

Report No. 1792/2

March 2014

**GEOENVIRONMENTAL APPRAISAL**  
**of land at**  
**MOORTHORPE GATE, OWLTHORPE**

**Prepared for**  
**KIER SERVICES**



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## MOORTHORPE GATE, OWLTHORPE - SUMMARY OF GEOENVIRONMENTAL ISSUES

The site is located off Moorthorpe Gate, approximately 7.5km south-east of Sheffield city centre (NGR SK418 827), and occupies an area of approximately 6.8 hectares (16.8 acres).

The site comprises two separate areas of rough grassed undulating land, with localised areas of copse and bushes, divided north and south by Moorthorpe Gate. The northern area slopes steadily down to the east with a steep slope on the eastern boundary where re-grading works are likely to have taken place during construction of a roundabout on Moorthorpe Gate.

No previous development is shown at the site on historical OS plans.

Lithos were commissioned by Kier Services to provide a geoenvironmental appraisal of the site. It is understood that the site is to be redeveloped with housing; a proposed layout has not yet been prepared. Lithos's investigation included a site walkover and a review of available desk study information, together with a ground investigation comprising 32 trial pits and 25 rotary open hole probeholes.

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

Issue	Remarks
Made Ground	No significant thicknesses of made ground were encountered in any of the exploratory holes. Reworked natural soils were identified in TP30 to 1.0m depth.
Natural Ground	Identified in each exploratory hole generally comprising topsoil (typically 300mm thick) over Residual Soil (clays and gravelly clays). Isolated gravel size fragments of coal were identified within the clay strata in TPs 3 & 4 with lenses of coal recorded in TP9 between 2.3m and 2.7m depth. A grey and black clay with gravel of coal and carbonaceous mudstone was encountered in TP29 between 1.7m and 2.1m depth. Underlying bedrock comprised Sandstones, Siltstones and Mudstones, with a band of Ironstone identified in TP10 at 2.7m depth.
Mining & Quarrying	The site is underlain by two seams of coal: <ul style="list-style-type: none"> <li>The Sitwell Coal (typically is 0.6m thick; maximum recorded thickness of 0.9m) which is shown on Geological Plans to outcrop across the centre of the site.</li> <li>The Sitwell Thin Coal (typically is 0.4m thick; maximum recorded thickness of 1.0m), which lies about 8m below the Sitwell Coal.</li> </ul> No evidence of shallow mineworkings in either the Sitwell or Sitwell Thin seams has been recorded in any of 25 probeholes drilled.
Hazardous Gas	The site is not located in a radon affected area. The site is underlain by shallow coal seams, although no workings have been identified. Monitoring wells have been installed in 10 probeholes, and a period of gas monitoring commenced.
Contamination	No issues. Topsoil is suitable for re-use.
Foundations	Strip footings at a minimum depth of 900mm; founding stratum will be firm and stiff clays. Foundations should be deepened near trees; this may affect about 50% of the site.
Groundwater & Excavations	Groundwater was not encountered within any of the exploratory holes. It has subsequently been recorded in 10 wells, at depths of between ground level and 3.6m. The majority of the trial pits remained stable, suggesting that shallow excavations should also remain stable, in the short term, during the construction phase.
Flooding & Drainage	Soakaways are unlikely to provide a suitable means of surface water disposal at the site given the cohesive nature of the residual soils. Bedrock proved variable with low permeability layers of Mudstone and Siltstone encountered.
Development Constraints	A foul water and surface water sewer cross the centre of the southern area of the site from south to north.
Highways	Natural soils at the site are likely to yield CBR values of greater than 3%; if necessary re-engineering of natural deposits is likely to be feasible and produce CBR values in excess of 5%.

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

## TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	The Commission and Brief	1
1.2	The Proposed Development	1
1.3	Report Format and Limitations	1
<b>2</b>	<b>SITE DESCRIPTION</b>	<b>2</b>
2.1	General	2
2.2	Site Features	2
<b>3</b>	<b>SITE HISTORY</b>	<b>3</b>
<b>4</b>	<b>ENVIRONMENTAL SETTING</b>	<b>4</b>
4.1	General	4
4.2	Landfills	5
4.3	Geology & Mining	5
4.4	Mineral Safeguarded Areas	5
<b>5</b>	<b>GROUND INVESTIGATION DESIGN</b>	<b>6</b>
5.1	Anticipated Ground Conditions & Potential Issues	6
5.2	Preliminary Conceptual Site Model	7
5.3	Ground Investigation Design & Strategy	7
<b>6</b>	<b>FIELDWORK</b>	<b>7</b>
6.1	Objectives	7
6.2	Exploratory Hole Location Constraints	7
6.3	Scope of Works	8
<b>7</b>	<b>GROUND CONDITIONS</b>	<b>9</b>
7.1	General	9
7.2	Made Ground	9
7.3	Natural Ground	9
7.4	Visual & Olfactory Evidence of Organic Contamination	9
7.5	Stability	9
7.6	Mining Investigation	9
7.7	Groundwater	13
7.8	Revised Conceptual Ground Model (Ground Conditions)	13
<b>8</b>	<b>CONTAMINATION (ANALYSIS)</b>	<b>14</b>
8.1	General	14
8.2	Testing Scheduled	14
8.3	Soil Contamination Results	14
<b>9</b>	<b>CONTAMINATION (QUALITATIVE RISK ASSESSMENT &amp; REMEDIATION)</b>	<b>15</b>
9.1	General	15
<b>10</b>	<b>HAZARDOUS GAS</b>	<b>17</b>
10.1	General	17
10.2	Scope of Works	17
10.3	Monitoring Results	17
10.4	Discussion	18
<b>11</b>	<b>GEOTECHNICAL TESTING</b>	<b>18</b>
11.1	General	18
11.2	Atterberg Limits	18

11.3	Soluble Sulphate and pH .....	18
<b>12</b>	<b>GEOTECHNICAL ISSUES.....</b>	<b>19</b>
12.1	Conceptual site Model .....	19
12.2	Mining .....	19
12.3	Quarrying.....	19
12.4	Site Regrade and/or Ground Improvement .....	19
12.5	Foundation Recommendations .....	20
12.6	Floor Slabs .....	21
12.7	Designated Concrete Mixes.....	22
12.8	Excavations .....	22
12.9	Drainage.....	22
12.10	Highways .....	23
12.11	External Works .....	23
<b>13</b>	<b>REDEVELOPMENT ISSUES.....</b>	<b>23</b>
13.1	General.....	23
13.2	Remediation Strategy .....	23
13.3	Coal Extraction .....	23
13.4	Health & Safety Issues - Construction Workers .....	24
13.5	New Utilities .....	24
13.6	Potential Development Constraints .....	24
<b>14</b>	<b>SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.....</b>	<b>25</b>
14.1	General.....	25
14.2	Hazardous Gas.....	25
14.3	Mining .....	25
14.4	Contamination .....	25
14.5	Foundations.....	25
14.6	Flooding .....	25
14.7	Drainage .....	26
14.8	Highways .....	26

## APPENDICES

### Appendix A - General Notes

01	Environmental Setting
02	Ground Investigation Fieldwork
03	Geotechnical Testing
04	Contamination Laboratory Analysis & Interpretation
05	Hazardous Gas

### Appendix B – Drawings

Drawing No.	Revision	Title
1792/1	-	Site Location Plan
1792/3	-	Existing Site Features
1792/4	-	Site Photographs
1792/5	-	Preliminary Conceptual Site Model
1792/6	B	Exploratory Hole Location Plan
1792/7	-	Revised Conceptual Site Model

### Appendix C - Commission

### Appendix D - Historical OS Plans<sup>#</sup>

### Appendix E - Search Responses<sup>#</sup>

From	Date	Content
Landmark	13 <sup>th</sup> December 2013	Envirocheck Report
Coal Authority	13 <sup>th</sup> December 2013	Mining Report

### Appendices F & G – Exploratory Records

Appendix F	TP1 to TP32
Appendix G	PH1 to PH25, including PH's 1A to 10A

### Appendix H – Chemical Test Results

### Appendix I – Geotechnical Test Results

### Appendix J – Gas Monitoring Results

<sup>#</sup> Some of this data is not included within the paper or PDF copies of this report; it is all included on the CD.

## **FOREWORD (Geoenvironmental Investigation 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.

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. laboratory test certificates) is only included within the "electronic", PDF Report on the accompanying 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. All 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 geo-environmental 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 Consulting Limited cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remediation options.

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

**GEOENVIRONMENTAL APPRAISAL**  
**of land at**  
**MOORTHORPE GATE, OWLTHORPE**

**1 INTRODUCTION**

**1.1 The Commission and Brief**

1.1.1 Lithos Consulting Limited were commissioned by Kier Services to carry out a geoenvironmental appraisal of land off Moorthorpe Gate, Owlthorpe.

1.1.2 Correspondence regarding Lithos's 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
- an intrusive ground investigation comprising 32 trial pits, 25 deep rotary probeholes to check for the presence of mineworkings, with 10 shallow rotary probeholes to allow installation of gas/groundwater monitoring wells
- assessment of the geotechnical properties of the near surface deposits to enable provision of foundation and highway recommendations
- a qualitative assessment of contamination risks

1.1.3 This document is a revision of the Geoenvironmental Appraisal (Report 1792/1) issued by Lithos in January 2014; Report 1792/1 is now superseded. This document now includes the findings of additional rotary probing undertaken at the site. The only significant revisions to Report 1792/1 appear in Sections 6.3, 7.6, 12.2 & 14.3.

1.1.4 It is understood that Kier Services (acting for Sheffield City Council) are looking to market the site for residential development, with the benefit of an information pack.

1.1.5 Primary aims of this investigation were to identify salient geoenvironmental issues affecting the site to enable prospective purchasers to assess ground-related abnormal costs and make an unconditional offer in this respect. This Report is also suitable for submission to the local authority in support the submission of a planning application.

**1.2 The Proposed Development**

1.2.1 It is understood that consideration is being given to redevelopment of the site with two to three storey domestic dwellings, associated gardens, POS and adoptable roads and sewers. No site layout has been provided at this stage.

**1.3 Report Format and Limitations**

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

- Assessment of the site's environmental setting
- Ground investigation fieldwork
- Geotechnical Testing
- Contamination Testing
- Hazardous Gas

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

## 2 SITE DESCRIPTION

### 2.1 General

- 2.1.1 The site's location is shown on Drawing No. 1792/1 presented in Appendix B to this report. Site details are summarised in the Table below.

Detail	Remarks
Location	7.5 km south-east of Sheffield city centre
NGR	SK 418 827
Approximate Area	6.8 ha (16.8 acres)
Known services	Underground sewers. Underground electric in existing highways.

### 2.2 Site Features

- 2.2.1 A Lithos Engineer completed a walkover survey of the site on 17<sup>th</sup> December 2013.
- 2.2.2 The site comprises two separate areas of rough grassed undulating land with localised areas of copse and bushes divided north and south by Moorthorpe Gate.
- 2.2.3 The northern area slopes steadily down to the east, with a steep slope on the eastern boundary where re-grading works are likely to have taken place during construction of a roundabout on Moorthorpe Gate.
- 2.2.4 A soil bund is located at the crest of the slope above the roundabout.
- 2.2.5 Further re-grading appears to have taken place in the south-west adjacent to a recently constructed pharmacy and doctor's surgery.
- 2.2.6 A tarmac footpath/cycle path crosses the north of the site, connecting Moorthorpe Gate with further footpaths just beyond the northern site boundary.
- 2.2.7 Existing salient features, at the time of the walkover survey, are presented on Drawing No. 1792/3 in Appendix B to this report, and summarised in the Table below.

Feature	Remarks
Current Access	Off Moorthorpe Gate which divides the site into separate northern and southern areas
Topography	Steady fall from west to east, dropping steeply down on eastern boundary, adjacent to the roundabout on Moorgate Gate.
Approximate areas	270m <sup>2</sup> tarmac hardstand 1,100m <sup>2</sup> soil mound 67,000m <sup>2</sup> grass, overgrown areas
Nature of boundaries	North – trees, bushes. West – bushes. East – no physical boundary. South – no physical boundary.
Surrounding land uses	North – Wooded area with footpaths and Ochre Dike. East – Rough grass with Ochre Dike. Housing beyond. South – Rough grass and woodland with housing beyond south-west, agricultural land beyond south-east. Watercourse located beyond southern boundary. West – Open fields beyond western boundary of northern area. Doctor's surgery and pharmacy beyond western boundary of southern area.

- 2.2.8 A selection of site photographs are included on Drawing No. 1792/4.

### 3 SITE HISTORY

3.1.1 Site centred extracts from Ordnance Survey (OS) plans dating back to 1877 have been examined. Some of these plans are presented in Appendix D to this report.

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

Date	Site	Surrounding Land
1877	Site comprises open fields with several footpaths crossing the centre of the site.	Predominantly open fields, pasture to the south-east. <b>'Well'</b> labelled immediately north of the site. <b>Stream</b> labelled Ochre Dike running west to east just beyond northern and eastern boundaries. Stream approximately 25m beyond southern boundary flowing west to east. <b>'Moorhole Collieries'</b> with associated shafts approximately 250m to the south-west. Further <b>'shafts'</b> and <b>'engine house'</b> approximately 100m to west of site.
1894		Well to north no longer shown.
1935		Shafts to west and south-west labelled as <b>'old shafts'</b> .
1937		Moorhole Colliery labelled as disused.
1955		Buildings etc associated with Moorhole Colliery absent, land shown as spoil heaps, embankments etc
1956		Sewage works approximately 50m to north adjacent to stream.
1967	One of the footpaths crossing from the north-east of the site no longer shown.	
1969		<b>Electricity pylons</b> shown approximately 50m beyond sites northern boundary.
1971		Land associated with former Moorhole colliery reinstated; now shown as fields, woodland etc with tracks and occasional buildings including glass houses.
1993		Extensive residential development to the north of the site.
2006	Moorthorpe Gate with associated roundabouts shown. Footpath in south-east of site no longer shown.	Residential development to the south-west. Construction of Doctor's surgery and pharmacy adjacent to south-western boundary.

## 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. The responses received from Landmark and the Coal Authority are presented in Appendix E. These responses are summarised below, together with the findings of our own "desk study" investigation.

Issue	Data reviewed	Summary
Geology	1:50,000 BGS map (Sheet 100 Sheffield) 1:10,560 BGS map (Sheet SK 48 SW) BGS BH Log SK48SW/237 Geology of the Country around Sheffield (IGS, 1957)	Drift – none shown. Solid – Lower Coal Measures strata. Shallowest coal seams - The Sitwell Coal (c. 1m thick) outcrops across the centre of the site. The Sitwell Thin Coal (c. 0.55m) lies about 5m below the Sitwell Coal. The next shallowest significant seam is the Parkgate Coal (c. 1.8m thick), which crops about 1 km to the south-west; and is likely to lie at a depth of about 60m below the subject site Strata Dip – to the east. Faults – none at or adjacent to the site. See also Section 4.3 below.
Mining	Coal Authority BGS maps	The site is predominantly located within a Standing Advice Area, with the central area of the site (along the line of conjectured outcrop of the Sitwell Coal) shown within a Coal Mining Development Referral Area. Opencast – none shown at or adjacent to the site. Mine entries – None at, or within 20m of, the site. See also Section 4.3 below.
Quarrying	Historical OS Plans	None shown at or adjacent to the site.
Radon	BRE Report BR211	No protection measures required.
Hydrogeology	Environment Agency Groundwater Vulnerability map (Sheet 18 Notts)	Source Protection Zone - None. Aquifer - Secondary A (Solid). Groundwater abstractions – None within 500m Soil leaching potential – High (H3).
Hydrology	Environment Agency Envirocheck Report	Nearest watercourse(s) – Ochre Dike approximately 10m beyond northern boundary flowing west to east, running around eastern boundary towards the south. Tributary of Ochre Dike flowing west to east approximately 20m from southern boundary. Abstractions – None within 500m. Discharge consents – None within 500m
Flood Risk	Environment Agency	The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. The site area is greater than 1 hectare, therefore a Flood Risk Assessment, focused on the management of surface water run-off, will be required. Development that increases the amount of impermeable surfaces can result in an increase in surface water run-off, which in turn can result in increased flood risk both on site and elsewhere within the catchment.

## 4.2 Landfills

- 4.2.1 There are no known or suspected areas of landfill within 250m of the proposed development site.

## 4.3 Geology & Mining

- 4.3.1 The Sitwell Coal is shown on BGS Sheet SK48SW to outcrop across the centre of the site. The Sitwell Coal is indicated to be about 1m thick, and has been worked in opencast 100m to the north.
- 4.3.2 According to the legend for Sheet SK48SW an unnamed seam (presumably the Sitwell Thin) lies about 5m below the Sitwell Coal. At Holbrook (2.5km east) the Sitwell Thin is recorded (IGS, 1957) as being 0.55m thick. The Sitwell Thin is not shown to outcrop on Sheet SK48SW anywhere near the site, but if present, it should outcrop close to the site's western boundary.
- 4.3.3 The next shallowest significant seam is the Parkgate Coal, which crops about 1 km to the south-west; beyond Moorhole Colliery. A BGS log for Moorhole Colliery, indicates that the Parkgate seam (inclusive of dirt partings etc) is 1.8m thick, and was encountered at a depth of about 18m. The Parkgate Coal is likely to lie at a depth of about 60m below the subject site.
- 4.3.4 The site is predominantly located within a Standing Advice Area – within the defined coalfield, but no known defined risks have been recorded by the Coal Authority; there may still be unrecorded issues. However, the central area (along the line of conjectured outcrop of the Sitwell Coal) lies within a Coal Mining Development Referral Area – an area with specific mining legacy risks to the surface, including mine entries; shallow coal workings etc.
- 4.3.5 According to the Coal Authority's mining report indicates that the property is in the likely zone of influence from workings in two seams of coal at 60m to 170m depth (likely to be the Parkgate and Silkstone coals), and last worked in 1932. Any ground movement from these coal workings should have stopped by now.
- 4.3.6 However, the property also lies in an area where the Coal Authority believe there is coal at or close to the surface; this coal may have been worked at some time in the past.

## 4.4 Mineral Safeguarded Areas

- 4.4.1 The site is underlain by the Sitwell Coal and might therefore be considered by the Local Authority to lie within a Mineral Safeguarding Area (MSA).
- 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 143 of the National Planning Policy Framework (NPPF) requires Local Authorities, when preparing Local Plans to:
- Define Minerals Safeguarding Areas and adopt appropriate policies in order that known locations of specific minerals resources of local and national importance are not needlessly sterilised by non-mineral development, whilst not creating a presumption that resources defined will be worked; and define Minerals Consultation Areas based on these Minerals Safeguarding Areas;
  - Set out policies to encourage the prior extraction of minerals, where practicable and environmentally feasible, if it is necessary for non-mineral development to take place
- 4.4.5 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 Kier Services to consider the opportunity to recover (extract) the coal. Applicants submitting planning applications may need to demonstrate to the Local Authority that they will extract the coal, unless:
- it can be shown it is not economically viable to do so, or
  - it is not environmentally acceptable to do so, or
  - the need for the development outweighs the need to extract the coal, or
  - the coal will not be sterilised by the development
- 4.4.7 The viability of coal extraction at this site is considered later in this Report (Section 13.3) in light of the findings of Lithos' intrusive mining investigation, which comprised the drilling of ten rotary probeholes to depths of 30m (see Section 7.6).

