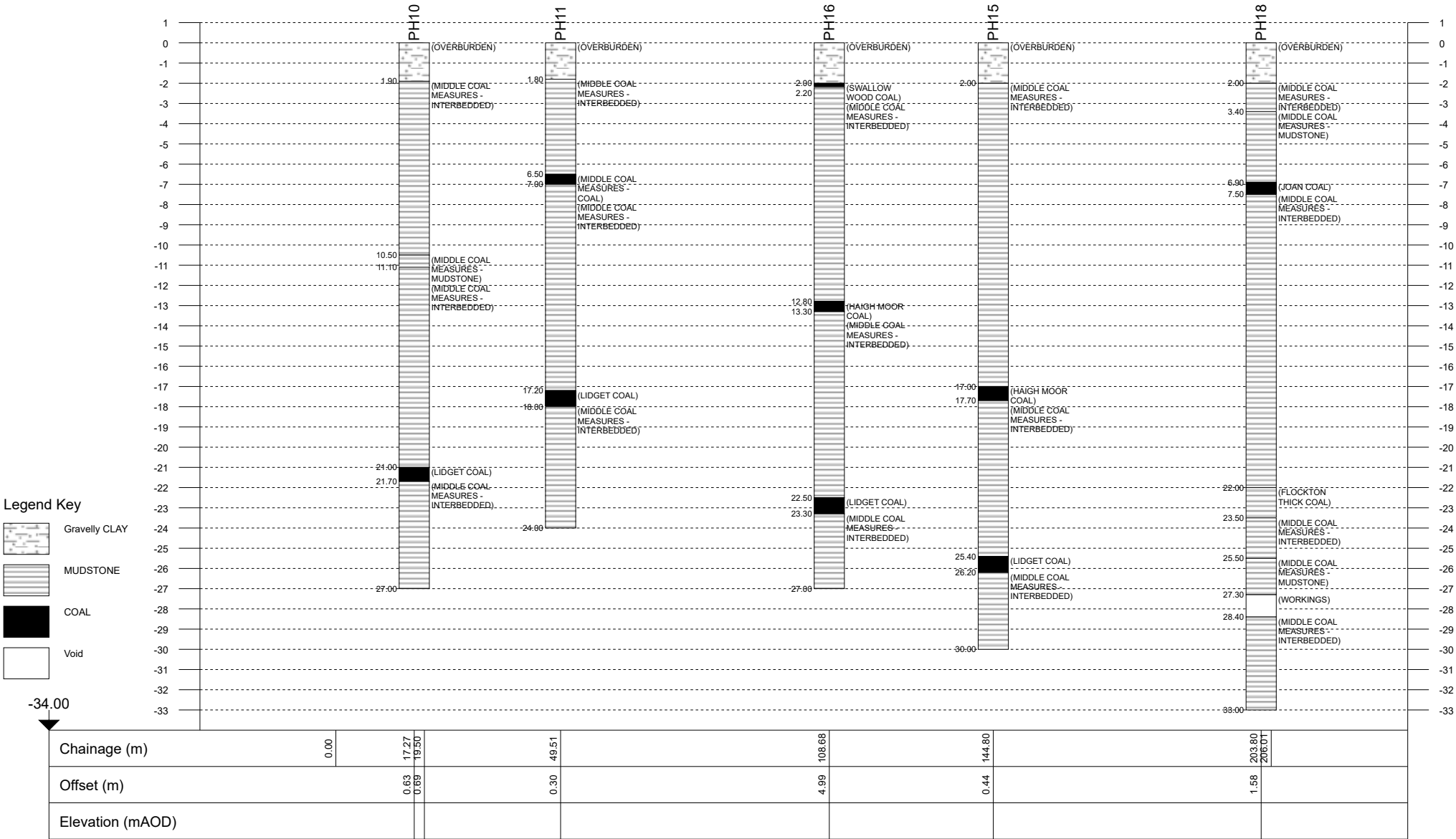
Project Id: 1979
Project Title: Smithy Wood Lane, Dodworth
Location: Dodworth
Client: The Wentworth Trustees

Title: Section line 2
Vertical Scale: 1:284
Horizontal Scale: 1:1179
Engineer: LT



Project Id: 1979
Project Title: Smithy Wood Lane, Dodworth
Location: Dodworth
Client: The Wentworth Trustees

Title: Section line 3
Vertical Scale: 1:268
Horizontal Scale: 1:1194
Engineer: LT



Appendix C

Commission

012/1979/MJT

21st February 2020

Mr J Franklin
Savills
3 Wellington Place
Leeds
LS1 4AP



Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

t 01937 545 330

www.lithos.co.uk

Dear Josh

Smithy Wood Lane, Dodworth

Further to your recent invitation, please find attached our proposal for undertaking a site investigation on the above land. We understand that your client's site is being marketed for proposed residential development, including traditional 2 storey domestic dwellings with associated gardens, POS and adoptable roads and sewers; although no layout is available yet.

Review of the information supplied suggests that the site consists of two parcels of land of approximately 1.0 hectare and 4.4 hectares west and east of Smithy Wood Lane respectively. Review of Google Maps suggests both parcels are in use as arable farmland.

Lithos have previously issued a Preliminary Geoenvironmental Appraisal Report (ref. 1979/1 dated June 2015) to the Wentworth Trustees. This report focussed on the smaller parcel of land in the west, but included search information from Landmark and the Coal Authority for the whole site.

Key findings of Report 1979/1 were that the site:

- Appears to have remained undeveloped throughout its history, with the exception of a former reservoir in the south-west,
- Is located within 250m of two landfill sites,
- Is not within a groundwater source protection zone,
- Is underlain by up to 3 coal seams at shallow depth.

Brief examination of the relevant geological map suggests the site is underlain by undifferentiated Coal Measures strata with no overlying drift deposits.

This site is located within a Coal Mining Development High Risk Area, therefore an up to date consultant's mining report will be obtained. Based on examination of the geological map, the majority of the site is likely to be at risk from any workings within the Lidgett Coal seam, and the north-east is at risk from both the Swallow Wood and Haigh Moor coal seams.

It might be that abandonment plans are available for any shallow mineworkings beneath the site. If so, we would normally obtain copies from the Coal Authority at an additional cost of £*** (initial enquiry), plus £*** for each plan.

Due to the presence of shallow coal the Local Authority may consider the site to lie within a Mineral Safeguarding Area. As a consequence of this and the NPPF, the Local Authority may require you to consider the opportunity to recover (extract) the coal. Our report will include an assessment of the feasibility of coal extraction.

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 £***.



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: Environmental search data and historical maps (which we already have on file), 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.

We will also visit site to undertake a walkover survey.

Fieldwork: We have allowed for 2 day's trial pitting (around 25no. trial pits), and 5 day's rotary open probing to assess risks from coal mining. 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.

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.

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.

Soakaway testing will also be carried out in at least 5 pits in order to assess suitability of the ground for house and highway surface water drainage. This will provide an 'initial sweep' at relatively wide spacings and often with only 1 or 2 fills. It should be noted that if the initial soakaway tests yield satisfactory results, in order to obtain approvals from the LLFA, Highways etc, the drainage designer is likely to require further testing: (a) within 25m of proposed chamber locations; and (b) to include 3 fills.

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 site is underlain by the Swallow Wood, Haigh Moor and Lidget coal seams, and therefore we have allowed for the drilling of around 30 **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 much of the western parcel), 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.

Exploratory holes will be positioned a hand-held GPS (typically +/- 3m accuracy); if required we could arrange for a **surveyor** to pick-up exploratory holes (and provide co-ordinates/ground levels) for an E\O cost of £***.

Given the likely presence of shallow mineworkings and two landfills within 250m, we have allowed for the installation of wells in 12 holes 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 12 moisture content & Atterberg limits, and 15 pH & water-soluble sulphate.

This site is greenfield and therefore we could obtain in-situ CBR values from plate tests on site. However, at this stage routes, formation level and total length, of proposed estate roads are unknown. Consequently, we will simply estimate CBR values from strata descriptions and classification test results.

The site is understood to be essentially Greenfield, and therefore testing of potentially **contaminated** samples should only be required if made ground is encountered in the exploratory holes. However, we have allowed for analysis of topsoil (12 samples) to confirm its suitability for re-use. The test suite will include heavy metals and speciated PAH.

Within in our proposal we have allowed for the screening (ID) of 12 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 3 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.

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, B, C, D & E) within 5 days of fieldwork completion, with exploratory hole logs and an interim letter report outlining our initial findings
- 2nd milestone invoice (Items F, G & H) on issue of the final SI report
- 3rd and final invoice (Item I) 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 last for at least 3 working days and therefore this proposal includes for provision of a Welfare Unit, with the benefit of full canteen facilities, hot water with full size sink, toilet and drying room.

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).

If you have copies of the necessary utility plans (including electricity, gas, water, drainage & telecom), 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.

Terms & conditions: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

At the time of writing, we understand that our report is solely for Wentworth Trustee's benefit. However, it is anticipated that eventually a third party (the Developer) will wish to rely on our report. We confirm that we will assign, free of charge, the benefit of our Report(s) to the Developer on receipt of an instruction from Wentworth Trustees. In the event that both Wentworth Trustees and the Developer require reliance, or if more than one Developer requires reliance, a warranty will be required. We confirm that we will consent to a request from Wentworth Trustees to enter a collateral warranty, provided it is our approved standard form, and subject to payment of a fee to cover our legal and incidental costs. We will require approval from our insurers if more than one beneficiary requires a warranty, or if the proposed warranty is not Lithos' approved standard form.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely

A handwritten signature in dark ink, appearing to read "Matt Thompson".

Matt Thompson
Associate Director

for and on behalf of
LITHOS CONSULTING LIMITED

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 to 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 licence 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.

From: [Joshua Franklin](#)
To: [Matt Thompson](#)
Cc: [Andrew Nicholson](#); [Matthew Jones](#)
Subject: RE: Quotation Request - Smithy Wood Lane, Dodworth, Barnsley, S75 3QW
Date: 09 March 2020 16:05:09
Attachments: [image001.gif](#)
[image003.jpg](#)
[image004.jpg](#)
[image006.jpg](#)
[image007.jpg](#)
[image009.jpg](#)
[image010.jpg](#)
[image011.jpg](#)
[image012.png](#)
[image013.png](#)
[image015.jpg](#)
[image016.jpg](#)
[image017.jpg](#)
[image018.jpg](#)

Good afternoon Matthew,

Thank you for your Phase 1 & Phase II quote below. I am pleased to say that my client would like to instruct the work accordingly – to include soakaway testing. I have copied in Andrew Nicholson at Barker Gotelee, who is the solicitor handling matters for the landowner. Please can you invoice the following address:

Messrs R E Barker and J A Nicholson as trustees of the Wentworth Nominee Settlement care of 41 Barrack Square, Martlesham Heath, Ipswich, IP5 3RF.