## 5 GROUND INVESTIGATION DESIGN

### 5.1 Anticipated Ground Conditions & Potential Issues

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

Anticipated Condition	Remarks
Made Ground	Localised shallow re-working of natural strata.
Natural Soils	Topsoil overlying Residual Soil (clays, clayey gravels etc).
Bedrock	Lower Coal Measures strata (sandstone, mudstone & siltstone) at shallow depth.
Mineworkings	Possible unrecorded shallow workings in the Sitwell Coal and/or Sitwell Thin.
Groundwater	Likely to lie at depth within the 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. Localised re-working of natural soils	1. Localised made ground
Potential off-site contamination sources	1. Surrounding historical industry	1. Airborne contaminants/dust
Potential geotechnical hazards	1. Shallow workings	1. Unrecorded workings/bell pitting
Other potential constraints	1. Underground utilities	1. Sewer pipes in south of site

## 5.2 Preliminary Conceptual Site Model

- 5.2.1 A preliminary conceptual site model, presented as Drawing No. 1792/5 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 Given the site's history, it is unlikely that any significant soil contamination will be encountered.

## 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, the scope of which is summarised below.

Exploratory Holes	Purpose
TPs 1 to 28	To determine the general nature of soils underlying the site, including the: <ul style="list-style-type: none"> <li>nature, distribution and thickness of shallow soils, including any made ground</li> <li>suitability of the ground for founding structures and highways</li> </ul>
PHs 1 to 10	To check for the presence of voids or broken ground associated with possible unrecorded shallow mine workings.
PHs 1A to 10A	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 5.1 above. A nominal 50m grid spacing was proposed. 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.

## 6 FIELDWORK

### 6.1 Objectives

- 6.1.1 The original investigation strategy is outlined in Section 5.3 above.
- 6.1.2 The additional exploratory holes listed below were advanced in light of ground conditions actually encountered.

Exploratory Holes	Purpose
TPs 29 to 32	To determine ground conditions in areas of additional land due to revision of the site boundary.
PHs 11 to 25	To check for the presence of voids or broken ground associated with possible unrecorded shallow mine workings. To delineate the area underlain by <10x seam cover thickness

### 6.2 Exploratory Hole Location Constraints

- 6.2.1 Access was restricted in areas of dense vegetation around the site.
- 6.2.2 A suitable easement had to be maintained adjacent to sewers in the south of the site.

### 6.3 Scope of Works

6.3.1 Fieldwork was supervised by Lithos on 17<sup>th</sup> & 18<sup>th</sup> December 2013 (pitting), on the 7<sup>th</sup> & 9<sup>th</sup> January 2014 (drilling), and on the 13<sup>th</sup> March 2014 (additional drilling) and comprised the exploratory holes listed below.

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs 1 to 32	1.0m to 3.2m	Trial pits typically encountered weathered rockhead from around 2m depth
Rotary Openhole Probeholes	PHs 1 to 10	30m	To check for the presence of shallow mine workings
	PHs 1A to 10A	3.0m to 7.0m	Gas/groundwater monitoring wells installed in each hole
	PHs 11 to 25	9m to 21m	To further check for the presence of shallow mine workings and determine the areas with <10x seam cover thickness

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

6.3.3 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

6.3.4 Exploratory hole locations are shown on Drawing No. 1792/6 presented in Appendix B.

## **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. However, a summary of the ground conditions is provided below.
- 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 page 10.

### **7.2 Made Ground**

- 7.2.1 No significant thicknesses of made ground were encountered in any of the exploratory holes at the site. Reworked natural soils were identified in TP30 to 1.0m depth.
- 7.2.2 A bund located in the east of the site was found to comprise reworked natural topsoil.

### **7.3 Natural Ground**

- 7.3.1 Natural ground was identified in each exploratory hole and generally comprised topsoil (typically 300mm in thickness), over Residual Soils (Completely Weathered Coal Measures bedrock) clays and gravelly clays. Locally, clay with lithorelicts was encountered.
- 7.3.2 Isolated gravel-sized fragments of coal were identified within the clay strata in TPs 3 & 4, with lenses of coal recorded in TP9 between 2.3m and 2.7m depth.
- 7.3.3 A grey and black clay, with gravel of coal and carbonaceous mudstone, was encountered in TP29 between 1.7m and 2.1m depth.
- 7.3.4 Underlying bedrock comprised sandstones, siltstones and mudstones, with a band of Ironstone identified in TP10 at 2.7m depth. Rockhead was encountered from 0.5m depth to >3.2m in the trial pits, typically from 1.5m to 2.5m.

### **7.4 Visual & Olfactory Evidence of Organic Contamination**

- 7.4.1 No visual or olfactory evidence of hydrocarbon contamination was noted in any of the exploratory holes.

### **7.5 Stability**

- 7.5.1 Stability of excavations within the natural ground was generally good in all the trial pits.

### **7.6 Mining Investigation**

- 7.6.1 It is clear from the desk study that the site is likely to be underlain by:
- the Sitwell Coal – shown on BGS maps to outcrop through the centre of the site approximately north to south, dipping to the east, and
  - the Sitwell Thin Coal – may lie about 5m below the Sitwell Coal, although it is not shown to outcrop in the vicinity.
- 7.6.2 The conjectured position of the outcrop of the Sitwell Coal is shown on Drawing No. 1792/3 in Appendix B to this report. This coal was encountered in TP9, suggesting the BGS map is reasonably accurate (at least north of Moorthorpe Gate).
- 7.6.3 If present, the Sitwell Thin would outcrop somewhere close to the site's western boundary and dip beneath the site. This coal was probably encountered in TPs 3, 4 & 29; at shallow depth and consequently highly weathered.

**Summary of Ground Conditions – Trial Pits**

Hole ID	Final Depth (m)	Topsoil Thickness (m)	Depth to Base of (m)							
			Made Ground	Residual Soils			Weathered Coal Measures			
				Clay	Gravelly Clay	Clay & lithorelicts	Mudstone	Siltstone	Sandstone	Ironstone
TP01	2.00	0.20		0.50		1.90			>2.00	
TP02	2.50	0.20				2.20			>2.50	
TP03	2.40	0.20				2.00		>2.40		
TP04	3.20	0.30				>3.20				
TP05	2.50	0.30		1.90				>2.50		
TP06	1.90	0.30		0.80		1.60			>1.90	
TP07	2.50	0.25		1.00		1.60	2.30	>2.50		
TP08	2.60	0.20		1.60		2.30			>2.60	
TP09	2.70	0.30		0.70	>2.70					
TP10	2.80	0.30		1.40		2.70				>2.80
TP11	1.00	0.30			0.60				>1.00	
TP12	2.20	0.20		0.50					>2.20	
TP13	2.80	0.30			2.50			>2.80		
TP14	1.80	0.20			1.60				>1.80	
TP15	1.70	0.30		1.50					>1.70	
TP16	1.70	0.20				1.40			>1.50	
TP17	2.40	0.10		1.00		2.00		>2.40		
TP18	2.80	0.20		1.50		2.50	>2.80			
TP19	2.20	0.30			2.00			>2.20		
TP20	2.00	0.30		1.60				>2.00		
TP21	2.50	0.20			1.80	2.10		>2.50		
TP22	2.20	0.10			1.70			>2.20		
TP23	2.40	0.20			2.10			>2.40		
TP24	2.50	0.20		0.90				>2.50		
TP25	2.20	0.15				1.20		1.80	>2.20	
TP26	2.20	0.20		0.60		1.20			>2.20	
TP27	1.80	1.80								
TP28	2.20	0.20			1.90			>2.30		
TP29	2.60	0.30		1.70	2.10	2.50			>2.60	
TP30	2.20	0.10	1.00	>2.20						
TP31	2.00	0.30				1.70			>2.00	
TP32	2.50	0.30				2.10		>2.50		

- 7.6.4 An intrusive mining investigation, comprising the drilling of 25 deep rotary open-hole probeholes (PH's 1 to 25), has been undertaken. A further 10 probeholes were taken to shallow depth (3m to 7m depth) to allow the installation of gas monitoring wells (PH's 1A to 10A).
- 7.6.5 All of the deep probeholes were taken to between 9m and 30m depth and findings are summarised in the Table on page 11.
- 7.6.6 Where shallow mineworkings exist (almost certainly not the case here), the vertical distance through which a void can migrate is difficult to assess. CIRIA ('Construction over abandoned mine workings', 1989) suggest a thickness of solid rock through which a void can migrate as  $10h$  above the roof of the workings, where  $h$  is the height of the workings (generally assumed to be similar to the seam thickness; i.e. about 1m).
- 7.6.7 In places (i.e. close to outcrop), there is less than ten times competent rock cover above both seams. Cover ratios detailed in the Table on page 11 are based on maximum recorded seam thicknesses of 0.9m for the Sitwell Coal and 1.0m for the Thin Coal in the column headed 'max', and on actual recorded seam thickness in each hole (column headed 'actual').
- 7.6.8 PHs 3 to 6, 10, 15, 16, 18 & 20 to 24 encountered the Sitwell Coal, with a second seam (presumably the Sitwell Thin) about 8m deeper.
- 7.6.9 PHs 1, 2, 8, 9, 11 to 13 & 25 were drilled beyond the outcrop of the Sitwell Coal (to the west) and consequently only encountered the Sitwell Thin. PHs 7 & 25 did not encounter any coal, suggesting a local 'washout'.
- 7.6.10 Analysing the data obtained from the 25 probeholes, it is apparent that:
- The Sitwell Coal underlies the eastern area of the site.
  - Typical seam thickness of the Sitwell Coal is 0.6m; maximum recorded was 0.9m.
  - None of the 13 holes advanced through the Sitwell seam encountered evidence of workings.
  - The Sitwell Thin underlies the majority of the site.
  - Typical seam thickness of the Sitwell Thin is 0.4m; maximum recorded was 1.0m.
  - None of the 20 holes advanced through the Sitwell Thin encountered evidence of workings.
  - Linear triangulation suggests the coal seams dip at about  $7^{\circ}$  to the north-east.
  - Coal seams are about 5m shallower than expected (based on linear triangulation) in the vicinity of PHs 5, 16 & 22 (all located in the centre-north); this is probably due to the effect of a geological fault.
- 7.6.11 Drawing 1792/6 shows the approximate location of coal seam outcrops based on geological mapping (as shown on Drawing 1792/3), but slightly revised to take account of coal actually encountered in exploratory holes.
- 7.6.12 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 mineworkings in either the Sitwell or Sitwell Thin seams.

**Summary of Ground Conditions – Mining Investigation**

Hole ID	Final Depth (mbgl)	Depth to Rockhead (mbgl)	Sitwell Coal					Thin Coal				
			Depth to Base (mbgl)	Thickness (m)	Worked (Y/N)	Cover Ratio		Depth to Base (mbgl)	Thickness (m)	Worked (Y/N)	Cover Ratio	
						max	actual				max	actual
PH01	30	1.9	Beyond outcrop					5.1	1.0	N	2.2	2.2
PH02	30	2.3	Beyond outcrop					10.4	0.6	N	7.5	12.5
PH03	30	1.4	5.2	0.4	N	3.8	8.5	13.8	0.5	N	11.9	23.8
PH04	30	1.4	8.2	0.6	N	6.9	10.3	16.8	0.4	N	15.0	37.5
PH05	30	1.4	9.3	0.9	N	7.8	7.8	16.5	0.4	N	14.7	36.8
PH06	30	1.8	18.2	0.5	N	17.7	31.8	25.3	0.2	N	23.3	116.5
PH07	30	2	Beyond outcrop					?washed out				
PH08	30	1.4	Beyond outcrop					19.5	0.6	N	17.5	29.2
PH09	30	1.7	Beyond outcrop					20.4	0.6	N	18.1	30.2
PH10	30	1.6	21.2	0.5	N	21.2	38.2	too deep				
PH11	12	1.7	Beyond outcrop					8.0	0.5	N	5.8	11.6
PH12	21	1.7	Beyond outcrop					2.4	0.5	N	0.2	0.4
PH13	9	1.1	Beyond outcrop					2.4	0.7	N	0.6	0.9
PH14	9	1.8	Beyond outcrop					5.1	0.5	N	2.8	5.6
PH15	12	0.9	1.2	0.3	N	0.0	0.0	9.0	0.5	N	7.6	15.2
PH16	15	1.1	5.5	0.5	N	4.3	7.8	13.8	0.6	N	12.1	20.2
PH17	15	2	?Beyond outcrop					13.8	0.8	N	11.0	13.8
PH18	18	1.4	4.6	0.5	N	3.0	5.4	14.8	0.6	N	12.8	21.3
PH19	21	1.8	?Beyond outcrop					17.6	0.6	N	15.2	25.3
PH20	21	1.8	8.7	0.4	N	7.2	16.3	17.9	0.4	N	15.7	39.3
PH21	21	1.7	9.8	0.7	N	8.2	10.6	18.1	0.6	N	15.8	26.3
PH22	21	1.3	9.6	0.6	N	8.6	12.8	17.4	0.6	N	15.5	25.8
PH23	21	1.6	?washed out					19.4	0.6	N	19.1	28.7
PH24	21	1.8	?washed out					20.5	0.5	N	20.2	36.4
PH25	15		Beyond outcrop					too deep				

## 7.7 Groundwater

7.7.1 No significant inflows of groundwater were encountered during the investigation.

7.7.2 Groundwater levels recorded in the monitoring wells (one visit to date; 29<sup>th</sup> January 2014) are summarised in the Table below.

Hole ID	Response Zone (depth range & strata)	Groundwater Body	Typical standing water level (m bgl)
PH01A	2.0m to 5.0m (Coal Measures)	Bedrock – Secondary 'A' aquifer	0.7
PH02A	2.3m to 4.0m (Coal Measures)		0.0
PH03A	1.4m to 3.0m (Coal Measures)		0.6
PH04A	1.4m to 3.0m (Coal Measures)		1.0
PH05A	1.5m to 4.0m (Coal Measures)		1.6
PH06A	2.0m to 6.0m (Coal Measures)		2.9
PH07A	2.0m to 6.0m (Coal Measures)		3.0
PH08A	2.0m to 6.0m (Coal Measures)		3.6
PH09A	1.5m to 7.0m (Coal Measures)		2.0
PH10A	2.0m to 6.0m (Coal Measures)		0.4

## 7.8 Revised Conceptual Ground Model (Ground Conditions)

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

- the nature and distribution of made ground, including the presence of significant buried obstructions
- constraints/difficulties associated with sewers etc
- the strength, nature and depth of underlying natural strata
- the presence of coal/shallow workings, and
- the nature and distribution of contamination (based on visual/olfactory evidence only)

7.8.2 The revised Conceptual Site Model is presented in Appendix B, as Drawing No. 1792/8.

## 8 CONTAMINATION (ANALYSIS)

### 8.1 General

- 8.1.1 The site has had no known former industrial historical use, and is therefore unlikely to be affected by any significant ground contamination. Furthermore, no significant thicknesses of made ground were encountered in exploratory holes during the ground investigation.
- 8.1.2 Nonetheless, 12 samples of topsoil have been analysed to confirm suitability for re-use.
- 8.1.3 In the context of risks to human health associated with residential redevelopment, the Tier 1 Soil Screening Values referenced in this report have been derived via the CLEA default conceptual site model (CSM) used for generating SGVs, but amended, where appropriate, to be more specific to redevelopment within the planning process (see Generic Note 04 in Appendix A for further details).
- 8.1.4 This site is essentially greenfield and no evidence of significant contamination was noted. Consequently, the Tier 1 Soil Screening Values used in this report have been derived with reference to a CSM that assumes no clean soil cover will be placed in gardens\landscaped areas (Lithos Scenario A).
- 8.1.5 Notes outlining current guidance with respect to the interpretation of analytical data are included in Appendix A to this report.

### 8.2 Testing Scheduled

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

Type of Sample	No. of Samples	Determinands
Topsoil/ Reworked Topsoil	12	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc)
	2	Water soluble sulphate, chloride, nitrate and magnesium.
	12	Asbestos Screen
	12	Total Organic Carbon (TOC)
	12	Speciated Poly Aromatic Hydrocarbons (PAH)

### 8.3 Soil Contamination Results

- 8.3.1 The soil contamination test results are summarised in the Table on page 17.
- 8.3.2 Laboratory test certificates as received from the laboratory are presented in Appendix H to this report.

#### Inorganic Determinands

- 8.3.3 Of the 12 samples of topsoil/reworked topsoil analysed for inorganic parameters, all of the samples can be classified as uncontaminated.
- 8.3.4 These samples are classified by comparison of concentrations with Lithos 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

- 8.3.5 No asbestos fibres were identified in any of the 12 samples screened.

### Organic Determinands

- 8.3.6 Samples have been classified by comparison with Lithos risk-derived Tier 1 screening values (Lithos Scenario B, see Generic Notes 04 in Appendix A). 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 lower screening values are then more appropriate for many organic contaminants.
- 8.3.7 In order to check the validity of Lithos Scenario B screening values, the average TOC for each soil type have been determined.

Fill Type	Typical TOC	Comparison with revised Screening Value necessary?
Topsoil/ Reworked Topsoil	>2.5%	Yes, but no significant organic contamination was recorded in this soil type. All determinands well below "6%" screening value; most below limit of detection.

### Poly Aromatic Hydrocarbons (PAH)

- 8.3.8 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).
- 8.3.9 Speciated analysis has confirmed the absence of significant concentrations of both benzo(a)pyrene and naphthalene in the soils beneath this site.

## 9 CONTAMINATION (QUALITATIVE RISK ASSESSMENT & REMEDIATION)

### 9.1 General

- 9.1.1 Topsoil, typically 300mm thick underlies the entire site. Testing suggests this material is suitable for re-use

#### Waste Classification

- 9.1.2 Disposal of soil arisings off site is not considered appropriate, economically viable, nor in line with current Government philosophy regarding sustainable development. However, some excess arisings may be generated by excavations for foundations, sewers etc. Disposal to landfill may be the most practical solution, if redistribution and retention on site is not feasible.
- 9.1.3 Notes outlining the interpretation of analytical data with respect to waste classification are included in Appendix A to this report, together with notes about Waste Acceptance Criteria (WAC).
- 9.1.4 All soil arisings generated by excavations at this site are likely to be classified as inert waste.

### Summary of Degree of Ground Contamination

Hole ID	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 Brackets and assume a <b>residential with gardens</b> end-use.													
			TOC	pH	As (32)	Cd (5)	Cr (3,000)x	Pb (450)#	Hg (169)*	Se (350)	B (5)~	Cu ♣ \$	Ni (127)	Zn (200)\$	B(a)P (3)	Naphthalene (4)
TP29	0.60	Reworked Topsoil	9.7	8.0	23	<1.0	11	94	<1.0	<3.0	<1.0	33	15	65	0.4	0.3
TP30	0.50	Reworked Topsoil	19	7.3	13	<1.0	10	50	<1.0	<3.0	<1.0	34	18	51	<0.1	<0.1
TP04	0.10	Topsoil	4.4	6.0	19	<1.0	22	74	<1.0	<3.0	<1.0	35	17	79	<0.1	<0.1
TP06	0.10	Topsoil	2.7	7.0	13	<1.0	22	55	<1.0	<3.0	<1.0	24	16	78	<0.1	<0.1
TP09	0.10	Topsoil	1.7	6.5	14	<1.0	22	57	<1.0	<3.0	<1.0	17	13	63	<0.1	<0.1
TP10	0.10	Topsoil	3.0	6.8	15	<1.0	21	61	<1.0	<3.0	<1.0	18	13	68	<0.1	<0.1
TP13	0.10	Topsoil	2.4	7.0	10	<1.0	17	64	<1.0	<3.0	<1.0	19	17	87	<0.1	<0.1
TP16	0.10	Topsoil	1.7	6.4	11	<1.0	19	53	<1.0	<3.0	<1.0	21	19	92	<0.1	<0.1
TP18	0.10	Topsoil	3.6	7.0	13	<1.0	22	62	<1.0	<3.0	<1.0	23	16	84	<0.1	<0.1
TP21	0.10	Topsoil	2.5	6.9	10	<1.0	22	56	<1.0	<3.0	<1.0	35	16	84	<0.1	<0.1
TP25	0.10	Topsoil	1.4	7.0	13	<1.0	22	28	<1.0	<3.0	<1.0	28	27	89	<0.1	<0.1
TP27	1.00	Topsoil	2.2	6.9	12	<1.0	22	52	<1.0	<3.0	<1.0	25	18	86	<0.1	<0.1

Key		Source of Guidance Trigger Level	
12	Parameter tested for but not found to be in excess of threshold concentration	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. Values assume a source located in a sandy loam, with 6% soil organic matter (SOM).	
	Parameter not tested for		
♣	Tier 1 Value is pH dependent	#	Former CLEA SGV value.
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI screen would be 4mg/kg	\$	Dept of Environment Code of Practice for Agricultural use of Sewage Sludge 1996
*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.	◇	BRE Special Digest 1, Concrete in aggressive ground (2005)
~	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.		

## 10 HAZARDOUS GAS

### 10.1 General

10.1.1 BRE Report BR211 and the Landmark report indicate that the site is in an area where less than 1% of homes are estimated to be above the action level, therefore radon protection measures should not be required in new dwellings

10.1.2 Consideration of the conceptual site model and potential linkages has enabled a preliminary qualitative assessment of risks associated with additional sources of hazardous gas at the site:-

Source	Receptors	Hazard	Pathway	Initial Risk
Shallow mineworkings	Human Health	Asphyxiation & explosion.	Vertical migration, ingress & accumulation	<b>Very Low:</b> No shallow workings identified.
	Buildings	Explosion.		

10.1.3 Ten gas monitoring wells have been installed in shallow boreholes across the site. Details of the installations are given on the probehole logs presented in Appendix G to this the report.

10.1.4 The generation potential of the gas source was initially considered to be Very Low and this has been confirmed by the monitoring results obtained. Consequently, in accordance with CIRIA Report C665, given the proposed residential end use, 6 visits have been scheduled over a 3 month period.

### 10.2 Scope of Works

10.2.1 To date, the wells have been monitored on one occasion for groundwater levels and soils-gases. 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 LMSx infra-red gas analyser
- Standing water level using a dipmeter
- Ambient oxygen concentration (check for instrument drift)

### 10.3 Monitoring Results

10.3.1 The results of the monitoring completed to date are summarised below.

Monitoring Well	Response Zone	Recorded Methane Concentration (% v/v)	Recorded Dioxide Concentration (% v/v)	Recorded Steady Flow Rate (litre/hour)
PH01A	2.0m to 5.0m (Coal Measures)	0.0	2.0	0.1
PH02A	2.3m to 4.0m (Coal Measures)	NR	NR	ND
PH03A	1.4m to 3.0m (Coal Measures)	0.0	0.6	ND
PH04A	1.4m to 3.0m (Coal Measures)	0.0	0.0	ND
PH05A	1.5m to 4.0m (Coal Measures)	0.0	0.0	ND
PH06A	2.0m to 6.0m (Coal Measures)	0.0	1.4	ND
PH07A	2.0m to 6.0m (Coal Measures)	0.0	1.8	0.3
PH08A	2.0m to 6.0m (Coal Measures)	0.0	0.0	ND
PH09A	1.5m to 7.0m (Coal Measures)	0.0	0.2	0.0
PH10A	2.0m to 6.0m (Coal Measures)	0.0	0.0	0.0

## 10.4 Discussion

- 10.4.1 To date no concentrations of methane, significant concentrations of carbon dioxide or elevated positive flow rates have been recorded.
- 10.4.2 Generic Notes outlining how monitoring results are included as Generic Note 05 in Appendix A.
- 10.4.3 A hazardous gas risk assessment incorporating all of the results will be issued on completion of monitoring in April 2014.

## 11 GEOTECHNICAL TESTING

### 11.1 General

- 11.1.1 Twelve samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.
- 11.1.2 The geotechnical laboratory test results are presented in Appendix I to this report.

### 11.2 Atterberg Limits

- 11.2.1 The plasticity index of 12 samples of cohesive soil have been determined; results are summarised below.

Soil type	Range of Plasticity Indices* (Average)	Shrinkability
Residual Soil (Clay/gravelly Clay)	14 to 36 (24)	Medium

\* Modified where appropriate in accordance with revised Chapter 4.2 of the NHBC Standards (April 2003).

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

- 11.2.2 For the purposes of foundation design, it is recommended that all cohesive soils be regarded as being of medium shrinkability.

### 11.3 Soluble Sulphate and pH

- 11.3.1 In accordance with BRE Special Digest 1:2005, this site has been classified as greenfield with a mobile groundwater regime.
- 11.3.2 It is envisaged foundations will extend to depths of about 1m through existing natural strata and samples taken from this depth range have been submitted for pH and water-soluble sulphate (2:1 soil/water extract).
- 11.3.3 The concentrations of sulphate in the aqueous natural soil extracts of twelve samples were determined. In addition, two samples of Reworked Topsoil were tested as part of the contamination suite. The pH value of each sample has also been determined.
- 11.3.4 The highest water-soluble sulphate concentration and the lowest pH value for each soil type analysed are shown in the Table below.

Soil type	Lowest pH values	Highest Soluble Sulphate Concentration (mg/l)
Reworked Topsoil	7.3	<10
Residual Soil	5.1	99

- 11.3.5 pH values were above 5.5 for all but 1 of the 12 residual soil samples, therefore concentrations of chloride and nitrate are considered insignificant.
- 11.3.6 In accordance with Table C2 of SD1, sub-surface concrete should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-1.

## **12 GEOTECHNICAL ISSUES**

### **12.1 Conceptual site Model**

- 12.1.1 A revised Conceptual Site Model is presented as Drawing No. 1792/7 in Appendix B to this report.
- 12.1.2 No significant thicknesses of made ground were encountered in any of the exploratory holes at the site. Reworked natural soils were identified in TP30 to 1.0m depth.
- 12.1.3 Natural ground was identified in each exploratory hole and generally comprises topsoil (typically 300mm thick) over Residual Soils (clays and gravelly clays).
- 12.1.4 Underlying bedrock comprises sandstones, siltstones and mudstones with a band of ironstone identified in TP10 at 2.7m depth.

### **12.2 Mining**

- 12.2.1 The site is underlain by two seams of coal:
- The Sitwell Coal (typically is 0.6m thick; maximum recorded thickness of 0.9m) which is shown on Geological Plans to outcrop across the centre of the site.
  - The Sitwell Thin Coal (typically is 0.4m thick; maximum recorded thickness of 1.0m), which lies about 8m below the Sitwell Coal.
- 12.2.2 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 mineworkings in either the Sitwell or Sitwell Thin seams.

### **12.3 Quarrying**

- 12.3.1 There are no known quarries on, or within 50m of the site.

### **12.4 Site Regrade and/or Ground Improvement**

- 12.4.1 The site slopes gently from west to east, before dipping steeply down on the far eastern boundary.
- 12.4.2 Locally some minor re-grade is likely to be required to accommodate roads, driveways and the proposed plots.

## 12.5 Foundation Recommendations

### **General**

- 12.5.1 It is understood that consideration is being given to redevelopment of the site with domestic dwellings, associated gardens, POS and adoptable roads and sewers. No site layout has been provided at this stage.
- 12.5.2 Foundation recommendations assume that development will be two or three storey construction and that line loads will not exceed 70kN/m run. If this is not the case significant alteration to these recommendations will be required.
- 12.5.3 We have also 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.
- 12.5.4 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.
- 12.5.5 Sub-surface concrete at the site should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-1.
- 12.5.6 Based on the findings of the site investigation and laboratory testing conventional strip footings are considered the most suitable foundation solution option for two or three storey residential properties constructed on this site and these are discussed below.

### **Strip/Trench Fill Footings**

- 12.5.7 It is considered that shallow strip, or deepened trench fill, footings will be the most suitable foundation solution for the majority of two or three storey houses constructed at the site. This solution is viable where firm clay or competent rock is the founding material.
- 12.5.8 The clay/gravelly clay strata is generally considered to have a safe bearing capacity of at least 120kN/m<sup>2</sup>.
- 12.5.9 Assuming a strip foundation of 10m length and 0.6m width, founding at 0.9m depth, and a maximum line load of 70kN/m run, minimal settlements would be anticipated. This is considered likely to be acceptable, however, further advice should be sought from the Structural Engineer responsible for foundation design.
- 12.5.10 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.
- 12.5.11 Where rock is encountered at shallow depth foundations should be placed entirely on rock and not partially on rock and partially on residual soil. This may, depending on surface gradient, necessitate significant overdeepening of foundations.
- 12.5.12 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.
- 12.5.13 Founding depths are from original or finished ground level, whichever is the lower, to the underside of the footing.

- 12.5.14 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that up to 50% of the site may be affected by trees.
- 12.5.15 Overdeepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.4.
- 12.5.16 Foundations will be required to be placed below a line drawn up at 45° from the base of any service or similar excavation.
- 12.5.17 In order to minimise softening and swelling of cohesive soils or loosening of granular soils, it is recommended that footings are cast as soon as formation level is reached (or alternatively formation could be blinded using concrete with as low a water:cement ratio as possible).
- 12.5.18 Locally, bedrock at the site comprises mudstone and siltstones which can be easily excavated using a backhoe excavator, and will be recovered as a tabular gravel. Where in-situ mudstone/siltstone is encountered at founding depth (minimum of 450mm), it will provide a suitable founding stratum for two or three storey dwellings, and need only be penetrated by the proposed foundation thickness. Note: any overlying residual soil (typically clay with gravel-sized lithorelicts of mudstone/siltstone) is likely to be a shrinkable soil; Mudstone and Siltstone are not.
- 12.5.19 The Developer 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.

## **12.6 Floor Slabs**

- 12.6.1 It is considered that the natural ground is generally suitable for the use of ground bearing floors. Ground Bearing slabs should not be cast on made ground. Where plots are elevated for design reasons, the depth of engineered stone below a ground bearing slab should not exceed 600mm, in accordance with NHBC guidance.
- 12.6.2 The natural ground beneath this site includes cohesive soils and is therefore subject to seasonal variation in moisture content. If ground slabs were constructed on desiccated soil, heave of the slab would occur on re-hydration of the ground. If any significantly desiccated soil is present, a block and beam floor construction should be adopted. In accordance with NHBC Standards Chapter 4.2, a minimum void height of 175mm should be adopted.
- 12.6.3 Where foundations are within the influence of existing or proposed trees, and a trench fill foundation depth of 1.5m or greater is required, the ground floor should be constructed using block and beam, or another suitable voided construction. A suitable approved compressible void former, should be used on the internal face of all external walls.
- 12.6.4 It should be noted that NHBC have suffered a significant number of claims resulting from the use of ground bearing floor slabs. Consequently, if ground bearing slabs are proposed, care should be taken correct and careful construction. For example, if fill to the internal face of the foundation excavation is not properly compacted, subsequent settlement can result in cracking of the slab.
- 12.6.5 Suspended floor slabs should be utilised where the depth of made ground (resulting from on-site re-grading) or engineered stone exceeds 600mm in accordance with NHBC Standards Chapter 5.1 (to negate potential settlement problems).

## 12.7 Designated Concrete Mixes

- 12.7.1 The following designated mixes in accordance with BRE Special Digest SD1 and BS 8500: Part 1: 2006 will be suitable for use on this site.

Application	DS-1 conditions ACEC Class AC-1
Unreinforced strip/trench fill footings	GEN1
Reinforced strip/ trench fill footings (mesh reinforcement)	RC25/30* <sup>1</sup>
Unreinforced concrete floor slabs	GEN2
In situ reinforced concrete floor slabs	RC28/35

Note. \*<sup>1</sup>Although RC25/30 is in line with BS8500, Lithos recommend the use of RC28/35 for concrete used in structurally sensitive works, to provide greater certainty of compliance with strength verification tests, enhanced durability and compliance with accepted NHBC practice.

## 12.8 Excavations

- 12.8.1 Based on the results of the investigation it is unlikely that major groundwater flows will be encountered in shallow excavations.
- 12.8.2 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 and made ground.
- 12.8.3 Bedrock was encountered in the majority of the exploratory holes across the site. Based on the exploratory hole logs, excavation greater than around 2.0m to 2.5m is likely to prove difficult across about 80% 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.
- 12.8.4 Some excavations for foundations, services etc. may come into contact with coal, most notably along the line of conjectured outcrop of the Sitwell Coal. Care should be taken not to unnecessarily overdeepen foundations, in order to minimise the chance of encountering coal.
- 12.8.5 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.
- 12.8.6 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).

## 12.9 Drainage

- 12.9.1 Based on observations made during the investigation, soakaways are unlikely to provide a suitable drainage solution for surface water run-off at the site. Consequently, there is likely to be a need for surface water balancing.
- 12.9.2 Any damage to the existing land drainage system caused by foundation or sewer excavations should be made good; this may require diversion and re-connection.
- 12.9.3 It is recommended that the developer contact Yorkshire Water Services with respect to capacity in existing foul and surface water sewers in the vicinity of the development area.

## **12.10 Highways**

12.10.1 Based on visual inspection of the natural materials and the recorded plasticity indices at the site, published tables (Interim Advice Note 73/06 Revision 1 (2009), Chapter 5. Characterisation of Materials Design Guidance For Road Pavement Foundations - Draft HD25) indicate that the natural cohesive deposits will have a CBR value of at least 3%. This value should be verified prior to or during construction.

## **12.11 External Works**

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

## **13 REDEVELOPMENT ISSUES**

### **13.1 General**

13.1.1 This report has presented options with respect to foundation solutions 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.

### **13.2 Remediation Strategy**

13.2.1 Given the absence of any significant contamination, a remediation strategy is not considered necessary.

13.2.2 Nonetheless, some preparatory works will be required, most notably:

- General site clearance of surface materials and vegetation.
- Topsoil strip.

### **13.3 Coal Extraction**

13.3.1 The Sitwell Coal (c. 0.6m thick) does underlie the east of the site; outcropping approximately north to south across the centre of the site, dipping to the north-east.

13.3.2 A second seam (the Sitwell Thin) has been identified in probeholes underlying the Sitwell Coal by around 8m.

13.3.3 As discussed in Section 7.6, no workings have been identified, and consequently mitigation measures (i.e. drilling & grouting) are not expected to be required.

13.3.4 It is understood from preliminary enquiries, that extraction is viable where the overburden above a seam is less than 12 times the seam's thickness; at this site extraction might be viable across about 50% of the total area.

13.3.5 Prior extraction of coal is encouraged by both the Coal Authority and Planning Authorities, largely because a potential mineral resource will not be sterilised by the development.

13.3.6 For the developer/landowner, extraction can be attractive from a financial perspective, especially where mineworkings in the seam of interest require grouting, and/or the desired build programme can accommodate the time necessary to ensure settlement of the replaced overburden has reduced to tolerable levels.

13.3.7 However, extraction usually increases developer abnormal foundation costs. This would be the case here due to the need for rafts instead of strip footings, and issues associated with the peripheral 'high walls' created.

#### **13.4 Health & Safety Issues - Construction Workers**

13.4.1 No significant made ground or contaminants have been identified during the fieldwork and laboratory testing.

13.4.2 However, as good practice simple precautionary measures are recommended, i.e. good personal hygiene and basic personnel protective equipment.

#### **13.5 New Utilities**

13.5.1 It is strongly recommended that all statutory service bodies are consulted at an early stage with respect to the ground conditions within which they will lay services in order to enable them to assess at an early stage any potential abnormal costs. However, no special precautions are anticipated during the placement of new utilities at the site in the natural soils.

13.5.2 Kier should consult Yorkshire Water at the earliest opportunity regarding the selection of pipes and fittings for the proposed water supply network. However, 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 this ground investigation. Consequently, there should be no chemical restriction when selecting pipe material. Further advice is contained in UKWIR Report 10/WM/03/21 - '*Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites*'.

#### **13.6 Potential Development Constraints**

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

13.6.2 Alternatively any future proposed layout should consider the existing route and depth of the sewer pipes.

## **14 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS**

### **14.1 General**

- 14.1.1 It is understood that consideration is being given to redevelopment of the site with two to three storey domestic dwellings, associated gardens, POS and adoptable roads and sewers. No site layout has been provided at this stage.
- 14.1.2 No significant thicknesses of made ground were encountered in any of the exploratory holes at the site.
- 14.1.3 Natural ground was identified in each exploratory hole and generally comprises topsoil over Residual Soil (clays and gravelly clays). Underlying bedrock comprises sandstones, siltstones and mudstones.

### **14.2 Hazardous Gas**

- 14.2.1 The site is not located in a radon affected area.
- 14.2.2 The site is underlain by shallow coal seams, although no workings have been identified. Gas wells have been installed in 10 probeholes, and a period of monitoring is underway.