Please arrange for works to begin ASAP - can you let me know when you intend upon undertaking the works and I will arrange access.

Many thanks, Josh

Josh Franklin BA(Hons) MPhil MRICS

Associate

Development

Savills, 3 Wellington Place , Leeds LS1 4AP

Tel : +44 (0) 113 220 1258

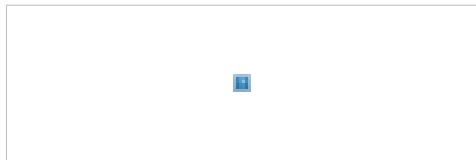
Mobile : +44 (0) 7807 999 923

Email : JFranklin@savills.com

Website : <http://www.savills.co.uk>



 Before printing, think about the environment



From: Matt Thompson [mailto:Matt.thompson@lithos.co.uk]

Sent: 21 February 2020 12:22

To: Joshua Franklin <JFranklin@savills.com>

Cc: Simon Douglas <SDouglas@savills.com>

Subject: RE: Quotation Request - Smithy Wood Lane, Dodworth, Barnsley, S75 3QW

Hi Josh,

As promised, please find attached our quote for the investigation at Dodworth.

The main issue on here is coal mining, so we've allowed for a comprehensive investigation, including a week of rotary open hole probing (at least c. 30 boreholes). We've also allowed for 9 monitoring visits to assess gas risks (not the minimum of 6 visits often opted for) because potential mineworkings pose a greater risk of gas generation.

Soakaways are also included as Item D, so could be removed if not required.

If your client wanted to opt for an 'exploratory' investigation, we could reduce the drilling to 2 days, which would reduce Item E down to £****, but additional drilling would be needed by the developer at a later stage, and their land bids are likely to be more heavily caveated without this information now.

For a full breakdown of costs, please scroll to the last page, after the T&Cs on the attached letter.

Any queries, please call.

Thanks & regards,

Matt Thompson
Associate Director
Lithos Consulting Ltd

M 07814 436 247
DD 01937 545 337



www.lithos.co.uk



From: Joshua Franklin <JFranklin@savills.com>

Sent: 14 February 2020 16:01

To: Matt Thompson <Matt.thompson@lithos.co.uk>

Subject: Quotation Request - Smithy Wood Lane, Dodworth, Barnsley, S75 3QW

Good afternoon Matt,

We have been instructed to seek quotations for a Phase I & Phase II Ground Investigation report at the below site – Smithy Wood Lane, Dodworth, Barnsley. The subject land comprise two agricultural fields (larger = 11.09 acres & smaller = 2.72 acres – i.e. total of 13.81 acres).

Please can you send over a quote for the works by the end of next week. We will be instructing the works ASAP.

Kind regards, Josh

Josh Franklin BA(Hons) MPhil MRICS
Associate
Development

Savills, 3 Wellington Place, Leeds LS1 4AP
Tel : +44 (0) 113 220 1258
Mobile : +44 (0) 7807 999 923
Email : JFranklin@savills.com
Website : <http://www.savills.co.uk>



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We are registered with the Scottish Letting Agent Register, our registration number is LARN1902057.

Please note any advice contained or attached in this email is informal and given purely as guidance unless otherwise explicitly stated. Our views on price are not intended as a formal valuation and should not be relied upon as such. They are given in the course of our estate agency role. No liability is given to any third party and the figures suggested are in accordance with Professional Standards PS1 and PS2 of the RICS Valuation – Global Standards 2017 incorporating the IVSC International Valuation Standards issued June 2017 and effective from 1 July 2017. Any advice attached is not a formal ("Red Book") valuation, and neither Savills nor the author can accept any responsibility to any third party who may seek to rely upon it, as a whole or any part as such. If formal advice is required this will be explicitly stated along with our understanding of limitations and purpose.

BEWARE OF CYBER-CRIME: Our banking details will not change during the course of a transaction. Should you receive a notification which advises a change in our bank account details, it may be fraudulent and you should notify Savills who will advise you accordingly.

031/1979/REG

15th February 2021

Mr G Little
Avant Homes (Yorkshire)
Unit 2
Mariner Court
Peel Avenue
Durkar
Wakefield
WF4 3FL



Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

t 01937 545 330

www.lithos.co.uk

Dear Gary

Smithy Wood Lane, Dodworth

Further to your recent invitation, please find attached our proposal for undertaking supplementary 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 sketch layout showing 170 units has been provided.

As you know we have already issued an SI Report (Ref. 1979/2A, dated February 2021), key findings of which were:

- Appears to have remained undeveloped throughout its history, with the exception of a former reservoir in the south-west,
- Made Ground was only encountered in the vicinity of a former reservoir (to 0.7m).
- Natural ground typically comprises firm/stiff gravelly Clay, over clayey and sandy Gravel to a maximum depth of 3.0m.
- Middle Coal Measures Bedrock comprising Sandstone, Siltstone & Mudstone was encountered from depths of between 0.1m and 2.9m
- Is underlain by up to 3 coal seams at shallow depth and as a consequence is located within a Development High Risk Area
- Mineworkings have been identified in the Flockton Thick seam in the north, but should be at sufficient depth not to pose risks of instability. Possible evidence of 'packed mineworkings' was encountered in the south-east. No workings have been identified in any other seams at shallow depth.

Report 1979/2A recommended some further investigation, most notably:

- Further drilling to remove any residual uncertainty in the south-east.
- Given the very shallow depth to the Lidget, Haigh Moor and Swallow Wood coal, and therefore the possibility of bell pits, consideration should be given to a geophysical survey.
- Efforts should be made to locate the line of the Champany Hill Fault in the north; initially this should be done via geophysics (resistivity).
- Following the geophysics, any features identified should be investigated by trial trenching (fault) and/or means of a topsoil strip (mine entries).

Our site investigation will be undertaken in accordance with UK good practice (as outlined in BS5930, BS10175, LCRM 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:

Field work: We have allowed for the drilling of about 15 **rotary probe holes** to check for the presence of mineworkings.

We may undertake some **coring** to check for the presence of **packed workings** and/or coal quality.

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.

We already have 'Permission to enter CA mining interests' (valid until 6th April 2021).

If the geophysics survey identifies any features of potential significance, we will investigate these via (relatively shallow) **trial pits**. A days' pitting should suffice, but if many features are identified an additional day or two might be required.

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.

We have allowed for all exploratory holes to be picked-up by a **surveyor** (co-ordinates/ground levels will be included on the logs).

Testing: No further soils analysis 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 fieldwork, we will update and re-issue Report 1979/2A.

At the time of writing, fieldwork could be commenced within 3 weeks of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report will be issued within 2 weeks 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. 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 our invoice for this project with the final report.

Geophysics: We have obtained a quotation from Phase, copy enclosed, although an update has been requested to include fault location via resistivity. We understand that Avant will appoint Phase direct.

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 last for at least 3 working days and therefore this proposal includes for provision of a

Welfare Unit, with the benefit of full canteen facilities, hot water with full size sink, toilet and drying room.

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.

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

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 licence 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.

Reg

Subject: 1979, Calver Lane/Smithy Wood Lane, Dodworth - Quote

From: Sharon Poole <Sharon.Poole@avanthomes.co.uk>
Sent: 08 March 2021 16:31
To: Reg <Reg@lithos.co.uk>
Cc: Gary Little <Gary.Little@avanthomes.co.uk>
Subject: RE: 1979, Calver Lane/Smithy Wood Lane, Dodworth - Quote

Good Afternoon

Please use PO 4063/YM-0458 for this work.

Kind regards

Sharon Poole
Development Assistant

Tel: **01924 248427**
Email: **Sharon.Poole@avanthomes.co.uk**

Avant Homes Yorkshire, Unit 2, Mariner Court, Peel Avenue, Durkar, Wakefield, WF4 3FL



From: Gary Little <Gary.Little@avanthomes.co.uk>
Sent: 24 February 2021 20:06
To: Reg <Reg@lithos.co.uk>
Cc: Sharon Poole <Sharon.Poole@avanthomes.co.uk>
Subject: RE: 1979, Calver Lane/Smithy Wood Lane, Dodworth - Quote

Good evening Reg,

As mentioned earlier this week, I have now received authorisation from our land team to instruct you with the supplementary ground investigation works at Smithy Wood Lane, Dodworth, in accordance with the attached quote.
Sharon – can you please send Reg a PO to the value of £*+VAT?**

Once you have managed to look into your diary, can you please confirm a start date so that I can advise the vendor accordingly?

Gary

PS – I will be looking to instruct Phase separately too for the geophysics/fault investigation works and will keep you informed of their works too.

Gary Little
Senior Development Manager

Tel: **01924 248430**
Mobile: **+447584773763**
Email: **Gary.Little@avanthomes.co.uk**



From: Reg <Reg@lithos.co.uk>
Sent: 15 February 2021 15:34
To: Gary Little <Gary.Little@avanthomes.co.uk>
Subject: [EXTERNAL] 1979, Calver Lane/Smithy Wood Lane, Dodworth - Quote

Afternoon Gary

Quote for supplementary SI as promised. As outlined in earlier e-mail of 14th Jan., we've allowed for:

- The drilling of about 15 rotary **probeholes** to check for the presence of mineworkings. We may also undertake some **coring** to check for the presence of packed workings and/or coal quality.
- A **days' pitting** to check any features identified by the **geophysics** - trial trenching (fault) and/or topsoil strip (mine entries) should suffice. A days' pitting, but if many features are identified an additional day or two might be required (I've included an E\O day rate).

We have obtained an updated quote from **Phase**, copy enclosed, to include fault location via resistivity. We understand that Avant will appoint Phase direct.

Any queries, please call.

Regards

Mark Penin
Director
Lithos Consulting Ltd
M 07703 396 635
DD 01937 545 331



www.lithos.co.uk

From: Gary Little <Gary.Little@avanthomes.co.uk>
Sent: 12 February 2021 17:14
To: Reg <Reg@lithos.co.uk>
Subject: RE: Calver Lane/Smithy Wood Lane, Dodworth - Quote

No problem Reg,

Here is the draft layout that we are currently working to.

Have a nice weekend.

Gary

Gary Little
Senior Development Manager

Tel: **01924 248430**
Mobile: **+447584773763**
Email: **Gary.Little@avanthomes.co.uk**

Avant Homes Yorkshire, Unit 2, Mariner Court, Peel Avenue, Durkar, Wakefield, WF4 3FL

From: Reg <Reg@lithos.co.uk>
Sent: 12 February 2021 16:55
To: Gary Little <Gary.Little@avanthomes.co.uk>
Subject: [EXTERNAL] RE: Calver Lane/Smithy Wood Lane, Dodworth - Quote

More or less. That's what I was calling about the other day.

Do you have any sort of layout?

ta

Mark Penin
Director
Lithos Consulting Ltd
M 07703 396 635
DD 01937 545 331



www.lithos.co.uk

From: Gary Little <Gary.Little@avanthomes.co.uk>
Sent: 12 February 2021 15:28
To: Reg <Reg@lithos.co.uk>
Subject: Calver Lane/Smithy Wood Lane, Dodworth - Quote

Afternoon Reg,

Have you managed to top & tail a fee proposal for the extra work that we discussed a week or so ago yet?

Cheers

Gary Little
Senior Development Manager

Tel: **01924 248430**
Mobile: **+447584773763**
Email: **Gary.Little@avanthomes.co.uk**

Avant Homes Yorkshire, Unit 2, Mariner Court, Peel Avenue, Durkar, Wakefield, WF4 3FL

Appendix D

Historical OS Plans



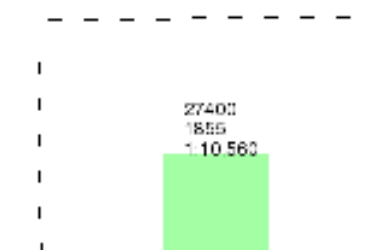
Yorkshire

Published 1855

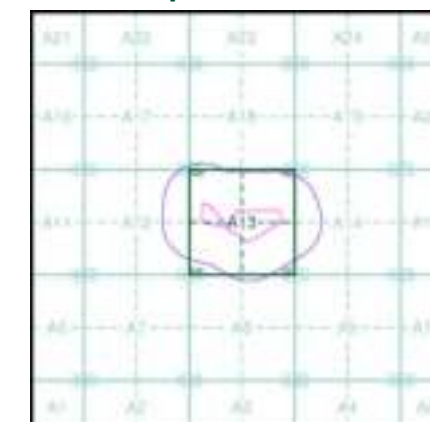
Source map scale - 1:10,560

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: 66166604_1_1
Customer Ref: 1979 - Smithy Wood Lane
National Grid Reference: 432270, 404410
Slice: A
Site Area (Ha): 6.05
Search Buffer (m): 250

Site Details

10 Calver Close, Dodworth, BARNSELY, South Yorkshire, S75 3QW



Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Ordnance Survey Plan

Published 1956

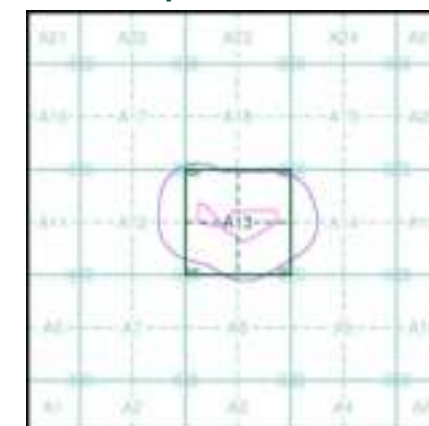
Source map scale - 1:10,000

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)

SE30NW
1956
1:10,560
SE30SW
1956
1:10,560

Historical Map - Slice A



Order Details

Order Number: 66166604_1_1
Customer Ref: 1979 - Smithy Wood Lane
National Grid Reference: 432270, 404410
Slice: A
Site Area (Ha): 6.05
Search Buffer (m): 250

Site Details

10 Calver Close, Dodworth, BARNSELY, South Yorkshire, S75 3QW



Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



VectorMap Local

Published 2015

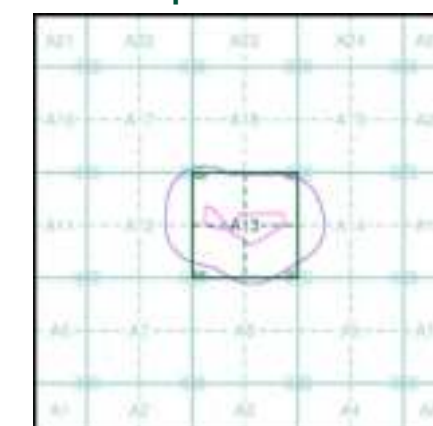
Source map scale - 1:10,000

VectorMap Local (Raster) is Ordnance Survey's highest detailed 'backdrop' mapping product. These maps are produced from OS's VectorMap Local, a simple vector dataset at a nominal scale of 1:10,000, covering the whole of Great Britain, that has been designed for creating graphical mapping. OS VectorMap Local is derived from large-scale information surveyed at 1:1250 scale (covering major towns and cities), 1:2500 scale (smaller towns, villages and developed rural areas), and 1:10 000 scale (mountain, moorland and river estuary areas).

Map Name(s) and Date(s)

SE00NW |
2015 |
Variable |
SE00SW |
2015 |
Variable |

Historical Map - Slice A



Order Details

Order Number: 66166604_1_1
Customer Ref: 1979 - Smithy Wood Lane
National Grid Reference: 432270, 404410
Slice: A
Site Area (Ha): 6.05
Search Buffer (m): 250

Site Details

10 Calver Close, Dodworth, BARNSELY, South Yorkshire, S75 3QW



Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix E

Search Responses & other Correspondence



Envirocheck[®] Report:

Datasheet

Order Details:

Order Number:

66166604_1_1

Customer Reference:

1979 - Smithy Wood Lane

National Grid Reference:

432270, 404410

Slice:

A

Site Area (Ha):

6.05

Search Buffer (m):

250

Site Details:

10 Calver Close

Dodworth

BARNSELY

South Yorkshire

S75 3QW

Client Details:

Mr M Perrin

Lithos Consulting Ltd

Parkhill

Walton Road

Wetherby

LS22 5DZ

Prepared For:

Wentworth Trustees

Report Section	Page Number
Summary	-
Agency & Hydrological	1
Waste	3
Hazardous Substances	-
Geological	5
Industrial Land Use	10
Sensitive Land Use	11
Data Currency	12
Data Suppliers	16
Useful Contacts	17

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

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Radon Potential dataset Copyright Notice

Information supplied from a joint dataset compiled by The British Geological Survey and Public Health England.

Report Version v49.0

Data Type	Page Number	On Site	0 to 250m (*up to 500m)
Agency & Hydrological			
Contaminated Land Register Entries and Notices			
Discharge Consents			
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			
Local Authority Pollution Prevention and Control Enforcements			
Nearest Surface Water Feature	pg 1		Yes
Pollution Incidents to Controlled Waters			
Prosecutions Relating to Authorised Processes			
Prosecutions Relating to Controlled Waters			
Registered Radioactive Substances			
River Quality	pg 1		1
River Quality Biology Sampling Points			
River Quality Chemistry Sampling Points			
Substantiated Pollution Incident Register			
Water Abstractions	pg 1		1
Water Industry Act Referrals			
Groundwater Vulnerability	pg 1	Yes	n/a
Bedrock Aquifer Designations	pg 1	Yes	n/a
Superficial Aquifer Designations			n/a
Source Protection Zones			
Extreme Flooding from Rivers or Sea without Defences	pg 1		Yes
Flooding from Rivers or Sea without Defences	pg 1		Yes
Areas Benefiting from Flood Defences			
Flood Water Storage Areas			
Flood Defences			
Detailed River Network Lines	pg 1		Yes
Detailed River Network Offline Drainage			

Data Type	Page Number	On Site	0 to 250m (*up to 500m)
Waste			
BGS Recorded Landfill Sites			
Historical Landfill Sites	pg 3		2
Integrated Pollution Control Registered Waste Sites			
Licensed Waste Management Facilities (Landfill Boundaries)			
Licensed Waste Management Facilities (Locations)			
Local Authority Recorded Landfill Sites	pg 3		2
Registered Landfill Sites	pg 4		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			
Geological			
BGS 1:625,000 Solid Geology	pg 5	Yes	n/a
BGS Estimated Soil Chemistry	pg 5	Yes	Yes
BGS Recorded Mineral Sites	pg 7		2
BGS Urban Soil Chemistry			
BGS Urban Soil Chemistry Averages			
Brine Compensation Area			n/a
Coal Mining Affected Areas	pg 7	Yes	n/a
Mining Instability	pg 7	Yes	n/a
Man-Made Mining Cavities			
Natural Cavities			
Non Coal Mining Areas of Great Britain	pg 8	Yes	
Potential for Collapsible Ground Stability Hazards	pg 8	Yes	
Potential for Compressible Ground Stability Hazards	pg 8		Yes
Potential for Ground Dissolution Stability Hazards			
Potential for Landslide Ground Stability Hazards	pg 8	Yes	Yes
Potential for Running Sand Ground Stability Hazards	pg 8		Yes
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 9	Yes	Yes
Radon Potential - Radon Affected Areas	pg 9	Yes	n/a
Radon Potential - Radon Protection Measures			n/a

Data Type	Page Number	On Site	0 to 250m (*up to 500m)
Industrial Land Use			
Contemporary Trade Directory Entries	pg 10		9
Fuel Station Entries			
Sensitive Land Use			
Areas of Adopted Green Belt	pg 11	1	
Areas of Unadopted Green Belt			
Areas of Outstanding Natural Beauty			
Environmentally Sensitive Areas			
Forest Parks			
Local Nature Reserves			
Marine Nature Reserves			
National Nature Reserves			
National Parks			
Nitrate Sensitive Areas			
Nitrate Vulnerable Zones	pg 11	1	
Ramsar Sites			
Sites of Special Scientific Interest			
Special Areas of Conservation			
Special Protection Areas			



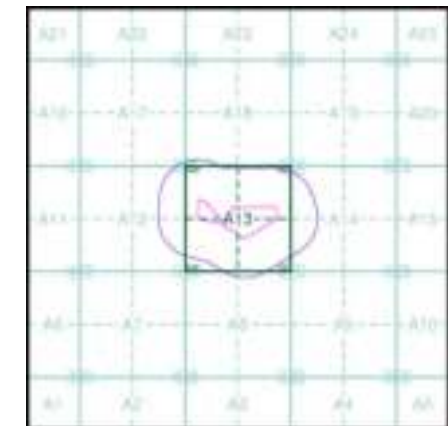
General

- X Study Point
- Search Buffer
- X Flood Defence Point

Agency and Hydrological (Flood)