### **14.3 Mining**

- 14.3.1 The site is predominantly located within a Standing Advice Area, although the central area of the site (along the line of conjectured outcrop of the Sitwell Coal) shown within a Coal Mining Development Referral Area (an area with specific mining legacy risks to the surface, including mine entries; shallow coal workings etc).
- 14.3.2 The site is underlain by two seams of coal:
- The Sitwell Coal (typically is 0.6m thick; maximum recorded thickness of 0.9m) which is shown on Geological Plans to outcrop across the centre of the site.
  - The Sitwell Thin Coal (typically is 0.4m thick; maximum recorded thickness of 1.0m), which lies about 8m below the Sitwell Coal.
- 14.3.3 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 mineworkings in either the Sitwell or Sitwell Thin seams.

### **14.4 Contamination**

- 14.4.1 No significant thicknesses of made ground (or associated contamination) have been identified.
- 14.4.2 Topsoil is suitable for re-use.

### **14.5 Foundations**

- 14.5.1 Conventional strip/trenchfill footings are considered the most suitable foundation solution option for two or three storey residential properties constructed on this site.
- 14.5.2 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that up to 50% of the site may be affected by trees.

### **14.6 Flooding**

- 14.6.1 The EA indicate that the site is not located within an indicative floodplain.

## **14.7 Drainage**

- 14.7.1 Soakaways are unlikely to be a suitable means of surface water disposal at the site given the cohesive nature of the drift deposits. Bedrock proved variable with low permeability layers of Mudstone and Siltstone encountered.

## **14.8 Highways**

- 14.8.1 Based on visual inspection of the natural materials and the recorded plasticity indices at the site, published tables (Interim Advice Note 73/06 Revision 1 (2009), Chapter 5. Characterisation of Materials Design Guidance For Road Pavement Foundations - Draft HD25) indicate that the natural cohesive deposits will have a CBR value of at least 3%. These values should be verified prior to or during construction.

**APPENDIX A  
GENERAL NOTES**

01	Environmental Setting
02	Ground Investigation Fieldwork
03	Geotechnical Testing
04	Contamination Laboratory Analysis & Interpretation
05	Hazardous Gas

## 01 - Environmental Setting

### General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the Correspondence 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 from the Local Authority and by reference to current and historical OS plans. A coal mining report is obtained from the Coal Authority (CA).

In July 2011, the 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 areas of higher risk (known as the Coal Mining Development **Referral Area**) and lower risk (known as the **Standing Advice Area**). The Coal Mining Development Referral Areas contain a range of specific mining legacy risks to the surface, including mine entries; shallow coal workings; workable coal seam outcrops; mine gas; geological features; and previous surface mining sites. The Standing Advice Area is the remainder of the defined coalfield. In this area no known defined risks have been recorded; although there may still be unrecorded issues.

### Landfills

Lithos obtain data from the Landmark Information Group, the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site. Reference is also made to historical OS plans, which are 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 BR211, 2007: "*Radon: guidance on protective measures for new buildings*". The level of protection needed is site-specific and is determined by reference to the maps contained in Annex A of BR211. These maps are derived from the Radon Atlas of England and Wales (2007), and indicate the highest radon potential within each 1km grid square.

If the site falls within a light grey square on the relevant map in Annex A then basic radon protection should be installed in new buildings; if the site falls within a dark grey square then full radon protection should be installed. **If the site is in an un-shaded square then no radon protection is needed.**

BR211 provides a preliminary indication of the measures required for a particular site, but it is also often beneficial to request a BR211 Radon Report from the BGS. The Annex A maps indicate the highest geological radon potential within each 1km grid square, but in many cases the radon potential varies considerably within the grid square. The BR211 Radon Report gives definitive guidance on the requirement for radon protective measures, and therefore may allow the adoption of a lower level of protection than that indicated in the Annex A maps.

Lithos typically obtain a BR211 Radon Report for all sites that fall within a shaded square on the relevant Annex A map. When requesting a BR211 Radon Report from the BGS Lithos select the search radius carefully, since too large a search radius may result in the inclusion of areas of higher geological radon potential, and therefore in the recommendation of too high a level of protection. Further details of the protective measures required are provided in the Hazardous Gas section of this Geoenvironmental Report.

### Hydrogeology

Lithos obtain information from the Environment Agency (EA) and the Landmark Information Group 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 type 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 drift 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 drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two 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** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

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

*Note:* The maps only display the principal and secondary aquifers as coloured areas. All uncoloured areas on the bedrock designation 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 drift is present. To do this, it is necessary to consult the published geological survey maps.

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

- if no superficial (drift) aquifers are shown, we will use the bedrock designation;
- in areas where the bedrock designation shows unproductive strata (the uncoloured areas) we will use the superficial (drift) designation;
- in all other areas, we will use the more sensitive of the two designations (e.g. if secondary drift overlies principal bedrock, we will adopt an overall designation of principal)

The EA have also designated 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 the Landmark Information Group 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 six 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 provide 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 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 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

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 (or 1 in 200 year as appropriate), 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 consultant who can advise on appropriate mitigating measures; ie raising slab levels, provision of storage etc.

### COMAH & Explosive Sites

Lithos obtain information from the Landmark Information Group with respect to COMAH or explosive sites within 1km of the proposed development site. Lithos's 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 Ground 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 targets.

Potential pollutant linkages are shown on a preliminary conceptual site model, presented as a Drawing in an Appendix to this Geoenvironmental Report. The preliminary model is revised in light of data arising from the subsequent ground investigation.

## 02 - Ground Investigation Fieldwork

### General

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

- BS5930:1999 "Code of practice for site investigation"
- BS10175:2011 "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 logs are presented in Appendices to this Geoenvironmental Report. These logs include details of the:

- Investigation technique adopted
- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of any in-situ testing
- Any gas\groundwater monitoring well installed

### 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: 1999 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. 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 tricone rock roller 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

Where relative densities of granular materials given on the trial pit and window sample logs are based on visual inspection only, they do not relate to any specific bearing capacities. However, wherever possible Lithos employ a Mackintosh probe to assess relative density. Mackintosh probe results can be related to approximate allowable 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 reported on trial pit logs are considered to be more reliable than those reported on window sample logs. Significant sample disturbance occurs during window sampling and consequently shear strength results on disturbed window samples are generally lower than results obtained during trial pitting, in-situ or in large excavated blocks.

### Sampling

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

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

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

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

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

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

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

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

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

Sometimes it is necessary to obtain samples that are not representative of the wider soil matrix, for example when investigating localised, significant, but non-pervasive conditions. Any such unrepresentative samples are annotated with the suffix ‘\*’ (eg 2D\*, or 4G\*). Lithos’s 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)
pH & metals only	1 kg plastic tub
organics (TPH, PAH) etc only	500ml wide-necked glass jar. Vial required if TPH is to include GRO.
VOCs (incl. naphthalene and/or GRO) only	glass vial & 1kg plastic tub
pH & metals, and organics	1 litre wide-necked glass jar & 1kg plastic tub
pH & metals, and organics (incl. VOCs or GRO)	glass vial; 1 litre wide-necked glass jar; & 1kg plastic tub

*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 an Lithos investigation are described (logged) in general accordance with BS 5930. 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(ces) containing the logs. There are two Keys – Symbols & Legends and Terms & Definitions.

<sup>1</sup> Mark Perrin. *Stoned – Sample Preparation for Soils Analysis. Ground Engineering, April 2007.*

## 03 - Geotechnical Laboratory Tests

### 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 are routinely carried out on a selection of samples:

- Atterberg limits & moisture contents
- Soluble sulphate & pH

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

- Grading.
- Compaction tests
- Particle density.

The test results are presented as received in an Appendix to this Geoenvironmental Report.

### Atterberg Limits & Moisture Content

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

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

$$I'p = Ip * (\% < 425\mu\text{m}/100)$$

ie 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 adopt a conservative approach and recommend 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 (DC Class) and
- the Aggressive Chemical Environment for Concrete (ACEC Class)

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

The concentrations of sulphate in aqueous soil/fill extracts are determined in the laboratory using the gravimetric method. The results are expressed in terms of SO<sub>4</sub> 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.

## 04 - Contamination Analysis & Interpretation (including WAC)

### 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.

### Contamination Laboratory Analysis & Interpretation

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).

### 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 the (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.

Tier 1 **groundwater** risk assessments are undertaken by comparing leachate or groundwater concentrations with the appropriate water quality standard. Depending upon the specific characteristics and environmental setting of the site the appropriate standard is likely to be one of the following:

- Water Supply (Water Quality) Regulations 1989
- Environmental Quality Standards (for Freshwater)
- The Surface Waters (Abstraction for Drinking Water) Regulations

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 (2006) – Assessing risks posed by hazardous ground gases to buildings
- BS 8485:2007 – 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 ICRCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that:

*"In general it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn"*

## Soil Screening Values derived 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 (Version 1.05) Handbook 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). Lithos consider it reasonable to adopt the CLEA default TOC for made ground. 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.

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)	<ul style="list-style-type: none"> <li>• Direct ingestion of soil</li> <li>• Dermal contact</li> <li>• Consumption of vegetables and soil attached to vegetables</li> <li>• Inhalation of indoor vapours and dust</li> <li>• Inhalation of outdoor vapours and dust</li> </ul>	Minimal cover – insufficient to break any pathways therefore all exposure pathways are relevant
B	Residential with garden minimum 600mm cover	<ul style="list-style-type: none"> <li>• Inhalation of indoor vapours</li> <li>• Inhalation of outdoor vapours</li> </ul>	The 600mm cover removes the risk from all pathways other than inhalation.
C	Residential apartments with landscaped areas and minimum 300mm cover	<ul style="list-style-type: none"> <li>• Direct ingestion of soil</li> <li>• Dermal contact</li> <li>• Inhalation of indoor vapours and dust</li> <li>• Inhalation of outdoor vapours and dust</li> </ul>	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	<ul style="list-style-type: none"> <li>• Direct ingestion of soil</li> <li>• Dermal contact</li> <li>• Inhalation of indoor vapours and dust</li> <li>• Inhalation of outdoor vapours and dust</li> </ul>	All pathways applicable due to possible exposure from landscaped areas. Assumed the commercial development consists of offices to provide a conservative assessment.

Lithos have assumed the source of contamination is directly below the building foundations i.e. a depth to source of 0.15m as opposed to the CLEA default of 0.65m. This assumption provides for a more conservative approach than the UK default. 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.

## Generic Notes –Geoenvironmental Investigations



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

Inorganic Contaminant	Source	Tier 1 Assessment Criteria (mg/kg) for Scenarios A to D					Comments/Notes
		SGV (Resi)	A	B	C	D	
As	CLEA	32	32	Use (A) in SI Report for initial "screen".  If >5 x A, then consider increase of cover to 1,000mm	35	635	
Cd	CLEA	10	5		17	230	
Cr	CLEA		3,000		3,000	30,000	Assumes Cr is CrIII.
Pb	CLEA		450		450	750	Based on former SGV
Ni	CLEA	130	127		127	1,700	Assessment of health risk only
Se	CLEA	350	350		595	13,000	
Hg	CLEA	170	169		238	3,640	Assumes in an inorganic compound.
B	Lithos		5		5	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Cu	DoE		80-200		80-200	80-200	
Zn	DoE		200		200	200	
Cyanide	CLEA		527		530	14,000	

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

Organic Contaminant (all sourced via CLEA)	Tier 1 Assessment Criteria (mg/kg) for Scenarios A to D					Comments/Notes
	SGV (Resi)	A	B	C	D	
Benzene	0.33	0.3	0.5	0.6	100	
Toluene	610	497	1,440	1,690	4,360	
Ethyl Benzene	350	240	416	498	2,840	
Xylenes	240	127	146	183	2,620	
Phenol	420	412	2,360	557	38,700	
PCBs		1.7	1.8	1.8	1.8	Based on toxicity of EC7.
Benzo(a)pyrene		3	15	3	15	Where source is <b>not</b> a coal tar
Naphthalene		4	4	5	430	
Gasoline Range Organics		15	16	21	1,000	See <b>3-step</b> assessment of TPH below.
Diesel Range Organics		151	153	232	5,000	
Lubricating Range Org		1,000	5,000	1,000	5,000	

Note: **PAH** cannot be assessed as a single "total" value, as each individual PAH compound has different toxicity and mobility in the environment. Speciated analysis is required to determine the concentrations of the various compounds, most notably the key PAHs: Benzo(a)Pyrene (considered the most toxic of the PAHs); and Naphthalene (the most mobile and volatile of the PAHs).

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 thirteen representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the thirteen bandings. The significance of speciated TPH results can be assessed by following the 3 steps outlined in Table 3 below.

Step	Result	Action
1. Consider indicator compounds: Are BTEX, Naphthalene, Benzo(a)pyrene (and the other toxic PAHs) above their respective Tier 1 screening values?	Yes	DQRA required
	No	Proceed to Step 2
2. Consider individual TPH fractions: are they above respective screening values?	Yes	DQRA required
	No	Proceed to Step 3
3. Assess Cumulative effects: Is the calculated Hazard Index for each source > 1	Yes	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	0.3	0.5	0.6	100
Toluene	497	1,400	1,690	4,360
Ethylbenzene	240	416	498	2,840
Xylene	127	146	183	2,620
Naphthalene	4	4	5	430
Benzo(a)pyrene	5	25	5	25

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	63	5,000^
Aliphatic 6-8	GRO	123	123	191	
Aliphatic 8-10	GRO	30	31	48	
Aliphatic 10-12	DRO	151	153	232	
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	52	56	72	
Aromatic 7-8	GRO	15	16	21	1,000^
Aromatic 8-10	GRO	47	50	77	5,000^
Aromatic 10-12	DRO	212	282	390	
Aromatic 12-16	DRO	683	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

$$HI = \sum_{F_i=1}^{16} HQ F_i = \frac{\text{Measured concentration } F_i \text{ (mg kg}^{-1}\text{)}}{SGV F_i \text{ (mg kg}^{-1}\text{)}}$$

where HI = Hazard Index  
 HQ = Hazard Quotient  
 F<sub>i</sub> = Fraction<sub>i</sub>  
 SGV = Soil Guideline Value

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).

- 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 200 " 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).
- Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
- 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 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.

## 05 - Hazardous Gas

### 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 1. – 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 are:

- Landfill sites
- Made ground, especially where significant depths are present
- Shallow mineworkings associated with coal extraction
- Geological strata, including peat, organic silts, coal-bearing strata 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 on site immediately prior to and on completion of monitoring.
- 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 are used. Gas concentrations in the well are typically recorded immediately before and after retrieval of a sample.

### Current Guidance

CIRIA Report 151 (1995)<sup>i</sup> 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 (2006)<sup>ii</sup> advocates two methodologies for characterising sites:

**A** – All developments except low rise housing. The advocated methodology is that proposed by Wilson & Card, 1999<sup>iii</sup>.

**B** – Low rise housing. An alternative (traffic light) methodology, derived by Boyle and Witherington, 2006<sup>iv</sup> 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)<sup>v</sup> revised Table 28 of CIRIA 149<sup>v</sup> 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.

Table 1 – Site Classification (Wilson & Card)

Characteristic Situation (W&C, 1999)	Gas Screening Value, CH <sub>4</sub> or CO <sub>2</sub> (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, mineworking flooded.
4	<15	Quantitative Risk Assessment required to evaluate scope of protection measures.	Mineworking – susceptible to flooding, completed landfill, inert waste (WMP 26B criteria)
5	<70		Mineworking unflooded, inactive
6	>70		Recent landfill site

Notes:

borehole flow rate = volume of gas (regardless of composition) which is escaping from well (l/hr) Gas Screening Value (litre/hour) = gas concentration ( ) / 100 x borehole flow rate (l/hr) To facilitate design implementation, the limiting values for both methane and carbon dioxide are identical

**B – Low rise housing.**

NHBC have developed a characterisation system similar to that of Wilson & Card above, but specific to low-rise housing development (Boyle and Witherington<sup>xii</sup>) (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 worse case adopted in order to establish the appropriate protection measures.

Table 8.7 NH C Traffic light system for 150 mm void

Traffic light	Methane <sup>1</sup>		Carbon dioxide <sup>1</sup>	
	Typical maximum concentration <sup>2</sup> (% v/v)	Gas screening value (GSV) <sup>2,4,6</sup> (litres per hour)	Typical maximum concentration <sup>2</sup> (% v/v)	Gas screening value (GSV) <sup>2,3,4,5</sup> (litres per hour)
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.
- The **small room** is considered to be a downstairs toilet, with dimensions of 1.50 × 1.50 × 2.50 m, with a soil pipe passing into the sub-floor void.
- 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 (2006) – Assessing risks posed by hazardous ground gases to buildings.  
 iii Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.  
 iv Boyle & Witherington (2006) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating “traffic lights”. Report Ref. 10627-R01-(02), for NHBC  
 v Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.