- Flooded Floodplain (in Flood or Flood Defence Zone)
- Flooded Floodplain (not in Flood or Flood Defence Zone)
- Area Benefiting from Flood Defence
- Floodable Along Road
- Flood Defence

Flood Map - Slice A



Order Details

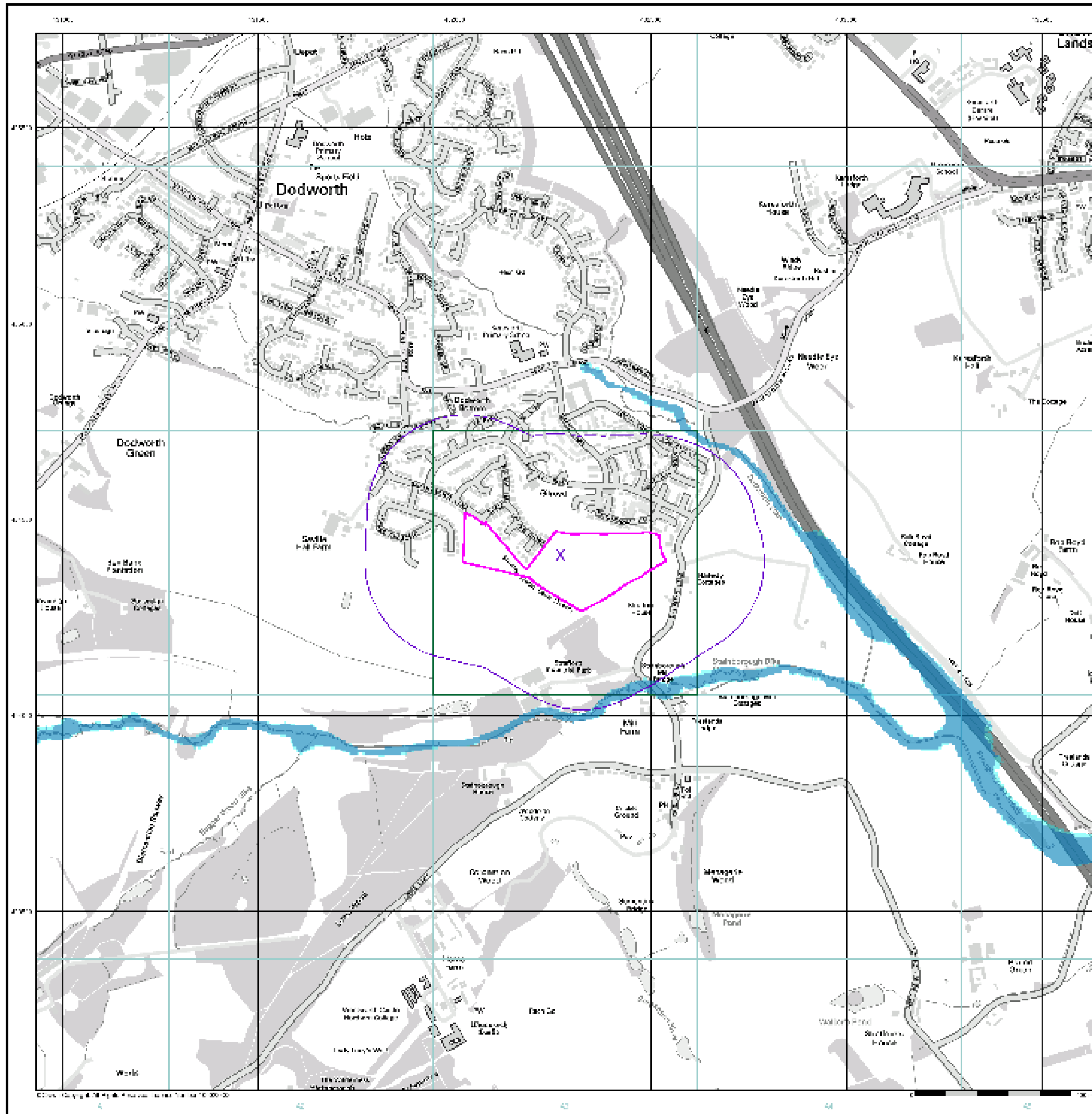
Order Number: 66166604_1_1
 Customer Ref: 1979 - Smithy Wood Lane
 National Grid Reference: 432270, 404410
 Slice: A
 Site Area (Ha): 6.05
 Search Buffer (m): 250

Site Details

10 Calver Close, Dodworth, BARNSELY, South Yorkshire, S75 3QW



Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk





General

- Survey Point
- Stream Buffer
- X Proposed Point
- Map 1

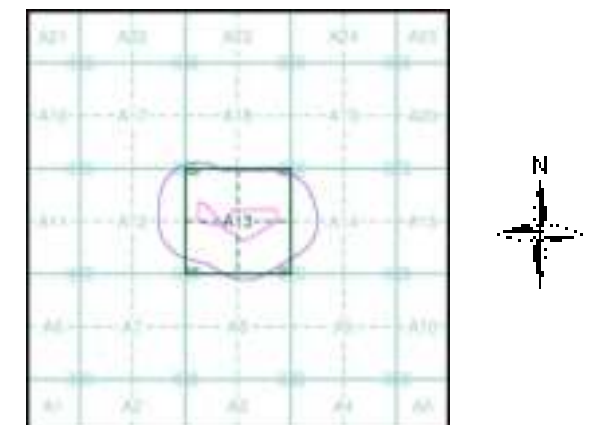
Detailed River Network Data

- | | |
|------------------------|--------------------------------|
| Primary River | Estimated Catchment Area |
| Secondary River | Underground Pipe |
| Tertiary River | Underground Pipe (in a tunnel) |
| Canal | Underground Pipe (in a tunnel) |
| Canal Tunnel | Underground Pipe (in a tunnel) |
| Interim River | Underground Pipe (in a tunnel) |
| Non-Designated | Underground Pipe (in a tunnel) |
| Other Drainage Feature | Underground Pipe (in a tunnel) |

Contours (Height in metres)

- | | | | |
|-------------------|-----|-----|-----|
| Primary Contour | 10m | 10m | 10m |
| Secondary Contour | 10m | 10m | 10m |
| Spot High | 10m | 10m | 10m |

EANRW Detailed River Network Map - Slice A



Order Details

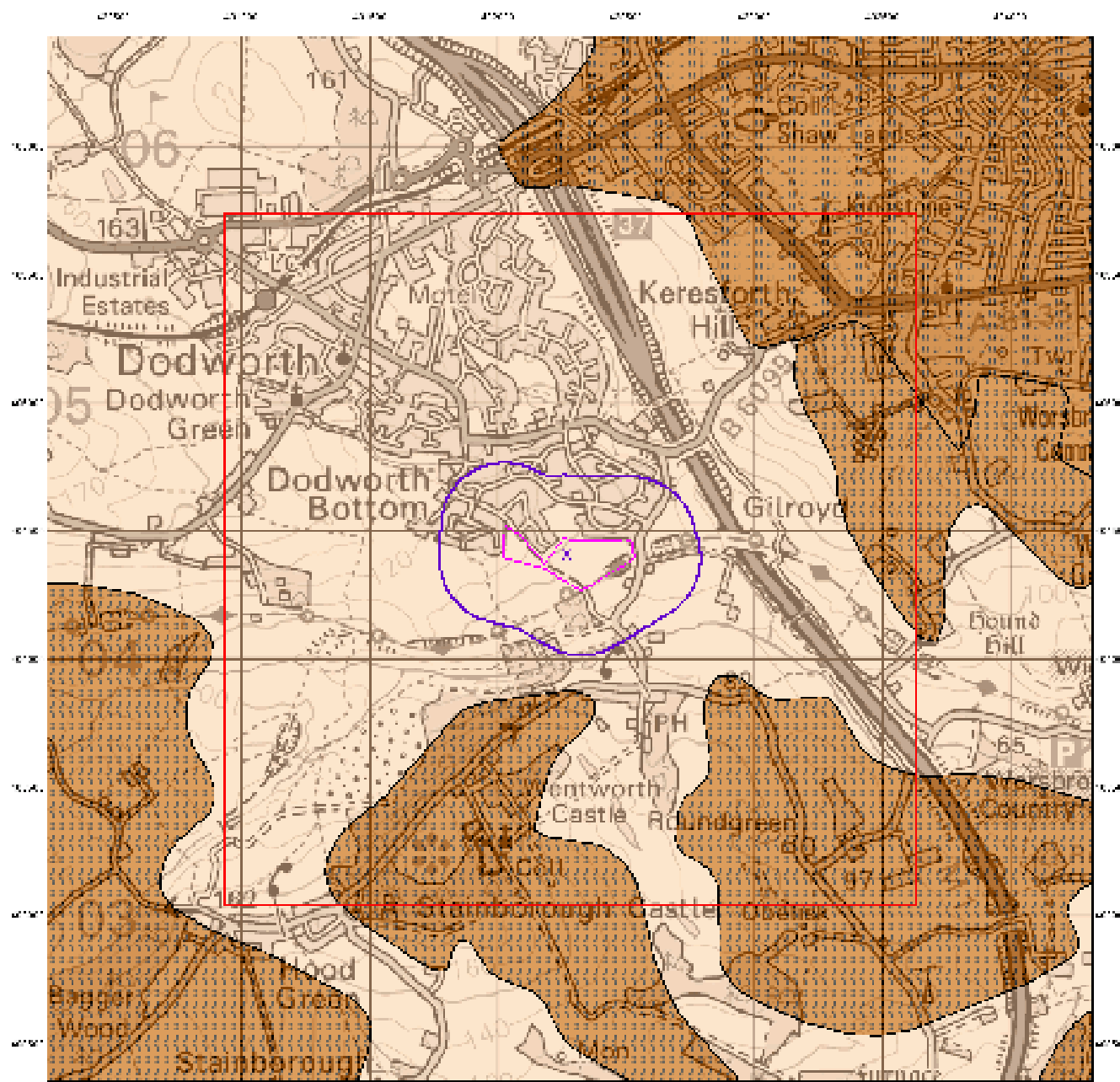
Order Number: 66166604_1_1
Customer Ref: 1979 - Smithy Wood Lane
National Grid Reference: 432270, 404410
Slice: A
Site Area (Ha): 6.05
Search Buffer (m): 250

Site Details

10 Calver Close, Dodworth, BARNSELY, South Yorkshire, S75 3QW



Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Groundwater Vulnerability

Groundwater

Groundwater Vulnerability
 Groundwater Vulnerability
 Groundwater Vulnerability

Agency and Hydrological

Geological Classes

High Permeability
 High Permeability
 High Permeability

Medium Permeability
 Medium Permeability
 Medium Permeability

Low Permeability
 Low Permeability
 Low Permeability

Medium Permeability
 Medium Permeability
 Medium Permeability

High Permeability
 High Permeability
 High Permeability

Soil Classes

High Permeability
 High Permeability
 High Permeability

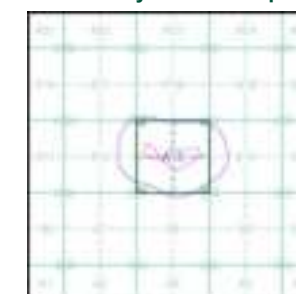
Medium Permeability
 Medium Permeability
 Medium Permeability

Low Permeability
 Low Permeability
 Low Permeability

Medium Permeability
 Medium Permeability
 Medium Permeability

High Permeability
 High Permeability
 High Permeability

Site Sensitivity Context Map - Slice A



Order Details

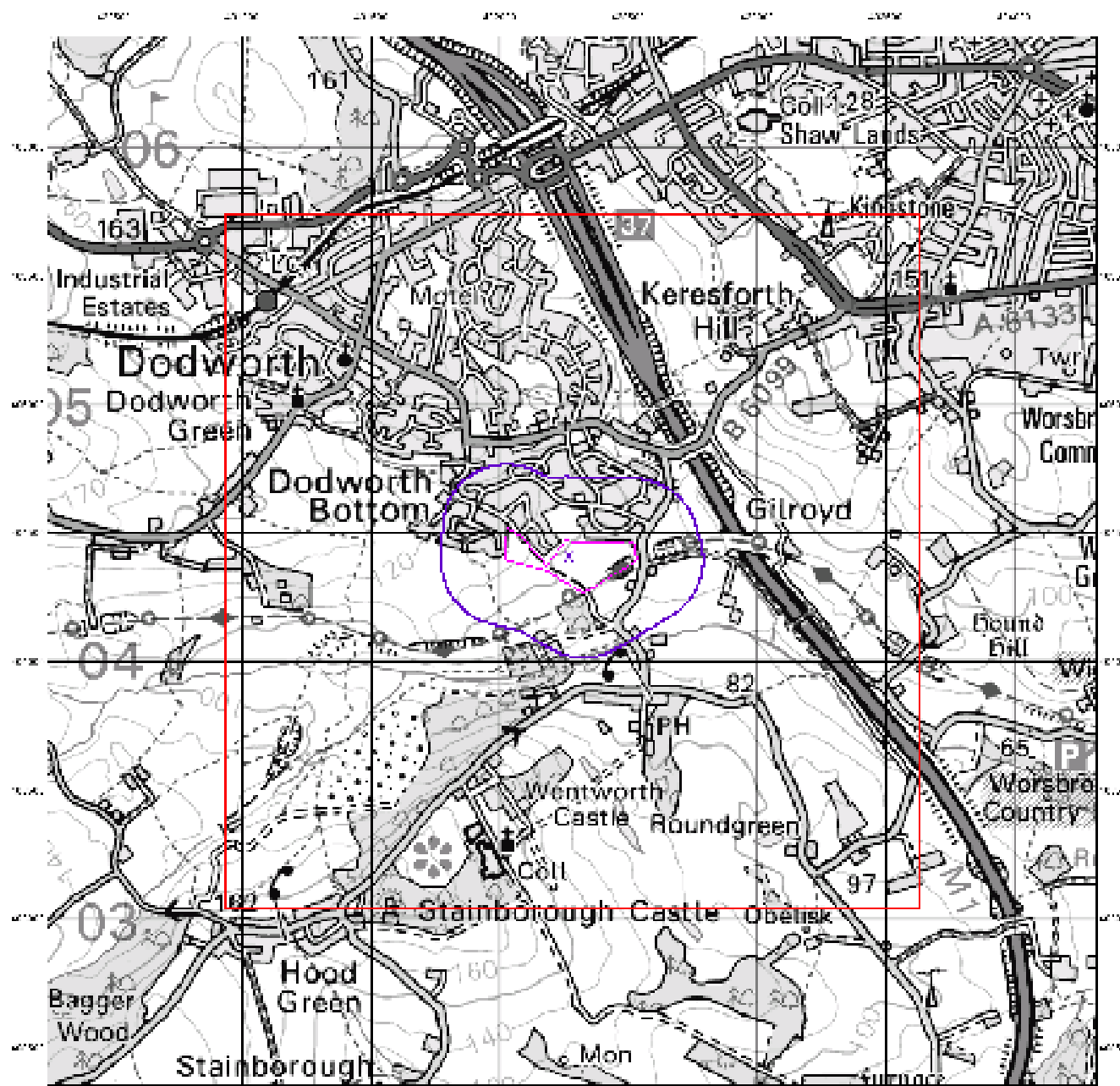
Order Number: 66166604_1.1
 Customer Ref: 1979 - Smithy Wood Lane
 National Grid Reference: 432270, 404410
 Slice: A
 Site Area (Ha): 6.05
 Search Buffer (m): 250

Site Details

10 Calver Close, Dodworth, BARNSELY, South Yorkshire, S75 3QW



Tel: 0844 844 9952
 Fax: 0844 844 9951
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Source Protection Zones

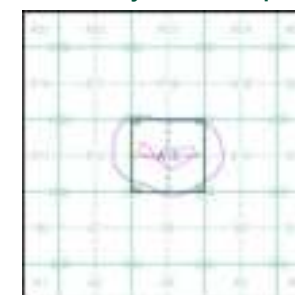
Ground

Groundwater Protection Zone (GWPZ)
 Groundwater Protection Zone (GWPZ)

Agency and Hydrological

Flood Risk
 Flood Risk (Flood Risk Assessment)
 Flood Risk (Flood Risk Assessment)
 Flood Risk (Flood Risk Assessment)
 Flood Risk (Flood Risk Assessment)
 Flood Risk (Flood Risk Assessment)
 Flood Risk (Flood Risk Assessment)
 Flood Risk (Flood Risk Assessment)

Site Sensitivity Context Map - Slice A



Order Details

Order Number: 66166604_1.1
 Customer Ref: 1979 - Smithy Wood Lane
 National Grid Reference: 432270, 404410
 Slice: A
 Site Area (Ha): 6.05
 Search Buffer (m): 250

Site Details

10 Calver Close, Dodworth, BARNSELY, South Yorkshire, S75 3QW



Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk

Appendix F

Trial Pit Logs

				Trial Pit Log			Trialpit No TP01 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432036.60 - 404478.71 Level: 113.60		Date 15/04/2020	
Location: Dodworth				Dimensions (m):		Scale 1:25		Logged LT	
Client: The Wentworth Trustees				Depth 1.85					

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.35	113.25		TOPSOIL: Brown slightly sandy silty CLAY. (TOPSOIL)	
			HVP=98				Stiff brown slightly gravelly slightly sandy CLAY with occasional subangular sandstone cobbles. Gravel is subangular fine to coarse sandstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL) <i>From 0.50m mottled grey and orange.</i>	
	0.80	D	HVP=62	0.80	112.80		Grey and orangish brown sandy clayey angular to subangular fine to coarse GRAVEL of sandstone with occasional subangular sandstone cobbles. Sand is fine to coarse. (GRANULAR RESIDUAL SOIL)	1
				1.75	111.85		Weathered dark grey SILTSTONE recovered as clayey angular to subangular fine to coarse GRAVEL with water on fracture surfaces. (MIDDLE COAL MEASURES - SILTSTONE)	
				1.85	111.75		<i>Terminated at 1.85m - unable to excavate further</i> <i>End of pit at 1.85 m</i>	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. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

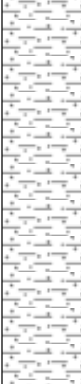
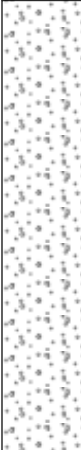


				Trial Pit Log			Trialpit No TP02 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432046.00 - 404422.00 Level: 113.70		Date 15/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.10		Logged LT	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	2.10	D	HVP=100	0.35	113.35		TOPSOIL: Brown slightly gravelly slightly sandy silty CLAY. Gravel is subangular sandstone. Sand is fine to coarse. (TOPSOIL)	1
			HVP=90	0.70	113.00		Firm orangish brown and grey slightly gravelly slightly sandy CLAY with frequent subangular cobbles of sandstone. Gravel is subangular fine to coarse sandstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	
						Firm light grey slightly gravelly slightly sandy silty CLAY. Gravel is subangular mudstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)		
				2.00	111.70		Grey and dark grey angular to subangular fine to coarse GRAVEL of siltstone with frequent cobbles of subangular siltstone. (GRANULAR RESIDUAL SOIL)	2
				3.10	110.60		----- End of pit at 3.10 m	3
								4
								5

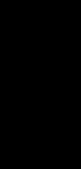
Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.		
Stability: 1. The sides of the trial pit remained stable during excavation.		

				Trial Pit Log			Trialpit No TP03 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432072.00 - 404395.00 Level: 111.20		Date 15/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.20		Logged LT	

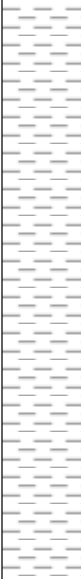
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	J&T	HVP=110	0.40	110.80		TOPSOIL: d ark brown slightly sandy silty CLAY. Sand is fine to coarse. (TOPSOIL)	
	0.80	D	HVP=95				Stiff orangish brown and grey slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone and siltstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	1
				1.70	109.50		Light and dark grey sandy clayey angular to subangular fine to coarse GRAVEL and subangular COBBLES of siltstone with occasional ironstone nodules. (GRANULAR RESIDUAL SOIL)	2
				3.20	108.00	End of pit at 3.20 m		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. Co-ordinates from hand held GPS, hole not surveyed in.		
Stability: 1. The sides of the trial pit remained stable during excavation.		