**APPENDIX B  
DRAWINGS**

<b>Drawing No.</b>	<b>Title</b>
1792/1	Site Location Plan
1792/3	Existing Site Features
1792/4	Site Photographs
1792/5	Preliminary Conceptual Site Model
1792/6	Exploratory Hole Location Plan
1792/7	Areas Potentially at Risk of Subsidence
1792/8	Revised Conceptual Site Model



The Site  
SK 418 827

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KIER SERVICES

MOORTHORPE WAY,  
OWLTHORPE

SITE LOCATION PLAN

ASw

12 12 13

REG

12 12 13

STATUS FOR COMMENT  DRAFT   
FOR APPROVAL  FINAL

SCALE 1:25,000 SHEET A4 DRAWING NO. 1792/1 REVISION



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CLIENT  
**KIER SERVICES**

JOB TITLE  
**MOORTHORPE WAY,  
OWLTHORPE**

DRAWING TITLE  
**SITE FEATURES**

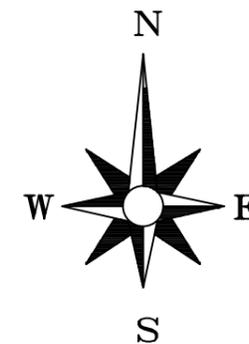
**NOTES**

- TREES & DENSE VEGETATION
- GRASS & OVERGROWN AREAS
- BUILDING
- SOIL MOUND
- TARMAC PATH
- COMBINED SEWER
- SURFACE WATER SEWER
- APPROXIMATE OUTCROP OF SITWELL COAL
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

**STATUS**  
FOR COMMENT  FOR APPROVAL  DRAFT  FINAL

<b>DRAWN</b> ASw	<b>DATE</b> 15 01 14
<b>APPROVED</b> REG	<b>DATE</b> 15 01 14
<b>SCALE</b> 1:1,500	<b>SHEET</b> A3
<b>DRAWING NO.</b> 1792/3	<b>REVISION</b>



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CLIENT

KIER SERVICES

JOB TITLE

MOORTHORPE WAY,  
OWLTHORPE

DRAWING TITLE

SITE PHOTOGRAPHS

NOTES

- TREES & DENSE VEGETATION
- GRASS & OVERGROWN AREAS
- BUILDING
- SOIL MOUND
- TARMAC PATH
- COMBINED SEWER
- SURFACE WATER SEWER
- APPROXIMATE OUTCROP OF SITWELL COAL
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

STATUS

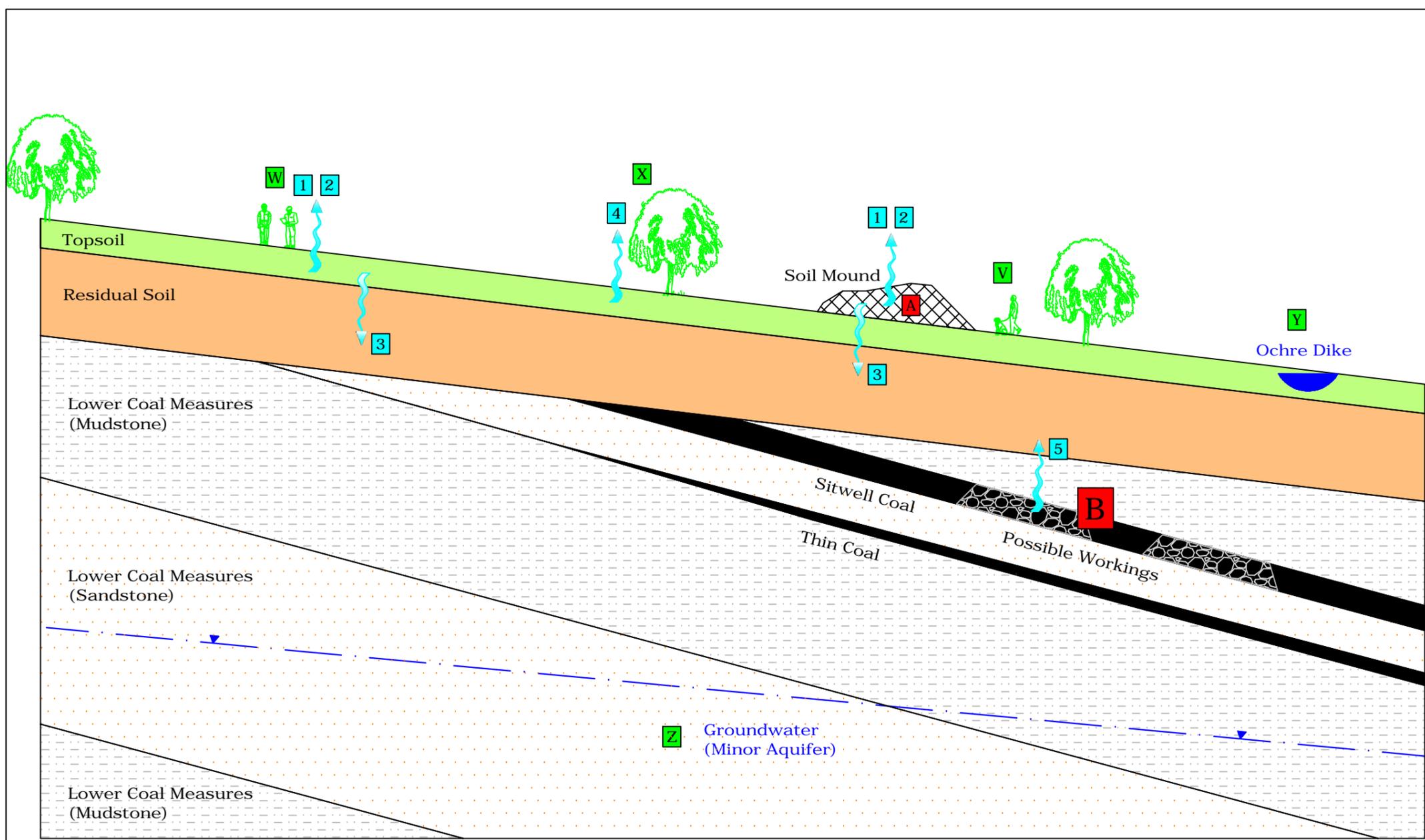
FOR COMMENT  FOR APPROVAL  DRAFT  FINAL

DRAWN	DATE
ASw	15 01 14

APPROVED	DATE
REG	15 01 14

SCALE	SHEET
NTS	A3

DRAWING NO.	REVISION
1792/4	



SOURCES	
<b>A</b>	MADE GROUND (INORGANICS)
<b>B</b>	MINEWORKINGS (GAS)

PATHWAYS	
<b>1</b>	DERMAL CONTACT
<b>2</b>	INGESTION\INHALATION
<b>3</b>	LEACHING OF CONTAMINANTS
<b>4</b>	UPTAKE BY PLANTS
<b>5</b>	MIGRATION OF GAS

RECEPTORS	
<b>V</b>	END USERS (RESIDENTS)
<b>W</b>	SITE WORKERS
<b>X</b>	VEGETATION
<b>Y</b>	SURFACE WATERS
<b>Z</b>	GROUNDWATER

NOTES

REV.	DESCRIPTION	DATE

**LITHOS CONSULTING**

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CLIENT

**KIER SERVICES**

JOB TITLE

**MOORTHORPE WAY, OWLTHORPE**

DRAWING TITLE

**PRELIMINARY CONCEPTUAL SITE MODEL**

DRAWN <b>ASw</b>	DATE <b>17 12 13</b>	STATUS FOR COMMENT <input type="checkbox"/> FOR APPROVAL <input type="checkbox"/> DRAFT <input type="checkbox"/> FINAL <input checked="" type="checkbox"/>	
CHECKED <b>REG</b>	DATE <b>17 12 13</b>		
SCALE <b>Not to scale</b>	SHEET <b>A3</b>	DRAWING NO. <b>1792/5</b>	REVISION



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CLIENT  
**KIER SERVICES**

JOB TITLE  
**MOORTHORPE WAY,  
OWLTHORPE**

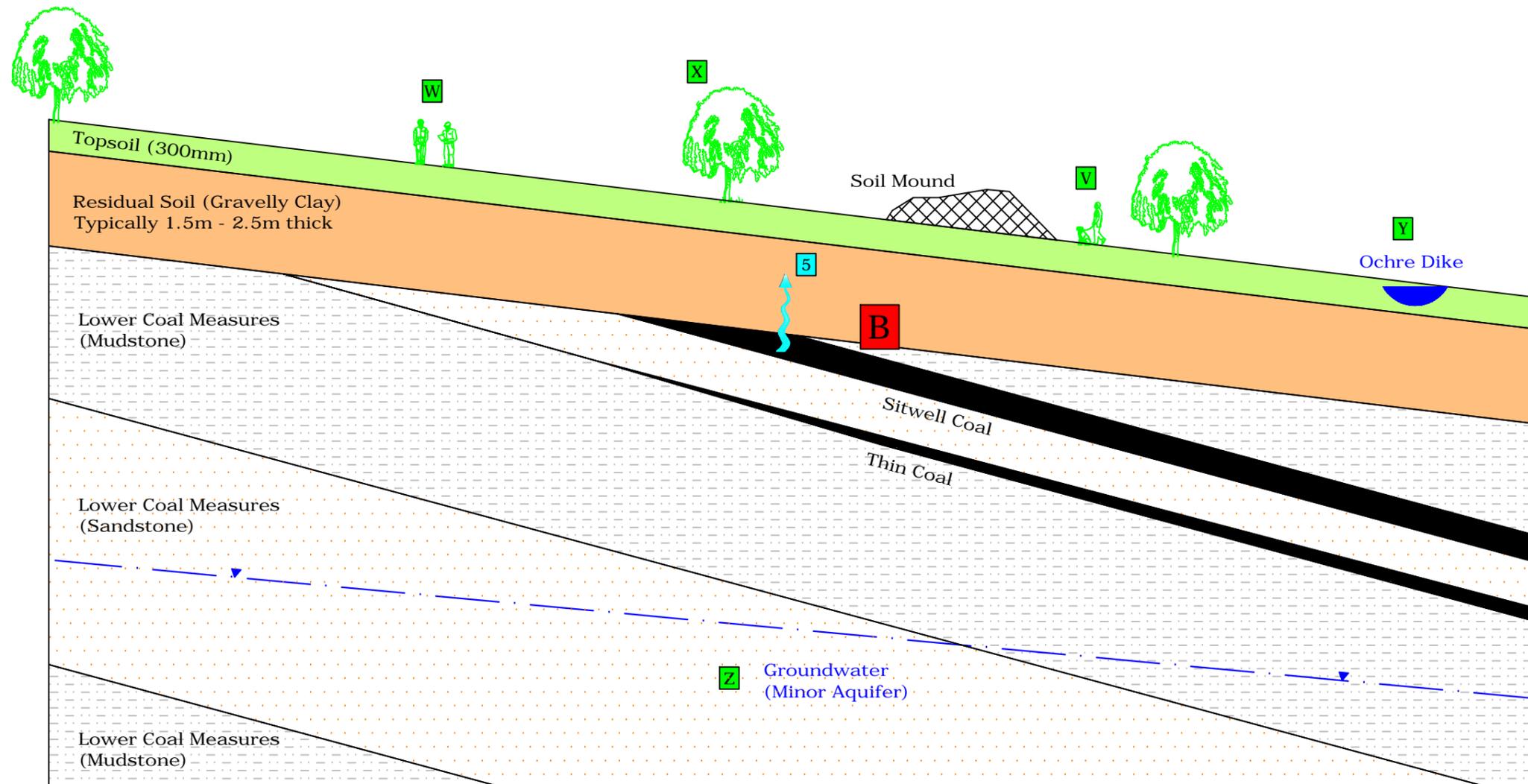
DRAWING TITLE  
**EXPLORATORY HOLE  
LOCATION PLAN**

NOTES

- TRIAL PIT LOCATION
- PROBEHOLE LOCATION
- APPROXIMATE SITE BOUNDARY
- APPROXIMATE OUTCROP OF COAL SEAMS

REV.	DESCRIPTION	DATE
B	ADDITIONAL PROBEHOLE LOCATIONS ADDED (PH11 TO PH25)	13 03 14

STATUS	
FOR COMMENT <input type="checkbox"/>	FOR APPROVAL <input type="checkbox"/>
DRAFT <input type="checkbox"/>	FINAL <input checked="" type="checkbox"/>
DRAWN <b>ASw</b>	DATE <b>13 03 2014</b>
APPROVED <b>REG</b>	DATE <b>24 03 2014</b>
SCALE <b>1:2,000</b>	SHEET <b>A3</b>
DRAWING NO. <b>1792/6</b>	REVISION <b>B</b>



SOURCES	
<b>B</b>	SHALLOW COAL (GAS)

PATHWAYS	
<b>5</b>	MIGRATION OF GAS

RECEPTORS	
<b>V</b>	END USERS (RESIDENTS)
<b>W</b>	SITE WORKERS
<b>X</b>	VEGETATION
<b>Y</b>	SURFACE WATERS
<b>Z</b>	GROUNDWATER

NOTES		
REV.	DESCRIPTION	DATE



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CLIENT
KIER SERVICES

JOB TITLE
MOORTHORPE WAY, OWLTHORPE

DRAWING TITLE
REVISED CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
ASw	15 01 14	FOR COMMENT <input type="checkbox"/>
CHECKED	DATE	FOR APPROVAL <input type="checkbox"/>
REG	15 01 14	DRAFT <input type="checkbox"/>
		FINAL <input checked="" type="checkbox"/>

SCALE	SHEET	DRAWING NO.	REVISION
Not to Scale	A3	1792/7	

**APPENDIX C  
COMMISSION**

004/1776/REG

6<sup>th</sup> December 2013



Mr B Reynolds  
Kier Services  
4th Floor, Cathedral Court  
1 Vicar Lane  
Sheffield  
S1 1HD

*Please reply to*  
45 High Street  
South Milford  
North Yorkshire  
LS25 5AF

**T** 0 45 6 0 97 1  
**E** info lithos.co.uk

Dear Brian

### **Moorthorpe Way, Owlthorpe**

Further to your recent invitation, please find below our proposal for undertaking a geotechnical and environmental site investigation ('Phase 1 & Phase 2') of the above land. We can confirm that our Report will be assigned to the successful bidder on your instruction.

We understand that you are looking market the site for residential development, with the benefit of an information pack. Our final Report should enable prospective purchasers to assess ground-related abnormal ('hidden') costs and make an unconditional offer in this respect. However, the nature of site investigation is such that it is not always possible to foresee all the potential issues. Consequently, it is sometimes necessary to recommend additional work, but where this occurs we will inform you immediately, provide costs, and seek your further instruction. We have visited site and reviewed available geological maps in order to minimise the likelihood of further work.

It is understood that the site consists of a single parcel of land of approximately 7 hectares, and is currently predominantly rough grassland. A brief review of old historical maps suggest the site has always been open fields, with no significant development shown.

Brief examination of the relevant geological map suggests the site is underlain by Coal Measures bedrock, in the vicinity of the Sitwell coal. The map shows areas of worked opencast about 100m to the north, and 3 shafts about 100m to the east; we should be able to obtain more information from the Coal Authority (CA), and our proposal allows for this. This site is located within both a Coal Mining Referral (in the vicinity of the Sitwell coal outcrop) and Standing Advice Areas, and therefore a mining report will be obtained.

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

An Envirocheck report will be obtained from Landmark, and historical Ordnance Survey plans will be reviewed in order to determine whether any past land uses have had any effect on the proposed development. In addition we will visit site to undertake a walkover survey.

Our site investigation will be undertaken in accordance with UK good practice (as outlined in BS5930, BS10175, CLR11 etc), and allows for the following works:

**Desk Study:** An Environmental Search report will be obtained from Landmark or Groundsure, and historical Ordnance Survey plans will be reviewed in order to determine whether any 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.



We will need a Promap or topo survey in CAD format, to provide a base plan for technical drawings etc. If do not have one, we could obtain at cost (c. £\*\*\*) plus £\*\*.

**Fieldwork:** We have allowed for about 25 trial pits (equivalent to a c. 60m grid) and the drilling of at least 10 rotary probeholes. Given the anticipated depth to bedrock and the damp\clayey nature of the superficial deposits, no allowance has been made for soakaway testing at this stage. If required, or considered feasible based on ground conditions encountered, soakaway tests could be undertaken for an additional fee of about £\*,\*\*\*. All trial pits and probeholes will be supervised and logged by an experienced geoenvironmental engineer (a Chartered Geologist will Project Manage the works).

Representative soil samples of natural and man-made ground, including any contaminated samples, will be taken during the works. In-situ shear strengths of any cohesive soils encountered will be determined by the use of a hand-held shear vane.

We will make every effort to compact arisings and 'sweep' them over each pit to leave the site in a clean and tidy state. 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.

If the pitting encounters significant thicknesses of made ground or very soft/loose deposits (neither considered likely), boreholes may be required to obtain geotechnical data from greater depth. We will advise you of any need for boreholes within 2 days of completion of the pitting.

This investigation should yield sufficient data to enable a foundation zoning plan, and possibly a detailed Foundation Schedule. However, if ground conditions are found to be more variable than anticipated, a 'tighter' grid of pits will be necessary prior to preparation of a detailed Foundation Schedule. This proposal does not allow for the preparation of a detailed Foundation Schedule, but we will provide a quote on completion of the site investigation if requested.

The site is underlain by the Sitwell coal, and therefore we have allowed for the drilling of at least 10 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 site's size and location, we should be able to avoid the need to drill holes within 50m of surrounding residential properties and therefore, in accordance with CA requirements, we should be able to use air as the flushing medium.

This site is essentially greenfield and therefore highly unlikely to be underlain by made ground. However, any shallow mine workings encountered would be a potential source of hazardous gas. The generation potential of this gas source is considered likely to be Very Low. Therefore, in accordance with CIRIA Report C665, we have initially allowed for 6 visits over a 3 month period. A hazardous gas risk assessment will be issued on completion of monitoring.

**Soils Testing:** This will comprise routine geotechnical soils analysis (about 12 soil samples), typical of that normally required for greenfield sites. Although no allowance has been made for in-situ or laboratory CBR testing, CBR values will be estimated from the strata descriptions and classification test results, where appropriate (i.e. if no significant regrading or reworking of made ground is proposed).



At this stage, we have no reason to expect wide areas of the site to be underlain by significant thicknesses of made ground. Consequently, we have only allowed for contaminant testing of up to 6 made ground samples, plus a further 6 samples of topsoil to confirm its suitability for re-use. If more significant made ground is encountered, we will inform you immediately and provide costs for the recommended chemical testing.

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 bound, 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 (to establish any environmental concerns\liabilities). Our report will be in a format familiar to Sheffield CC, and therefore suitable for submission in support of a planning application.

The report will also provide technically feasible options for redevelopment of the site with housing, including consideration of foundation types and treatment\removal of contamination.

Fieldwork could be commenced within 2 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 copy of the final report will be issued to the relevant regulatory authorities on receipt of written instruction from yourselves.

**Invoicing:** The attached proposal provides a breakdown of the costs associated with this project. This breakdown is for information only and the proposal can be regarded as a lump sum price of £\*\*,\*\*\* plus VAT. Variation will only occur in the event that a given item is not undertaken or that substantial additional works are recommended, in which case we will inform you immediately, provide costs for the required works, and seek your prior consent.

Our proposal allows for submission of the report to the Local Authority and NHBC, and for submission of a single piece of subsequent correspondence with each regulator to address any queries they may have. Any further meetings, correspondence etc, would be chargeable.

We will submit invoices for this project at the milestones defined below:

- 1<sup>st</sup> milestone invoice (Item A) with the Desk Study Report.
- 2<sup>nd</sup> milestone invoice (Items B & C) within 5 days of fieldwork completion, with exploratory hole logs and an interim letter report outlining our initial findings and preliminary recommendations report
- 3<sup>rd</sup> milestone invoice (Items D, E & F) on issue of the final SI report.
- 4<sup>th</sup> 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 be completed within 3 working days and therefore it is not considered reasonably practicable to provide formal welfare facilities, and our proposal makes no allowance for so doing.

Utility plans are required in order to protect operatives from the hazards associated with striking buried services and avoid potentially substantial disruption\repair costs. We will make every effort not to damage any services (including review of utility plans and use of a CAT detector).

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.

**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 Kier'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 Kier. In the event that more than one Developer requires reliance, a warranty will be required. We confirm that we will consent to a request from Kier 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's approved standard form.

You will note that in the last two columns of our costed proposal we have included an estimate of the proportion of the total cost of the works that could be eligible for Land Remediation Tax Relief (LRR).

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 black ink, appearing to read "Mark Perrin". The signature is fluid and cursive.