				Trial Pit Log			Trialpit No TP04 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432076.00 - 404375.00 Level: 110.20		Date 15/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.50		Logged LT	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼	0.50	J,K&T	HVP=65				MADE GROUND: Dark brown gravelly slightly sandy CLAY with occasional cobbles of brick and subangular sandstone. Gravel is subangular fine to coarse sandstone and brick. Occasional small pieces of wood. (MADE GROUND TOPSOIL)	1
			HVP=60	0.70	109.50		Firm light brown and light grey CLAY. (COHESIVE RESIDUAL SOIL)	
	1.20	D		1.00	109.20		Black COAL recovered as clayey angular to subangular fine to coarse gravel. (LIDGETT COAL)	
				1.60	108.60		Firm grey slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse siltstone and mudstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	2
				2.40	107.80		Grey and dark grey sandy clayey angular to subangular fine to coarse GRAVEL of mudstone with orangish brown staining. (GRANULAR RESIDUAL SOIL)	3
			3.50	106.70	----- End of pit at 3.50 m -----			4
								5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater seepage at 1.0m. 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.		

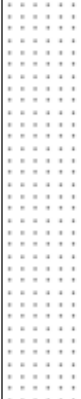
LITHOS CONSULTING				Trial Pit Log			Trialpit No TP05 Sheet 1 of 1	
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432109.00 - 404413.00 Level: 108.70		Date 15/04/2020
Location: Dodworth						Dimensions (m): Depth 3.40		Scale 1:25 Logged LT
Client: The Wentworth Trustees								
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	J&T		0.35	108.35		TOPSOIL: Dark brown slightly sandy CLAY. (TOPSOIL)	
			HVP=110 HVP=102				Firm orangish brown slightly gravelly slightly sandy CLAY with rare cobbles of subangular sandstone. Gravel is subangular to subrounded fine to coarse sandstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	
							From 1.60m gravelly. Gravel is subangular fine to coarse sandstone and siltstone.	
	2.50	D		2.30	106.40		Orangish brown and grey sandy clayey angular to subangular fine to coarse GRAVEL of siltstone. (GRANULAR RESIDUAL SOIL)	
				3.40	105.30	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. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.



				Trial Pit Log			Trialpit No TP06 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432075.00 - 404453.00 Level: 111.80		Date 15/04/2020	
Location: Dodworth				Dimensions (m):		Scale 1:25		Logged LT	
Client: The Wentworth Trustees				Depth 1.75					

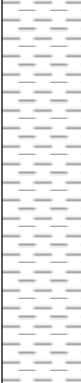
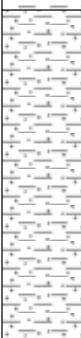
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.40	111.40		TOPSOIL: Dark brown slightly sandy silty CLAY. (TOPSOIL)	
				1.75	110.05		Weathered fine grained brown SANDSTONE recovered as subangular cobbles and boulders. (MIDDLE COAL MEASURES - SANDSTONE)	
							Terminated at 1.75m - unable to excavate further ----- End of pit at 1.75 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.

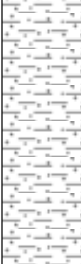
Stability: 1. The sides of the trial pit remained stable during excavation.



				Trial Pit Log			Trialpit No TP07 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432206.00 - 404365.00 Level: 99.60		Date 15/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.40		Logged LT	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T	HVP=105	0.20	99.40		TOPSOIL: Dark brown slightly gravelly slightly sandy silty CLAY. (TOPSOIL)	1
	0.70	D	HVP=120 HVP=80				Stiff light brown mottled grey CLAY. (COHESIVE RESIDUAL SOIL)	
				1.50	98.10		Firm greyish brown slightly gravelly slightly sandy CLAY with occasional ironstone nodules. Gravel is subangular fine to coarse siltstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	2
						From 1.90m gravelly.		
				2.60	97.00		Weathered SILTSTONE recovered as grey and dark grey sandy angular to coarse gravel with frequent cobbles and rare ironstone nodules. (MIDDLE COAL MEASURES - SILTSTONE)	3
						From 2.90m orangish brown staining		
				3.40	96.20		Terminated at 3.40m - unable to excavate further End of pit at 3.40 m	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. Co-ordinates from hand held GPS, hole not surveyed in.		
Stability: 1. The sides of the trial pit remained stable during excavation.		

				Trial Pit Log			Trialpit No TP08 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432291.00 - 404357.00 Level: 94.40		Date 15/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.80		Logged LT	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.20	J&T	HVP=102 HVP=110 HVP=104	0.30	94.10		TOPSOIL: Dark brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to medium of mixed lithology. Sand is fine to coarse. (TOPSOIL)		
	1.40	D		1.20	93.20		Stiff light brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse siltstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)		
			2.50			91.90		Grey and orangish brown slightly sandy slightly clayey angular to subangular fine to coarse GRAVEL of siltstone and sandstone with occasional cobbles of subangular siltstone and sandstone. (GRANULAR RESIDUAL SOIL)	
	3.80	90.60			Weathered SILTSTONE recovered as angular to subangular GRAVEL and subangular COBBLES. (MIDDLE COAL MEASURES - SILTSTONE)				
						----- End of pit at 3.80 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 remained stable during excavation.									



				Trial Pit Log			Trialpit No TP09 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432243.00 - 404418.00 Level: 99.60		Date 15/04/2020	
Location: Dodworth				Dimensions (m):		Scale 1:25		Logged LT	
Client: The Wentworth Trustees				Depth 3.40					

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.30	99.30		TOPSOIL: Dark brown slightly gravelly slightly sandy silty CLAY. Gravel is subangular to subrounded fine to medium of mixed lithology. Sand is fine to coarse. (TOPSOIL)	1
			HVP=108 HVP=92				Stiff orangish brown and grey slightly gravelly slightly sandy CLAY. Gravel is subangular siltstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	
	1.20	D		1.80	97.80		Grey sandy clayey angular to subangular medium to coarse GRAVEL of siltstone. Sand is fine to coarse. (GRANULAR RESIDUAL SOIL)	2
				2.70	96.90		Black COAL recovered as clayey angular to subangular fine to coarse gravel. (HAIGH MOOR COAL)	3
				2.90	96.70		Weathered extremely weak grey MUDSTONE recovered as angular to subangular fine to coarse gravel and subangular cobbles. (MIDDLE COAL MEASURES - MUDSTONE)	
				3.20	96.40		Weathered SILTSTONE recovered as angular to subangular fine to coarse gravel and cobbles. (MIDDLE COAL MEASURES - SILTSTONE)	
				3.40	96.20	Terminated at 3.40m - unable to excavate further End of pit at 3.40 m		
								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. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.



LITHOS CONSULTING				Trial Pit Log			Trialpit No TP10 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432289.00 - 404392.00 Level: 95.80		Date 15/04/2020	
Location: Dodworth				Dimensions (m):		Depth 3.90		Scale 1:25	
Client: The Wentworth Trustees								Logged LT	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	3.35	D	HVP=92	0.40	95.40		TOPSOIL: Dark brown slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone and siltstone. Sand is fine to coarse. (TOPSOIL)		
			HVP=98	1.60	94.20		Firm light brown and grey slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone and siltstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)		
			HVP=112						
					2.90	92.90		Grey sandy angular to subangular fine to coarse GRAVEL of siltstone. Sand is fine to coarse. (GRANULAR RESIDUAL SOIL)	
					3.30	92.50		Weathered weak grey SILTSTONE recovered as angular to subangular cobbles and angular to subangular fine to coarse gravel. (MIDDLE COAL MEASURES - SILTSTONE)	
					3.40	92.40			
		3.90	91.90		Black COAL recovered as angular to subangular fine to coarse gravel. (HAIGH MOOR COAL)				
							Weathered weak grey SILTSTONE recovered as angular to subangular cobbles and angular to subangular fine to coarse gravel. (MIDDLE COAL MEASURES - SILTSTONE)		
							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. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

				Trial Pit Log			Trialpit No TP11 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432338.00 - 404379.00 Level: 93.10		Date 15/04/2020	
Location: Dodworth				Dimensions (m):		Scale 1:25		Logged LT	
Client: The Wentworth Trustees				Depth 3.90					

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.30	92.80		TOPSOIL: Dark brown slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone and siltstone. Sand is fine to coarse. (TOPSOIL)	1
			HVP=118				Firm orangish brown and grey slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse siltstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	
			HVP=92					
			HVP=120				<i>From 1.10m gravelly.</i>	
	2.00	D		1.80	91.30		Grey sandy clayey angular to subangular GRAVEL of siltstone with rare ironstone nodules. Sand is fine to coarse. (GRANULAR RESIDUAL SOIL)	2
				2.80	90.30		Weathered weak grey and dark grey SILTSTONE recovered as angular to subangular cobbles and angular to subangular fine to coarse gravel with occasional orangish brown staining. (MIDDLE COAL MEASURES - SILTSTONE)	3
				3.30	89.80		Black COAL recovered as angular to subangular fine to coarse gravel. (HAIGH MOOR COAL)	
				3.40	89.70		Weathered weak grey MUDSTONE with frequent shell fossils recovered as angular to subangular fine to coarse gravel. (MIDDLE COAL MEASURES - MUDSTONE)	
				3.90	89.20		End of pit at 3.90 m	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. Co-ordinates from hand held GPS, hole not surveyed in.	
Stability: 1. The sides of the trial pit remained stable during excavation.	

				Trial Pit Log			Trialpit No TP12 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432379.00 - 404351.00 Level: 91.10		Date 15/04/2020	
Location: Dodworth				Dimensions (m):		Scale 1:25		Logged LT	
Client: The Wentworth Trustees				Depth 3.20					

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	D	HVP=70	0.25	90.85		TOPSOIL: Dark brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse sandstone and mudstone. Sand is fine to coarse. (TOPSOIL)	1
HVP=78						Stiff orangish brown gleyed grey CLAY. (COHESIVE RESIDUAL SOIL)		
					HVP=94	1.10	90.00	
	2.40	D		2.20	88.90		Black COAL recovered as angular to subangular fine to coarse gravel. (HAIGH MOOR COAL)	3
				2.50	88.60		Weak grey laminated MUDSTONE recovered as angular to subangular gravel. (MIDDLE COAL MEASURES - MUDSTONE)	
						3.10	88.00	
				3.20	87.90		End of pit at 3.20 m	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. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.



				Trial Pit Log			Trialpit No TP13 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432433.00 - 404362.44 Level: 91.00		Date 15/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.90		Logged LT	

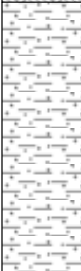
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.25	90.75		TOPSOIL: Dark brown slightly gravelly slightly sandy silty CLAY. Gravel is subangular to subrounded fine to coarse sandstone and mudstone. Sand is fine to coarse. (TOPSOIL) Stiff orangish brown and grey slightly sandy CLAY. Sand is fine. (COHESIVE RESIDUAL SOIL)	
			HVP=85					
			HVP=100					
	1.10	D	HVP=130	1.00	90.00		Stiff greyish brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse siltstone and rare ironstone nodules. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	1
	2.10	D					Stiff greyish brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse siltstone and rare ironstone nodules. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL) From 2.10m gravel is weak grey mudstone.	2
				3.00	88.00		Grey sandy clayey angular to subangular fine to coarse GRAVEL of siltstone. Sand is fine to coarse. (GRANULAR RESIDUAL SOIL)	3
				3.30	87.70		Black COAL recovered as angular to subangular fine to coarse gravel. (SWALLOW WOOD COAL)	
				3.50	87.50		Weathered weak grey MUDSTONE recovered as angular to subangular fine to coarse gravel with orangish brown staining. (MIDDLE COAL MEASURES - MUDSTONE)	
				3.90	87.10		End of pit at 3.90 m	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. Co-ordinates from hand held GPS, hole not surveyed in.		
Stability: 1. The sides of the trial pit remained stable during excavation.		

				Trial Pit Log			Trialpit No TP14 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432376.00 - 404396.00 Level: 94.60		Date 15/04/2020	
Location: Dodworth				Dimensions (m):		Scale 1:25		Logged LT	
Client: The Wentworth Trustees				Depth 3.90					

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.25	94.35		TOPSOIL: Dark brown slightly gravelly slightly sandy silty CLAY. Gravel is subangular fine to coarse sandstone and mudstone. Sand is fine to coarse. (TOPSOIL) Stiff orangish brown gleyed grey CLAY. (COHESIVE RESIDUAL SOIL)	
	0.90	D	HVP=110 HVP=78	0.80	93.80		Stiff orangish brown and grey slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	1
	1.40	D		1.10 1.15	93.50 93.45		Black COAL recovered as clayey angular to subangular fine to coarse gravel. (SWALLOW WOOD COAL)	
				2.30	92.30		Grey sandy clayey angular to subangular fine to coarse GRAVEL of siltstone. Sand is fine to coarse. (GRANULAR RESIDUAL SOIL)	2
				2.90	91.70		Weathered weak grey SILTSTONE recovered as angular to subangular cobbles and subangular fine to coarse gravel. (MIDDLE COAL MEASURES - SILTSTONE)	3
				3.90	90.70	End of pit at 3.90 m		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. Co-ordinates from hand held GPS, hole not surveyed in.	
Stability: 1. The sides of the trial pit remained stable during excavation.	

				Trial Pit Log			Trialpit No TP15 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432134.00 - 404375.00 Level: 106.90		Date 16/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 2.20		Logged LT	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.20	J&T		0.30	106.60		TOPSOIL: Dark brown slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone. Sand is fine to coarse. (TOPSOIL)		
			HVP=102				Stiff brown slightly gravelly slightly sandy CLAY with rare cobbles of subangular sandstone. Gravel is subangular fine to coarse sandstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)		
			HVP=90						
	1.50	D		1.60	105.30		Brown and grey sandy angular to subangular fine to coarse GRAVEL and subangular COBBLES of sandstone. (GRANULAR RESIDUAL SOIL)		
				1.80	105.10		Weathered medium strength fine grained brown SANDSTONE recovered as angular to subangular cobbles and subangular fine to coarse GRAVEL. (MIDDLE COAL MEASURES - SANDSTONE)		
				2.20	104.70		Terminated at 2.20m - unable to excavate further End of pit at 2.20 m		
1 2 3 4 5 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. Co-ordinates from hand held GPS, hole not surveyed in.									
Stability: 1. The sides of the trial pit remained stable during excavation.									

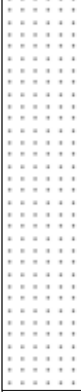


LITHOS CONSULTING				Trial Pit Log			Trialpit No TP16 Sheet 1 of 1	
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432043.00 - 404443.00 Level: 114.20		Date 16/04/2020
Location: Dodworth						Dimensions (m): Depth 2.90		Scale 1:25 Logged LT
Client: The Wentworth Trustees								
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T	HVP=94	0.30	113.90		TOPSOIL: Dark brown slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone and mudstone. Sand is fine to coarse. (TOPSOIL)	
				0.50	113.70		Grey angular to subangular medium strength COBBLES and BOULDERS of sandstone. (GRANULAR RESIDUAL SOIL)	
							Firm orangish brown and grey slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	
	1.10	D		1.60	112.60		Weathered weak grey MUDSTONE recovered as angular to subangular fine to coarse gravel and subangular cobbles with orangish brown staining. (MIDDLE COAL MEASURES - MUDSTONE)	
				2.90	111.30	----- End of pit at 2.90 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. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

				Trial Pit Log			Trialpit No TP17 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432300.00 - 404310.00 Level: 93.70		Date 16/04/2020	
Location: Dodworth				Dimensions (m):		Scale 1:25		Logged LT	
Client: The Wentworth Trustees				Depth 2.00					

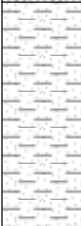
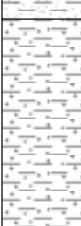
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼	0.20	J&T	HVP=72	0.25	93.45		TOPSOIL: Dark brown slightly gravelly sandy CLAY. Gravel is subangular fine to coarse sandstone and mudstone. Sand is fine to coarse. (TOPSOIL)	1
	0.50	D					Firm light brown gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)	
				0.70	93.00		Weathered fine grained medim strength brown SANDSTONE recovered as angular to subangular cobbles and boulders with orangish brown staining. (MIDDLE COAL MEASURES - SANDSTONE)	
				2.00	91.70		Groundwater strike at 1.8m - steady flow Terminated at 2.00m - unable to excavate further End of pit at 2.00 m	
								3
								4
								5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater strike at 1.8m. 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.

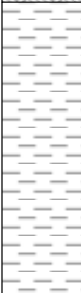
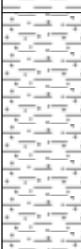


				Trial Pit Log				Trialpit No TP18 Sheet 1 of 1	
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432343.00 - 404306.00 Level: 91.20		Date 16/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.30		Logged LT	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.30	90.90		TOPSOIL: Dark brown slightly gravelly slightly sandy CLAY. Gravel is subangular to rounded fine to coarse mudstone and sandstone. (TOPSOIL)	1
			HVP=98				Firm orangish brown and grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)	
			HVP=92					
	1.20	D		1.10	90.10		Stiff dark grey gravelly CLAY. Gravel is subangular fine to coarse coal and mudstone. (COHESIVE RESIDUAL SOIL)	2
				1.80	89.40		Weathered dark grey weak MUDSTONE recovered as angular to subangular fine to coarse gravel and subangular cobbles. (MIDDLE COAL MEASURES - MUDSTONE)	
				2.30	88.90		Black COAL recovered as angular to subangular fine to coarse gravel. (HAIGH MOOR COAL)	
			2.60	88.60		Weathered grey extremely weak MUDSTONE recovered as angular to subangular fine to coarse gravel and subangular cobbles. (MIDDLE COAL MEASURES - MUDSTONE)	3	
2.80	D		3.30	87.90		End of pit at 3.30 m		
								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. Co-ordinates from hand held GPS, hole not surveyed in.	
Stability: 1. The sides of the trial pit remained stable during excavation.	

				Trial Pit Log			Trialpit No TP19 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432317.00 - 404412.00 Level: 95.90		Date 16/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.40		Logged LT	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	D	HVP=102	0.30	95.60		TOPSOIL: Brown slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse mudstone and sandstone. Sand is fine to coarse. (TOPSOIL)	1
			HVP=108				Stiff orangish brown and grey CLAY. (COHESIVE RESIDUAL SOIL)	
				1.30	94.60		Stiff greyish brown gravelly CLAY. Gravel is subangular fine to coarse mudstone. (COHESIVE RESIDUAL SOIL)	2
				2.10	93.80		Grey sandy very clayey angular to subangular fine to coarse GRAVEL of siltstone. (GRANULAR RESIDUAL SOIL)	
				3.00	92.90		Weathered weak to medium strength grey SILTSTONE recovered as angular to subangular cobbles and subangular fine to coarse gravel. (MIDDLE COAL MEASURES - SILTSTONE)	3
				3.40	92.50		----- End of pit at 3.40 m	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. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.



				Trial Pit Log			Trialpit No TP20 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432487.00 - 404387.00 Level: 91.95		Date 16/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.80		Logged LT	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.20	J&T		0.30	91.65		TOPSOIL: Dark brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse sandstone and mudstone. Sand is fine to coarse. (TOPSOIL)	1	
			HVP=110				Stiff light brown and grey CLAY. (COHESIVE RESIDUAL SOIL)		
			HVP=108						
	1.50	D		1.20	90.75		Stiff light grey and brown gravelly slightly sandy CLAY. Gravel is subangular fine to coarse siltstone, sandstone and rare ironstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	2	
				2.00	89.95		Grey and orangish brown clayey angular to subangular fine to coarse GRAVEL of siltstone. (GRANULAR RESIDUAL SOIL)		
				2.30	89.65		Weathered weak grey SILTSTONE recovered as angular to subangular cobbles and subangular fine to coarse gravel with occasional ironstone nodules. (MIDDLE COAL MEASURES - SILTSTONE)	3	
				3.30	88.65		Black COAL recovered as angular to subangular fine to coarse GRAVEL. (SWALLOW WOOD COAL)		
				3.60	88.35		Weathered extremely weak grey MUDSTONE recovered as angular to subangular fine to coarse gravel. (MIDDLE COAL MEASURES - MUDSTONE)	4	
				3.80	88.15		End of pit at 3.80 m		
	Stability: 1. The sides of the trial pit remained stable during excavation.								

				Trial Pit Log			Trialpit No TP21 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432500.00 - 404411.00 Level: 93.25		Date 16/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 4.10		Logged LT	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.80	D	HVP=60 HVP=88 HVP=102	0.35	92.90		TOPSOIL: Dark brown slightly gravelly slightly sandy silty CLAY. Gravel is subangular fine to coarse sandstone and mudstone. Sand is fine to coarse. (TOPSOIL)	1
							Stiff orangish brown and grey slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse siltstone. Sand is fine to coarse. (COHESIVE RESIDUAL SOIL)	
						<i>From 1.70m gravel is extremely weak mudstone.</i>		2
				2.00	91.25		Weathered weak grey SILTSTONE recovered as angular to subangular cobbles and subangular fine to coarse gravel with ironstone nodules. (MIDDLE COAL MEASURES - SILTSTONE)	
				3.60	89.65		Weathered weak black MUDSTONE recovered as angular to subangular cobbles and subangular fine to coarse gravel with orangish brown staining. (MIDDLE COAL MEASURES - MUDSTONE)	
4.10	89.15	End of pit at 4.10 m		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. Co-ordinates from hand held GPS, hole not surveyed in.	
Stability: 1. The sides of the trial pit remained stable during excavation.	