Mark Perrin  
Director

**for and on behalf of  
LITHOS CONSULTING LIMITED**

# Terms and Conditions for the Appointment of Lithos Consulting Limited

V002.10

## 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 45 High Street, South Milford, North Yorkshire, LS25 5AF.

"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 license to amend any drawing, design or other Intellectual Property produced by Lithos.

5.3 Should the Client wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, it must obtain the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and shall be upon such terms as may be required by Lithos. Lithos shall not be liable for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on behalf of Lithos.

5.4 Ownership of any proposals submitted to the Client that are not subsequently confirmed as part of the Services to be provided for the Client remain with Lithos and such proposals must not be used as the basis for any future work undertaken by the Client or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of the Client being in default of payment of any fees or other amounts due, Lithos may suspend further use of the licence on giving 2 days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts

## 6 TITLE

6.1 Lithos shall transfer only such title or rights in respect of the Documents as it has, and if any part is purchased from a third party Lithos shall transfer only such title or rights as that party had and has transferred to Lithos.

6.2 Title in the Documents shall remain with and shall not pass to the Client until the amount due under the invoice(s) (including interest and costs) has been paid in full.

6.3 Until title passes, the Client shall hold the Documents as bailee for Lithos and shall store or mark them so that they can at all times be identified as the property of Lithos.

6.4 At any time before title passes (save and except where payment is not due), but only after prior consultation with the Client, Lithos may without any liability to the Client repossess and use or sell all or any 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

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, 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's 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's 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) in the aggregate. 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's 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 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 determined 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 determination 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 determine 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 determination 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 determination 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.

**Alan**

---

**To:** Alan  
**Subject:** FW: Westfield development site, Mosborough

---

**From:** Brian Reynolds [<mailto:Brian.Reynolds@Chesterfield.gov.uk>]  
**Sent:** 12 December 2013 13:27  
**To:** Reg  
**Cc:** [brian.reynolds@kier.co.uk](mailto:brian.reynolds@kier.co.uk)  
**Subject:** FW: Westfield development site, Mosborough

Afternoon Reg,

As I had hoped, I am happy to say your tender on Owlthorpe has been accepted, please take this as formal instruction to proceed.

Just to confirm, the order will be for a full phase 1 and 2 site investigation on the basis of your tender dated 9 December in the sum of £\*\*,\*\*\*, and given the orders for both this and Westfield, your commentary stated a £\*,\*\*\* discount would be applied (could you let me know how you intended this to work - should we simply knock off £\*\*\* from the final payment on each?)

I will get the order in the system on Monday.

If you have any queries, please let me know.

Regards

Brian



**Kier Asset Partnership Services Ltd**  
 4<sup>th</sup> Floor, Cathedral Court  
 1 Vicar Lane  
 Sheffield S1 1HD  
 Tel: 0114 273 4583  
 Fax: 0114 273 6472

**Purchase order** Page 1 of 1

Requisition no:	Requisitioned by:	Date: 17/12/13	Order no. (please quote in full) 01CENT/0351
Terms: Nett	Carriage: Included	Delivery:	Account no: 149107
To: Lithos Consulting Limited 45 High Street South Milford North Yorkshire LS25 5AF  Mr Mark Perrin		Delivery address: Kier Asset Partnership Services Limited Brian Reynolds 4th Floor, Cathedral Court 1 Vicar Lane Sheffield S1 1HD	
Tel no: 01977 684 801 Fax no:		Tel no: 0114 2734583 Fax no: 0114 2736472	

Invoices (within 7 days of despatch) and statements to follow should be sent to:  
**Kier Asset Partnership Services Ltd, 4<sup>th</sup> Floor, Cathedral Court, 1 Vicar Lane, Sheffield S1 1HD**  
 Please quote full order number on all documentation

Cost Head	Item	Quantity	Unit	Description	Rate	Total
1208	1	1	EA	Provide full Phase 1 and 2 Site Investigation for land at Owithorpe in line with Tender dated 6th December 2013, in the sum of £ plus VAT, and specification provided by Kier on 4 December 2013  Please quote reference CS0087 on your invoice/s	/Each	
Total Order Value GBP						

Standard conditions of order printed overleaf apply where they do not conflict with any specific written agreement herein. When used as a plant hire order please note condition 17. The Supplier will comply with the Health and Safety legislation in force for the time relative to the execution of this order.

For and on behalf of Kier Asset Partnership Services Ltd  
Richard Hobson

**APPENDIX D  
HISTORICAL OS PLANS**



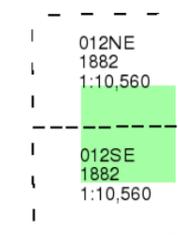
Derbyshire

Published 1882

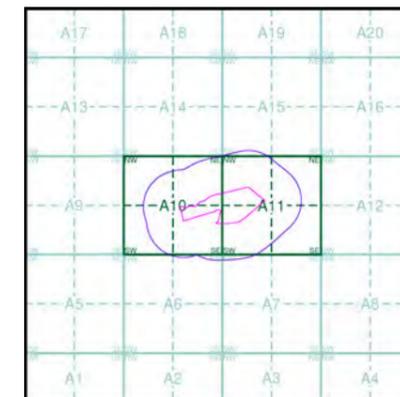
Source map scale - 1:10,560

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

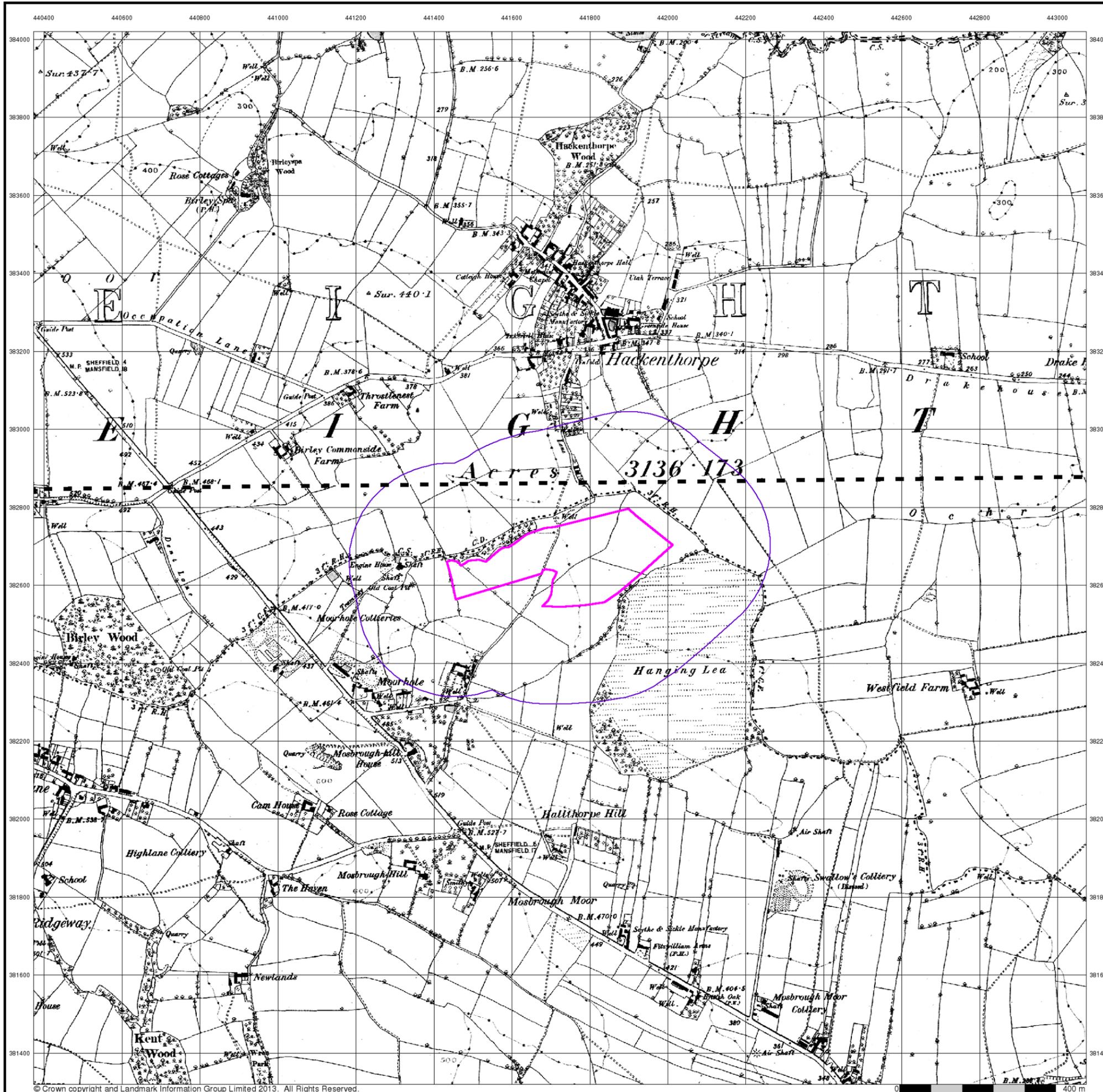
Order Number: 51782672\_1\_1
Customer Ref: 1792
National Grid Reference: 441720, 382660
Slice: A
Site Area (Ha): 7.76
Search Buffer (m): 250

Site Details

Site at 441800, 382700



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





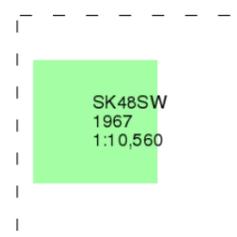
### Ordnance Survey Plan

Published 1967

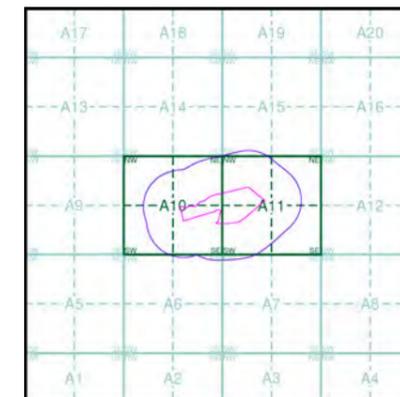
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

### Map Name(s) and Date(s)



### Historical Map - Slice A



### Order Details

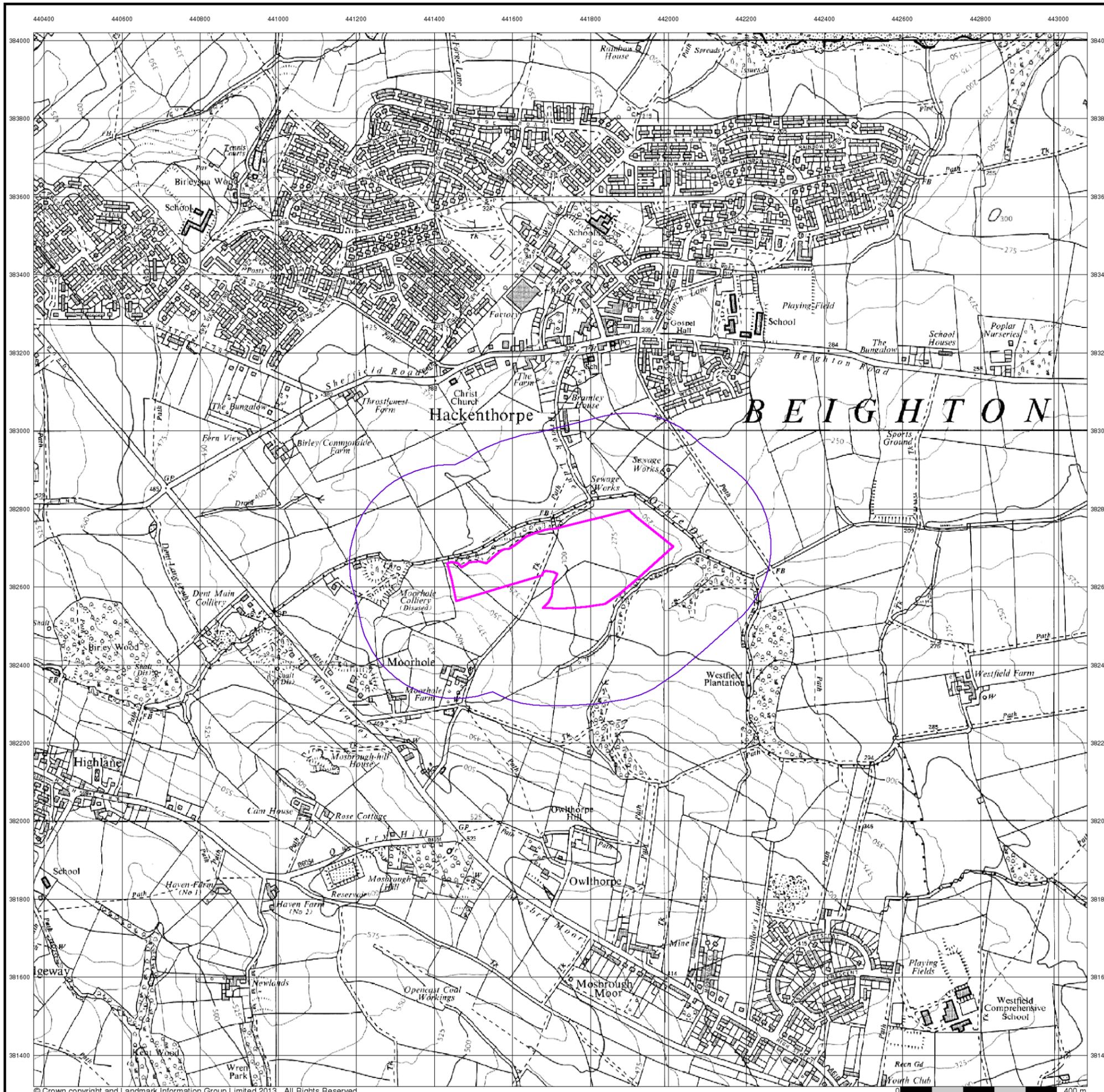
Order Number: 51782672\_1\_1  
Customer Ref: 1792  
National Grid Reference: 441720, 382660  
Slice: A  
Site Area (Ha): 7.76  
Search Buffer (m): 250

### Site Details

Site at 441800, 382700



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Fax: 0844 844 9951  
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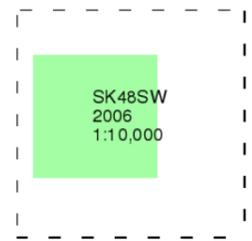
### 10k Raster Mapping

Published 2006

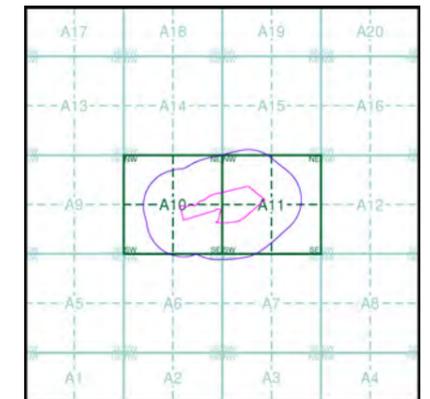
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

### Map Name(s) and Date(s)



### Historical Map - Slice A



### Order Details

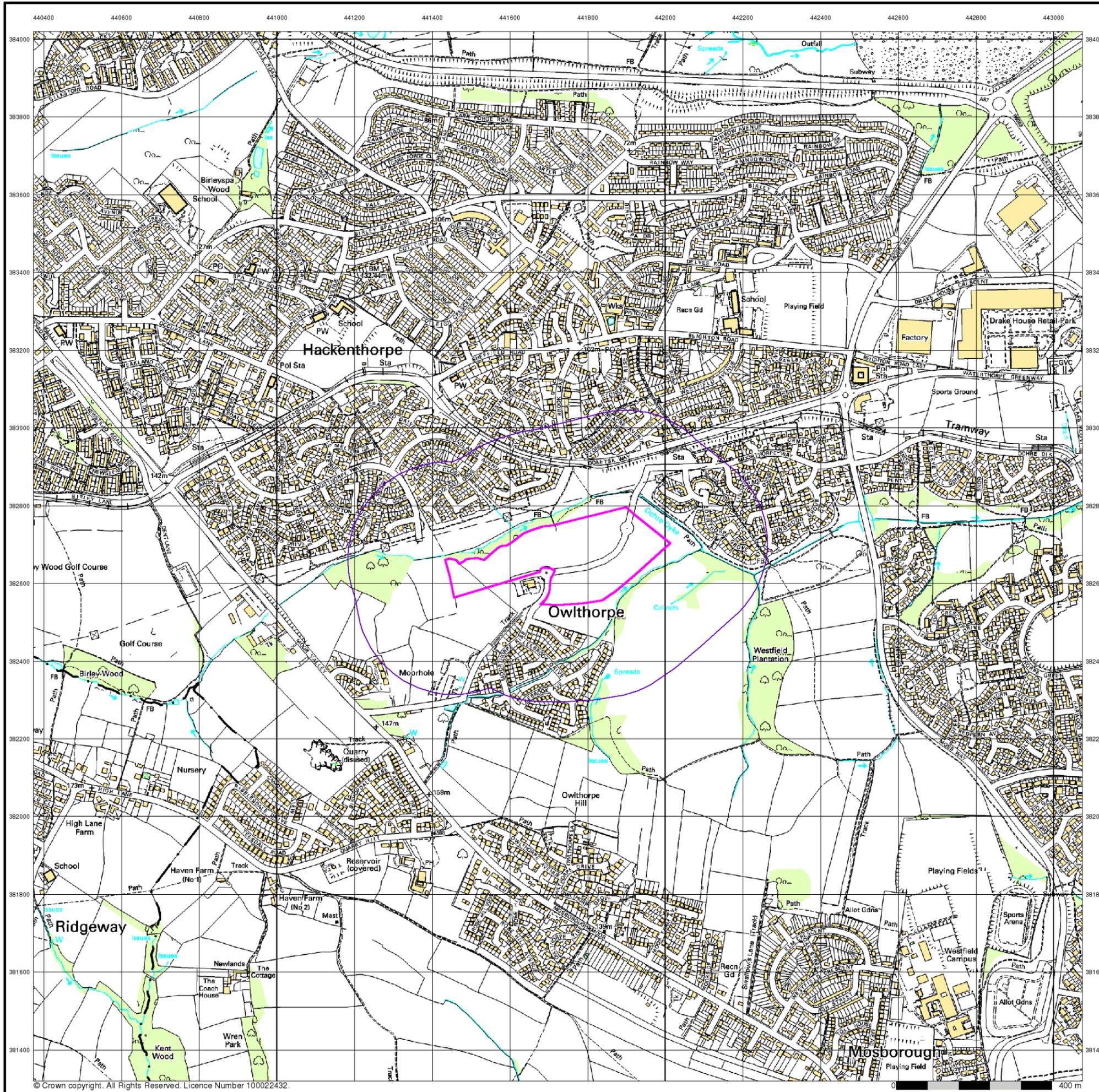
Order Number: 51782672\_1\_1  
 Customer Ref: 1792  
 National Grid Reference: 441720, 382660  
 Slice: A  
 Site Area (Ha): 7.76  
 Search Buffer (m): 250

### Site Details

Site at 441800, 382700



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**APPENDIX E  
SEARCH RESPONSES**

<b>From</b>	<b>Date</b>	<b>Content</b>
Landmark	13 <sup>th</sup> December 2013	Envirocheck Report
Coal Authority	13 <sup>th</sup> December 2013	Mining Report



## Envirocheck<sup>®</sup> Report:

### Datasheet

#### Order Details:

**Order Number:**

51782672\_1\_1

**Customer Reference:**

1792

**National Grid Reference:**

441720, 382660

**Slice:**

A

**Site Area (Ha):**

7.76

**Search Buffer (m):**

250

#### Site Details:

Site at 441800, 382700

#### Client Details:

Mr M Perrin  
Lithos Consulting Ltd  
45 High Street  
South Milford  
North Yorkshire  
LS25 5AF

#### Prepared For:

Kier Services Limited

Report Section	Page Number
Summary	-
Agency & Hydrological	1
Waste	4
Hazardous Substances	-
Geological	5
Industrial Land Use	12
Sensitive Land Use	13
Data Currency	14
Data Suppliers	19
Useful Contacts	20

## 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 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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The cavity data presented has been extracted from the PBA enhanced version of the original DEFRA national cavity databases. PBA/DEFRA retain the copyright & intellectual property rights in the data. Whilst all reasonable efforts are made to check that the information contained in the cavity databases is accurate we do not warrant that the data is complete or error free. The information is based upon our own researches and those collated from a number of external sources and is continually being augmented and updated by PBA. In no event shall PBA/DEFRA or Landmark be liable for any loss or damage including, without limitation, indirect or consequential loss or damage arising from the use of this data.