				Trial Pit Log			Trialpit No TP22 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432437.00 - 404420.00 Level: 94.10		Date 16/04/2020	
Location: Dodworth				Dimensions (m):		Scale 1:25		Logged LT	
Client: The Wentworth Trustees				Depth 4.20					

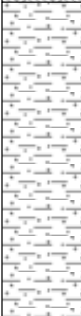
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.25	93.85		TOPSOIL: Dark brown slightly gravelly slightly sandy silty CLAY. Gravel is subangular to subrounded fine to coarse sandstone. Sand is fine to coarse. (TOPSOIL) Stiff orangish brown gleyed grey CLAY. (COHESIVE RESIDUAL SOIL)	1
	1.00	D						
	1.25	D		1.20 1.30	92.90 92.80		Black COAL recovered as clayey angular to subangular fine to coarse gravel. (SWALLOW WOOD COAL) Firm brown gravelly sandy CLAY. Gravel is subangular fine to coarse siltstone. (COHESIVE RESIDUAL SOIL)	2
								
				2.10	92.00		Grey and brown very clayey angular to subangular fine to coarse GRAVEL of siltstone. (GRANULAR RESIDUAL SOIL)	3
				2.70	91.40		Weathered weak grey SILTSTONE recovered as angular to subangular cobbles and subangular fine to coarse gravel with occasional ironstone nodules. (MIDDLE COAL MEASURES - SILTSTONE)	
				4.20	89.90	End of pit at 4.20 m		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. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

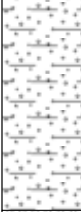


				Trial Pit Log			Trialpit No TP23 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432446.00 - 404443.00 Level: 96.10		Date 16/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.50		Logged LT	

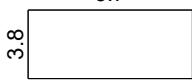
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	D	HVP=68	0.30	95.80		TOPSOIL: Brown gravelly slightly sandy CLAY. Gravel is subangular medium to coarse sandstone. (TOPSOIL)	1
							Stiff orangish brown and grey gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)	
				1.40	94.70		Firm grey gravelly CLAY. Gravel is angular to subangular fine to coarse extremely weak siltstone. (COHESIVE RESIDUAL SOIL)	
				1.80	94.30		Grey and brown very clayey angular to subangular fine to coarse GRAVEL of siltstone with occasional ironstone nodules. (GRANULAR RESIDUAL SOIL)	2
				2.60	93.50		Weathered weak grey fine grained SANDSTONE and rare SILTSTONE recovered as angular to subangular cobbles and subangular fine to coarse gravel. (MIDDLE COAL MEASURES - SANDSTONE)	3
				3.50	92.60		<i>Terminated at 3.40m - unable to excavate further</i> ----- End of pit at 3.50 m	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. Co-ordinates from hand held GPS, hole not surveyed in.	
Stability: 1. The sides of the trial pit remained stable during excavation.	

LITHOS CONSULTING				Trial Pit Log			Trialpit No TP24 Sheet 1 of 1	
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432396.00 - 404444.00 Level: 95.70		Date 16/04/2020
Location: Dodworth				Dimensions (m):				Scale 1:25
Client: The Wentworth Trustees				Depth 4.10				Logged LT
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼	0.20	J&T		0.25	95.45		TOPSOIL: Dark brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse mudstone, sandstone and siltstone. Sand is fine to coarse. (TOPSOIL)	1
			HVP=80				Stiff orangish brown and grey CLAY. (COHESIVE RESIDUAL SOIL)	
	0.80	D		0.70	95.00		Black COAL recovered as clayey angular to subangular fine to coarse GRAVEL. (MIDDLE COAL MEASURES - COAL)	
			HVP=110	0.85	94.85		Stiff grey and brown CLAY. (COHESIVE RESIDUAL SOIL)	2
	1.20	D						
			HVP=118					
				2.30	93.40		Weathered extremely weak grey MUDSTONE recovered as gravelly CLAY. Gravel is subangular fine to coarse. (MIDDLE COAL MEASURES - MUDSTONE)	
				2.90	92.80		Weathered extremely weak grey MUDSTONE recovered as angular to subangular fine to coarse gravel and subangular cobbles. (MIDDLE COAL MEASURES - MUDSTONE)	3
				3.30	92.40		Black COAL recovered as angular to subangular fine to coarse GRAVEL. (HAIGH MOOR COAL)	
				3.50	92.20		Weathered extremely weak grey MUDSTONE with fossilised plants recovered as angular to subangular fine to coarse gravel and subangular cobbles. (MIDDLE COAL MEASURES - MUDSTONE)	
			4.10	91.60	End of pit at 4.10 m			4
								5
Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater seepage at 2.9m. 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.								

				Trial Pit Log			Trialpit No TP25 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432296.00 - 404439.00 Level: 98.80		Date 16/04/2020	
Location: Dodworth						Dimensions (m):		Scale 1:25	
Client: The Wentworth Trustees						Depth 3.00		Logged LT	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.20	J&T	HVP=62	0.30	98.50		TOPSOIL: Dark brown slightly gravelly sandy CLAY. Gravel is subangular fine to coarse sandstone. Sand is fine to coarse. (TOPSOIL)		1
	0.90	D		1.30	97.50		Firm brown gravelly sandy CLAY. Gravel is subangular fine to coarse sandstone and siltstone. (COHESIVE RESIDUAL SOIL)		
				2.00	96.80		Brown and grey clayey angular to subangular fine to coarse GRAVEL of siltstone and sandstone. (GRANULAR RESIDUAL SOIL)		2
				2.70	96.10		Weathered weak grey SILTSTONE recovered as angular to subangular cobbles and subangular fine to coarse gravel. (MIDDLE COAL MEASURES - SILTSTONE)		
				3.00	95.80		Weathered medium strength grey fine grained SANDSTONE recovered as angular to subangular cobbles and subangular fine to coarse gravel. (MIDDLE COAL MEASURES - SANDSTONE)		
Terminated at 3.00m - unable to excavate further End of pit at 3.00 m							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. Co-ordinates from hand held GPS, hole not surveyed in.									
Stability: 1. The sides of the trial pit remained stable during excavation.									



				Trial Pit Log			Trialpit No TP101 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432222.37 - 404348.54 Level: 98.20		Date 14/04/2021	
Location: Dodworth				Dimensions (m):		3.7		Scale 1:25	
Client: The Wentworth Trustees				Depth 1.70				Logged LEW	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
				0.20	98.00		Dark brown slightly sandy CLAY with occasional rootlets. (TOPSOIL)		
							Stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (COHESIVE RESIDUAL SOIL) <i>At 0.5m, 2 inch armoured electric cable (not live) with warning tiles.</i> <i>Copper band extending from electric cable down to a steel plate (0.6m x 0.6m) - possible earthing plate.</i>		
				1.70	96.50	End of pit at 1.70 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 (co-ordinates & level) prior to excavation.									
Stability: 1. The sides of the trial pit remained stable during excavation.									



				Trial Pit Log			Trialpit No TP102 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432231.02 - 404393.09 Level: 99.25		Date 14/04/2021	
Location: Dodworth				Dimensions (m): Depth 1.10 3.4		Scale 1:25		Logged LEW	
Client: The Wentworth Trustees									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20	99.05		Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine of sandstone. (TOPSOIL)	
				0.60	98.65		Brown clayey sandy angular to subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)	
				1.10	98.15		Light brown slightly clayey sandy angular tabular fine to coarse GRAVEL of sandstone with low cobble content. (GRANULAR RESIDUAL SOIL)	
							No anomalous ground encountered. End of pit at 1.10 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 (co-ordinates & level) prior to excavation.		
Stability: 1. The sides of the trial pit remained stable during excavation.		

				Trial Pit Log			Trialpit No TP103 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432223.06 - 404386.46 Level: 98.35		Date 14/04/2021	
Location: Dodworth				Dimensions (m): Depth 1.10 4.1 3.3		Scale 1:25		Logged LEW	
Client: The Wentworth Trustees									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30	98.05		Dark brown slightly sandy CLAY with occasional rootlets. (TOPSOIL)	
				0.60	97.75		Firm orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of predominantly sandstone with rare coal and ironstone. (COHESIVE RESIDUAL SOIL)	
				1.10	97.25		Stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)	
							<u>No anomalous ground encountered.</u> End of pit at 1.10 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 (co-ordinates & level) prior to excavation.	
Stability:	1. The sides of the trial pit remained stable during excavation.	

				Trial Pit Log			Trialpit No TP104 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432248.86 - 404397.89 Level: 98.50		Date 14/04/2021	
Location: Dodworth				Dimensions (m): Depth 1.10 3.3 3.7		Scale 1:25		Logged LEW	
Client: The Wentworth Trustees									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30	98.20		Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of sandstone with rare coal. (TOPSOIL)	1
				0.70	97.80		Firm greyish brown CLAY. (COHESIVE RESIDUAL SOIL)	
				1.10	97.40		Stiff brown mottled grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (COHESIVE RESIDUAL SOIL) At 0.7m in northwest corner of pit, 0.9m wide band of black clay with gravel of coal (likley weathered outcrop).	
							End of pit at 1.10 m	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 (co-ordinates & level) prior to excavation.	
Stability:	1. The sides of the trial pit remained stable during excavation.	

				Trial Pit Log			Trialpit No TP105 Sheet 1 of 1		
Project Name: Smithy Wood Lane, Dodworth				Project No. 1979		Co-ords: 432244.72 - 404414.15 Level: 99.35		Date 14/04/2021	
Location: Dodworth				Dimensions (m): 3.6 3.5 3.5		Scale 1:25		Logged LEW	
Client: The Wentworth Trustees				Depth 1.20					

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20	99.15		Dark brown slightly sandy CLAY with occasional rootlets. (TOPSOIL)	
				1.20	98.15		Firm orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (COHESIVE RESIDUAL SOIL) <i>No anomalous ground encountered.</i> End of pit at 1.20 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 (co-ordinates & level) prior to excavation.	
Stability:	1. The sides of the trial pit remained stable during excavation.	