## Radon Potential dataset Copyright Notice

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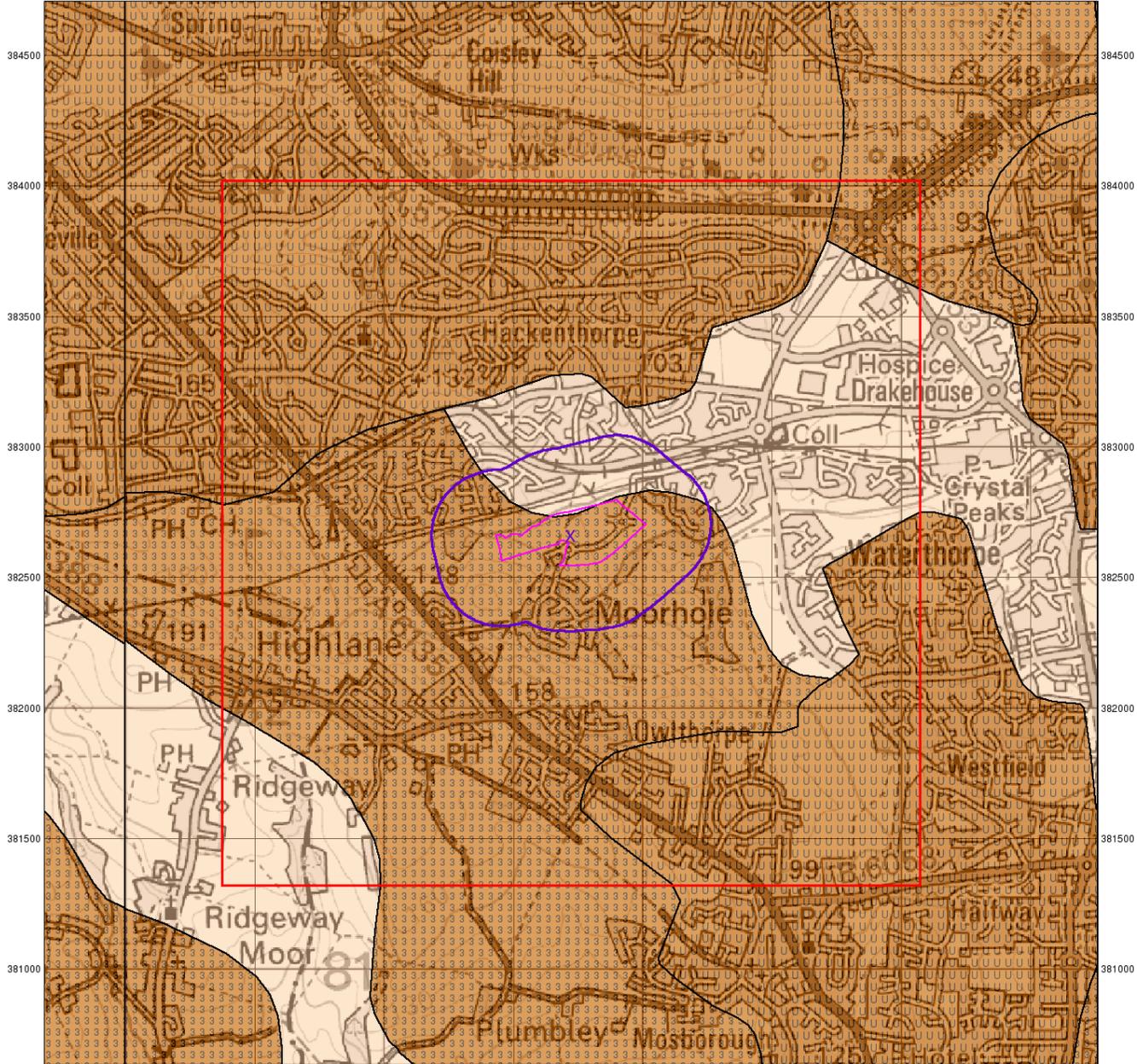
## Report Version v47.0

Data Type	Page Number	On Site	0 to 250m (*up to 500m)
<b>Agency &amp; Hydrological</b>			
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			
River Quality Biology Sampling Points			
River Quality Chemistry Sampling Points			
Substantiated Pollution Incident Register			
Water Abstractions			
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			
Flooding from Rivers or Sea without Defences			
Areas Benefiting from Flood Defences			
Flood Water Storage Areas			
Flood Defences			
Detailed River Network Lines	pg 1		Yes
Detailed River Network Offline Drainage	pg 3		Yes

Data Type	Page Number	On Site	0 to 250m (*up to 500m)
<b>Waste</b>			
BGS Recorded Landfill Sites			
Historical Landfill Sites			
Integrated Pollution Control Registered Waste Sites			
Licensed Waste Management Facilities (Landfill Boundaries)			
Licensed Waste Management Facilities (Locations)			
Local Authority Recorded Landfill Sites			
Registered Landfill Sites			
Registered Waste Transfer Sites			
Registered Waste Treatment or Disposal Sites			
<b>Hazardous Substances</b>			
Control of Major Accident Hazards Sites (COMAH)			
Explosive Sites			
Notification of Installations Handling Hazardous Substances (NIHHS)			
Planning Hazardous Substance Consents			
Planning Hazardous Substance Enforcements			
<b>Geological</b>			
BGS 1:625,000 Solid Geology	pg 5	Yes	n/a
BGS Estimated Soil Chemistry	pg 5	Yes	Yes
BGS Recorded Mineral Sites			
BGS Urban Soil Chemistry	pg 9		Yes
BGS Urban Soil Chemistry Averages	pg 10	Yes	
Brine Compensation Area			n/a
Coal Mining Affected Areas	pg 10	Yes	n/a
Mining Instability	pg 10	Yes	n/a
Man-Made Mining Cavities			
Natural Cavities			
Non Coal Mining Areas of Great Britain	pg 10		Yes
Potential for Collapsible Ground Stability Hazards	pg 10	Yes	
Potential for Compressible Ground Stability Hazards			
Potential for Ground Dissolution Stability Hazards			
Potential for Landslide Ground Stability Hazards	pg 10	Yes	Yes
Potential for Running Sand Ground Stability Hazards			
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 11	Yes	Yes
Radon Potential - Radon Affected Areas	pg 11	Yes	n/a
Radon Potential - Radon Protection Measures			n/a

Data Type	Page Number	On Site	0 to 250m (*up to 500m)
<b>Industrial Land Use</b>			
Contemporary Trade Directory Entries	pg 12		3
Fuel Station Entries			
<b>Sensitive Land Use</b>			
Areas of Adopted Green Belt	pg 13		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 13	1	
Ramsar Sites			
Sites of Special Scientific Interest			
Special Areas of Conservation			
Special Protection Areas			

440000 440500 441000 441500 442000 442500 443000 443500



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0 1 km



## Groundwater Vulnerability

### General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

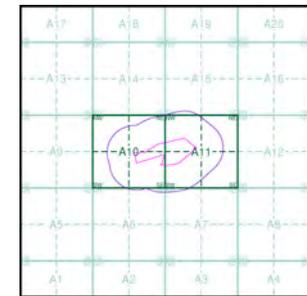
### Agency and Hydrological

#### Geological Classes

- |   |  |                       |
|---|--|-----------------------|
| <b>Major Aquifer<br/>(Highly Permeable)</b>   |  | High (H) 1, 2, 3, U   |
|   |  | Intermediate (I) 1, 2 |
|   |  | Low                   |
| <b>Minor Aquifer<br/>(Variably Permeable)</b> |  | High (H) 1, 2, 3, U   |
|   |  | Intermediate (I) 1, 2 |
|   |  | Low                   |
| <b>Non Aquifer<br/>(Negligibly Permeable)</b> |  |                       |
| <b>Water or Sea</b>                           |  |                       |
| <b>Drift Deposit</b>                          |  |                       |

#### Soil Classes

### Site Sensitivity Context Map - Slice A



### Order Details

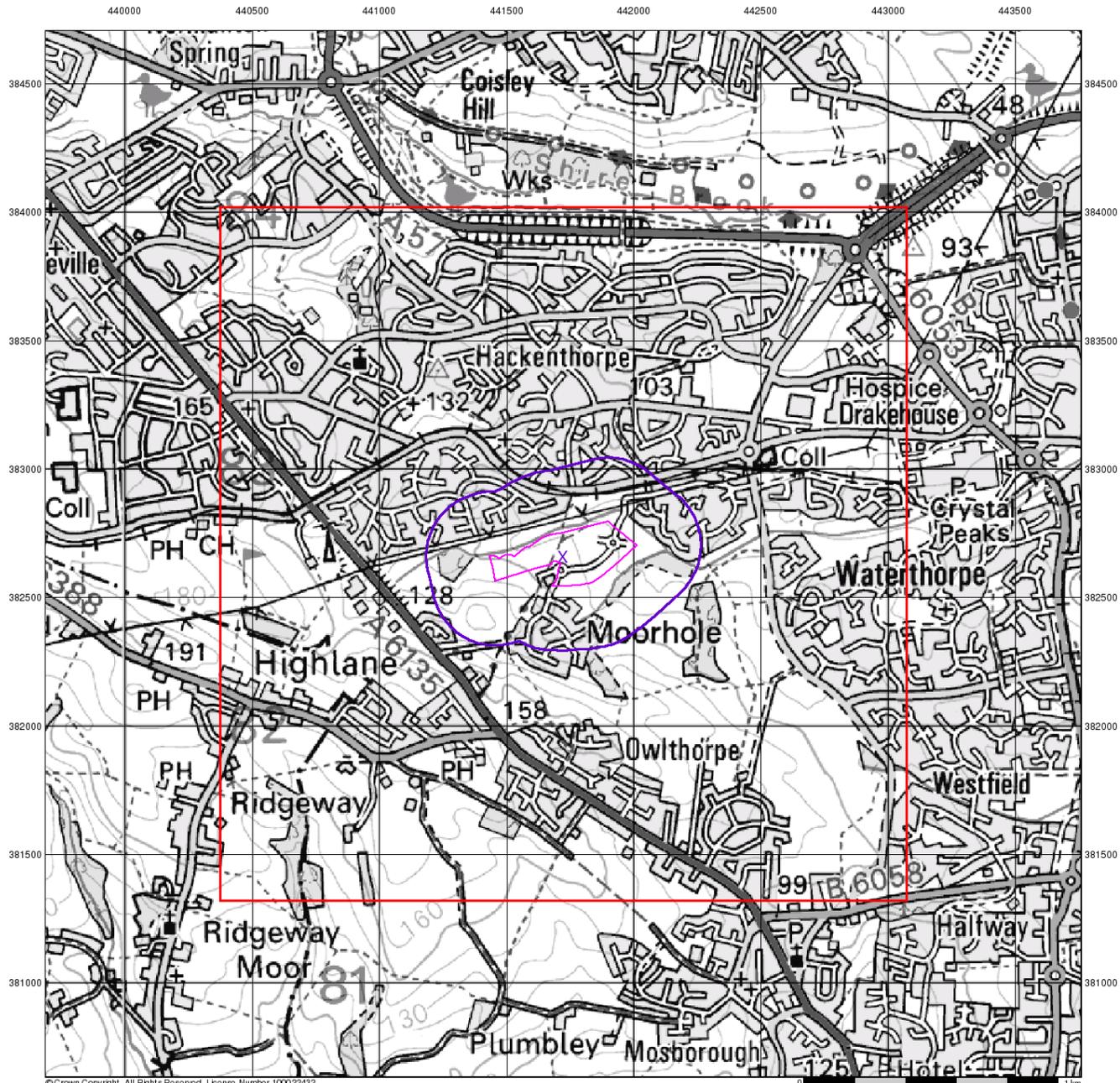
Order Number: 51782672\_1\_1  
 Customer Ref: 1792  
 National Grid Reference: 441720, 382660  
 Slice: A  
 Site Area (Ha): 7.76  
 Search Buffer (m): 250

### Site Details

Site at 441800, 382700



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



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## Source Protection Zones

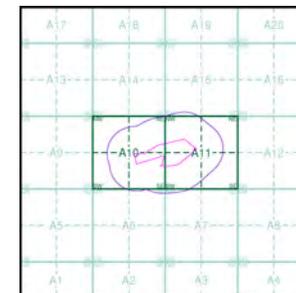
### General

- ◊ Specified Site
- Specified Buffer(s)
- X Bearing Reference Point
- Slice
- Map ID

### Agency and Hydrological

- Source Protection Zone I
- Source Protection Zone II
- Source Protection Zone III
- Zone of Special Interest
- Source Protection Zone Borehole

### Site Sensitivity Context Map - Slice A



### Order Details

Order Number: 51782672\_1\_1  
 Customer Ref: 1792  
 National Grid Reference: 441720, 382660  
 Slice: A  
 Site Area (Ha): 7.76  
 Search Buffer (m): 250

### Site Details

Site at 441800, 382700

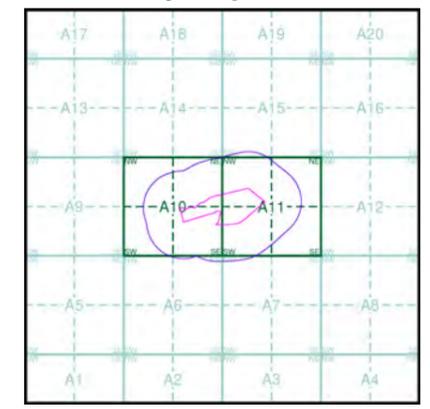


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 Fax: 0844 844 9951  
 Web: www.envirocheck.co.uk



- General**
- Specified Site
  - Specified Buffer(s)
  - Bearing Reference Point
  - Map ID
  - Several of Type at Location
- Agency and Hydrological**
- Contaminated Land Register Entry or Notice (Location)
  - Contaminated Land Register Entry or Notice
  - Discharge Consent
  - Enforcement or Prohibition Notice
  - Integrated Pollution Control
  - Integrated Pollution Prevention Control
  - Local Authority Integrated Pollution Prevention and Control
  - Local Authority Pollution Prevention and Control Enforcement
  - Pollution Incident to Controlled Waters
  - Prosecution Relating to Authorised Processes
  - Prosecution Relating to Controlled Waters
  - Registered Radioactive Substance
  - River Network or Water Feature
  - River Quality Sampling Point
  - Substantiated Pollution Incident Register
  - Water Abstraction
  - Water Industry Act Referral
- Waste**
- BGS Recorded Landfill Site (Location)
  - BGS Recorded Landfill Site
  - EA Historic Landfill (Buffered Point)
  - EA Historic Landfill (Polygon)
  - Integrated Pollution Control Registered Waste Site
  - Licensed Waste Management Facility (Landfill Boundary)
  - Licensed Waste Management Facility (Location)
  - Local Authority Recorded Landfill Site (Location)
  - Local Authority Recorded Landfill Site
  - Registered Landfill Site
  - Registered Landfill Site (Location)
  - Registered Landfill Site (Point Buffered to 100m)
  - Registered Landfill Site (Point Buffered to 250m)
  - Registered Waste Transfer Site (Location)
  - Registered Waste Transfer Site
  - Registered Waste Treatment or Disposal Site (Location)
  - Registered Waste Treatment or Disposal Site
- Hazardous Substances**
- COMAH Site
  - Explosive Site
  - NIHHS Site
  - Planning Hazardous Substance Consent
  - Planning Hazardous Substance Enforcement
- Geological**
- BGS Recorded Mineral Site
- Industrial Land Use**
- Contemporary Trade Directory Entry
  - Fuel Station Entry

### Site Sensitivity Map - Slice A



**Order Details**

Order Number: 51782672\_1\_1  
 Customer Ref: 1792  
 National Grid Reference: 441720, 382660  
 Slice: A  
 Site Area (Ha): 7.76  
 Search Buffer (m): 250

**Site Details**  
 Site at 441800, 382700

**Landmark** Information Group  
 Tel: 0844 844 9952  
 Fax: 0844 844 9951  
 Web: www.envirocheck.co.uk



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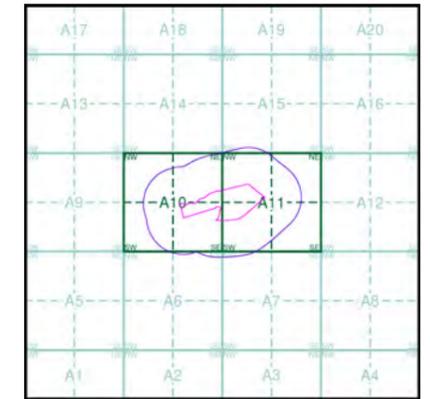
**General**

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

**Agency and Hydrological (Flood)**

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

**Flood Map - Slice A**



**Order Details**

Order Number: 51782672\_1\_1  
 Customer Ref: 1792  
 National Grid Reference: 441720, 382660  
 Slice: A  
 Site Area (Ha): 7.76  
 Search Buffer (m): 250

**Site Details**

Site at 441800, 382700



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



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### General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

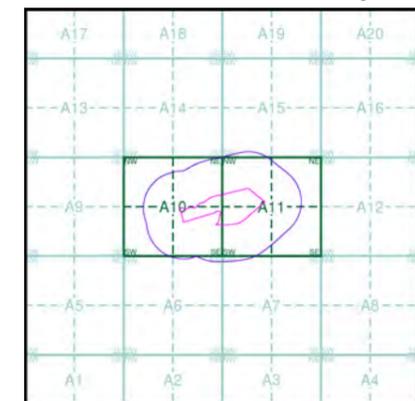
### EA Detailed River Network Data

- Primary River
- Secondary River
- Tertiary River
- Canal
- Canal Tunnel
- Undefined River
- Lake/Reservoir
- Offline Drainage Feature
- Extended Culvert (greater than 50m)
- Underground River (inferred)
- Underground River (local knowledge)
- Downstream of High Water Mark
- Downstream of Seaward Extension
- Not assigned River feature

### Contours (height in metres)

- Standard Contour 105
- Index Contour 100
- 167.3 Spot Height
- 45.8 Air Height

### EA Detailed River Network Map - Slice A



### Order Details

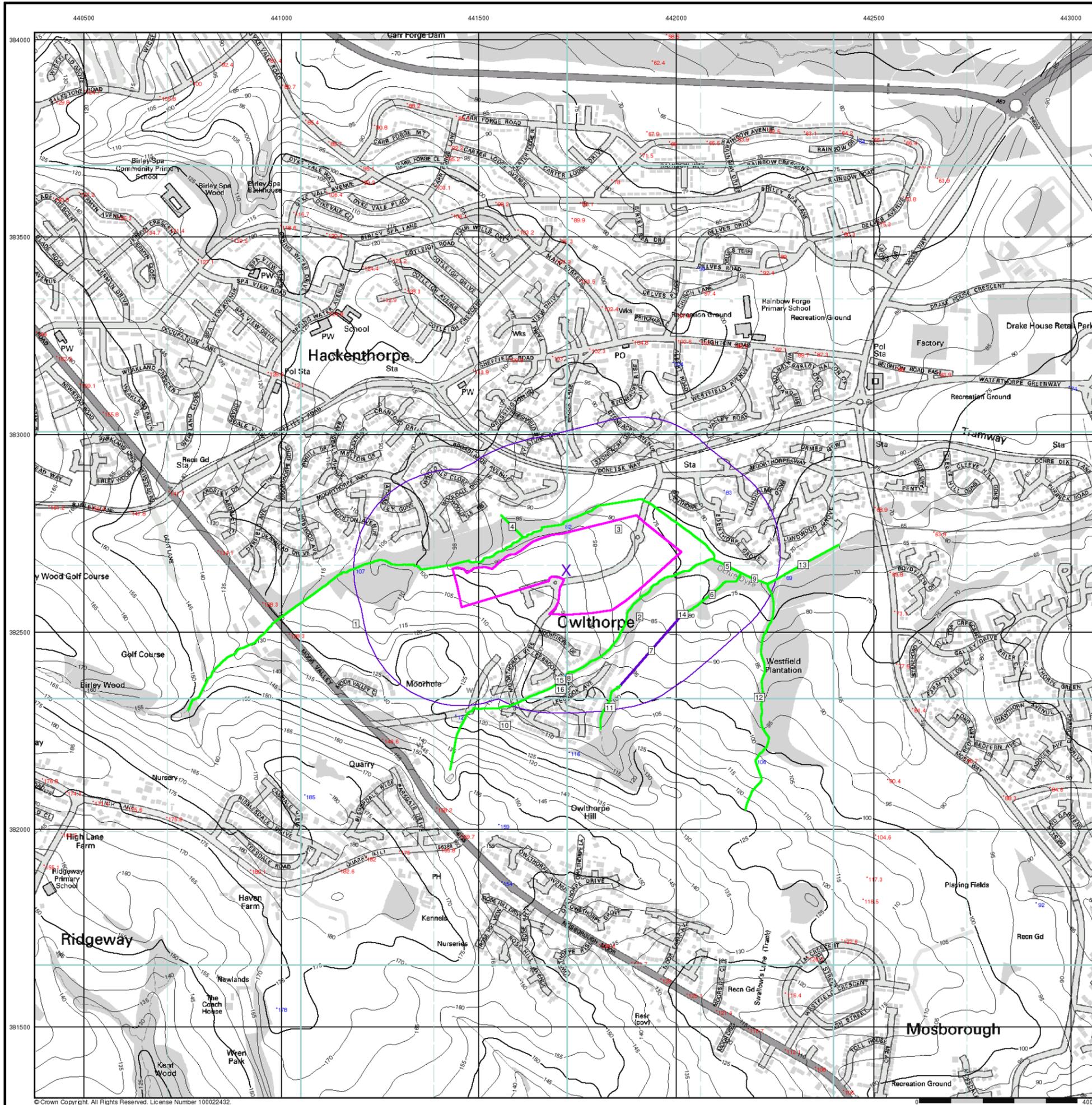
Order Number: 51782672\_1\_1  
 Customer Ref: 1792  
 National Grid Reference: 441720, 382660  
 Slice: A  
 Site Area (Ha): 7.76  
 Search Buffer (m): 250

### Site Details

Site at 441800, 382700



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





Issued by:

The Coal Authority, Property Search Services, 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire, NG18 4RG  
Website: www.groundstability.com Phone: 0845 762 6848 DX 716176 MANSFIELD 5

**LANDMARK INFORMATION GROUP  
LIMITED  
SOWTON INDUSTRIAL ESTATE  
ABBAY COURT  
UNIT 5/7 EAGLE WAY  
EXETER  
DEVON  
EX2 7HY**

Our reference: **51000433318002**  
Your reference: **51782672\_2|**  
Date of your enquiry: **13 December 2013**  
Date we received your enquiry: **13 December 2013**  
Date of issue: **14 December 2013**

This report is for the property described in the address below and the attached plan.

**Non-Residential Coal Authority Mining Report**

**SITE AT 441800, 382700, OWLTHORPE, SOUTH YORKSHIRE,**

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

Coal mining	See comments below
Brine Compensation District	No

***Information from the Coal Authority***

**Underground coal mining**

**Past**

The property is in the likely zone of influence from workings in 2 seams of coal at 60m to 170m depth, and last worked in 1932.

Any ground movement from these coal workings should have stopped by now.

In addition the property is in an area where the Coal Authority believe there is coal at or close to the surface. This coal may have been worked at some time in the past.

**Present**

The property is not in the likely zone of influence of any present underground coal workings.

**Future**

The property is not in an area for which the Coal Authority is determining whether to grant a licence to remove coal using underground methods.

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

The property is not in an area that is likely to be affected at the surface from any planned future workings.

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

No notice of the risk of the land being affected by subsidence has been given under section 46 of the Coal Mining Subsidence Act 1991.

### **Mine entries**

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

Records may be incomplete. Consequently, there may exist in the local area mine entries of which the Coal Authority has no knowledge.

### **Coal mining geology**

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.

### **Opencast coal mining**

#### **Past**

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

#### **Present**

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

#### **Future**

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.

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

### **Coal mining subsidence**

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

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

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

### **Mine gas**

There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.

### **Hazards related to coal mining**

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

### **Withdrawal of support**

The property is not in an area for which a notice of entitlement to withdraw support has been published.

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

### **Working facilities orders**

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

### **Payments to owners of former copyhold land**

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

### **Comments on Coal Authority information**

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

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

### ***Information from the Cheshire Brine Subsidence Compensation Board***

The property lies outside the Cheshire Brine Compensation District.

### ***Additional Remarks***

This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority and Cheshire Brine Board's Terms and Conditions 2006. The Coal Authority owns the copyright in this report. The information we have used to write this report is protected by our database right. All rights are reserved and unauthorised use is prohibited. If we provide a report for you, this does not mean that copyright and any other rights will pass to you. However, you can use the report for your own purposes.

## Location map



Approximate position of property

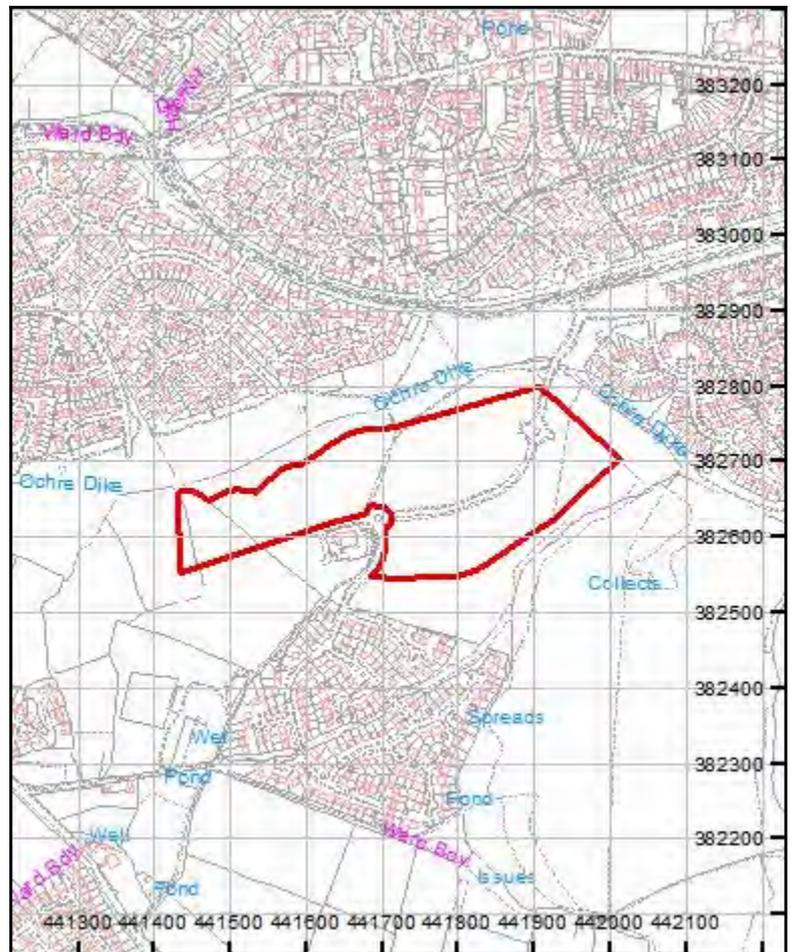


## Enquiry boundary

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## Key

Approximate position of enquiry boundary shown



**APPENDIX F  
TRIAL PIT LOGS**

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP1**

DATE 17/12/2013

Co-ords 441371E 382622N

Sheet 1 of 1

Ground Level 102.3mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Firm brown occasionally gleyed grey CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.20	102.10		
			Firm brown CLAY with many angular tabular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.50	101.80		
			Strong brown fine to medium grained SANDSTONE. Recovered as angular tabular cobbles. (WEATHERED COAL MEASURES)	1.90	100.40		
			Unable to excavate below 2.0m depth. End of trial pit at 2.00 m	2.00	100.30		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASw	JOB 1792	FIGURE
---	------------------	-------------	--------

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

TP2

DATE 17/12/2013

Co-ords 441382E 382596N

Sheet 1 of 1

Ground Level 104.8mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10	V = 110 kPa	Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.20	104.60		
			Stiff orange-brown gleyed grey CLAY with occasional angular tabular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
2D	0.90			Strong brown fine to medium grained SANDSTONE. Recovered as angular tabular gravel and cobbles with occasional red-brown staining on surfaces. (WEATHERED COAL MEASURES)	2.20		102.60
			Difficult to excavate below 2.5m depth. End of trial pit at 2.50 m	2.50	102.30		

Remarks

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the sandstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP3**

DATE 17/12/2013

Co-ords 441425E 382604N

Sheet 1 of 1

Ground Level 102.6mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.20	102.40		
		V = 75 kPa	Stiff orange-brown gleyed grey CLAY with occasional angular tabular fine to coarse gravel size lithorelicts of siltstone and coal. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
		V = 110 kPa					
			Moderately strong brown SILTSTONE. Recovered as angular tabular gravel and cobbles with occasional red-brown staining on surfaces. (WEATHERED COAL MEASURES)	2.00	100.60		
			Difficult to excavate below 2.4m depth.	2.40	100.20		
			End of trial pit at 2.40 m				

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASW	JOB 1792	FIGURE
---	------------------	-------------	--------

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP4**

DATE 17/12/2013

Co-ords 441464E 382625N

Sheet 1 of 1

Ground Level 99.5mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10	V = 70 kPa	Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.30	99.20		
			Firm orange-brown occasionally gleyed grey CLAY with occasional angular tabular fine to medium gravel size lithorelicts of siltstone and coal. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
2D	0.80	V = 85 kPa		1.20	98.30		
			Stiff brown gleyed grey CLAY with occasional angular tabular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
			Difficult to excavate below 3.2m depth. End of trial pit at 3.20 m	3.20	96.30		

Remarks

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP5**

DATE 17/12/2013

Co-ords 441488E 382576N

Sheet 1 of 1

Ground Level 104.7mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
		V = 70 kPa	Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Firm orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)	0.30	104.40		
			Moderately weak brown SILTSTONE. Recovered as clayey angular tabular fine to coarse gravel with occasional grey staining on surfaces. (WEATHERED COAL MEASURES)	1.90	102.80		
			End of trial pit at 2.50 m	2.30	102.40		
				2.50	102.20		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASw	JOB 1792	FIGURE
---	------------------	-------------	--------

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP6**

DATE 17/12/2013

Co-ords 441542E 382608N

Sheet 1 of 1

Ground Level 100.0mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10	V = 60 kPa	Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Firm orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)	0.30	99.70		
2D	0.90	V = 70 kPa	Firm brown gleyed grey CLAY with occasional angular tabular fine to medium gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)	0.80	99.20		
			Moderately strong brown fine to medium grained SANDSTONE. Recovered as angular tabular cobbles. (WEATHERED COAL MEASURES) Unable to excavate below 1.9m depth. End of trial pit at 1.90 m	1.60	98.40		
				1.90	98.10		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the sandstone strata.
4. Backfilled with materials arising upon completion.

**Equipment/Methods**

JCB 3CX with 0.6m wide toothed bucket.

**Logged by**

ASw

**JOB**

1792

**FIGURE**

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP7**

DATE 17/12/2013

Co-ords 441557E 382640N

Sheet 1 of 1

Ground Level 97.4mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.25	97.15		
		V = 80 kPa	Firm orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)				
		V = 120 kPa	Stiff orange-brown gleyed grey CLAY with some angular fine to medium gravel size lithorelicts of sandstone. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)	1.00	96.40		
			Weak grey MUDSTONE. Recovered as brown gleyed grey clayey angular tabular fine to coarse gravel and cobbles. (WEATHERED COAL MEASURES)	1.60	95.80		
			Strong brown and grey SILTSTONE. Recovered as angular tabular cobbles. (WEATHERED COAL MEASURES)	2.30	95.10		
			Unable to excavate below 2.5m depth. End of trial pit at 2.50 m	2.50	94.90		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the siltstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASw	JOB 1792	FIGURE
---	------------------	-------------	--------

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

TP8

DATE 17/12/2013

Co-ords 441588E 382610N

Sheet 1 of 1

Ground Level 98.0mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
2JKD	0.30		Firm brown and grey slightly gravelly CLAY. Gravel is angular fine to medium of mudstone and sandstone. Possibly re-worked. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.20	97.80		
			Stiff brown CLAY with some orange-brown gleyed rootlets. (RELICT TOPSOIL)	0.50	97.50		
			Stiff orange-brown slightly sandy CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.70	97.30		
3D	1.10	V = 80 kPa					
			Firm orange-brown gleyed grey slightly sandy CLAY with occasional angular fine to medium gravel size lithorelicts of mudstone and sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.60	96.40		
			Moderately strong brown fine to medium grained SANDSTONE. Recovered as angular tabular cobbles. (WEATHERED COAL MEASURES)	2.30	95.70		
			Unable to excavate below 2.6m depth. End of trial pit at 2.60 m	2.60	95.40		

Remarks

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the sandstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

TP9

DATE 17/12/2013

Co-ords 441633E 382668N

Sheet 1 of 1

Ground Level 93.8mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1J&D	0.10		Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
				0.30	93.50		
2D	0.60	V = 60 kPa	Firm orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
				0.70	93.10		
		V = 70 kPa	Firm orange-brown occasionally gleyed grey slightly sandy slightly gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
				2.30	91.50		
			Stiff brown and grey gleyed CLAY with occasional lenses of coal recovered as angular tabular fine gravel. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
				2.70	91.10		
			End of trial pit at 2.70 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP10**

DATE 17/12/2013

Co-ords 441664E 382647N

Sheet 1 of 1

Ground Level 93.3mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1J&D	0.10	V = 130 kPa	Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Firm grey with occasional orange-brown mottling CLAY with occasional rootlets. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.30	92.95		
			Stiff orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.50	92.75		
2D	1.00	V = 80 kPa	Stiff brown gleyed grey CLAY with occasional angular fine to coarse gravel size lithorelicts of mudstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.40	91.85		
			Very Strong red-brown IRONSTONE. Recovered as angular to subrounded cobbles. (WEATHERED COAL MEASURES)	2.70	90.55		
			Unable to excavate below 2.8m depth. End of trial pit at 2.80 m	2.80	90.45		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASw	JOB 1792	FIGURE
---	------------------	-------------	--------

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP11**

DATE 17/12/2013

Co-ords 441678E 382698N

Sheet 1 of 1

Ground Level 92.4mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Firm brown very gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.30	92.05		
			Strong brown fine to coarse grained SANDSTONE. Recovered as angular tabular cobbles. (WEATHERED COAL MEASURES)	0.60	91.75		
			Unable to excavate below 1.0m depth.	1.00	91.35		
			End of trial pit at 1.00 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the sandstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP12**

DATE 17/12/2013

Co-ords 441715E 382681N

Sheet 1 of 1

Ground Level 91.5mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Firm brown gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.20	91.30		
			Strong brown fine to medium grained SANDSTONE. Recovered as clayey angular medium to coarse gravel and cobbles. (WEATHERED COAL MEASURES)	0.50	91.00		
			Difficult to excavate below 2.3m depth. End of trial pit at 2.20 m	2.20	89.30		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the sandstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP13**

DATE 17/12/2013

Co-ords 441738E 382729N

Sheet 1 of 1

Ground Level 89.1mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
				0.30	88.75		
2D	0.70		Firm orange-brown gleyed grey very gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)				
			Difficult to excavate below 1.7m depth.				
				2.50	86.55		
			Weak brown SILTSTONE. Recovered as slightly clayey angular fine to coarse gravel with occasional red-brown staining on surfaces. Occasional subrounded gravel of ironstone. (WEATHERED COAL MEASURES)	2.80	86.25		
			End of trial pit at 2.80 m				

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP14**

DATE 17/12/2013

Co-ords 441765E 382668N

Sheet 1 of 1

Ground Level 87.9mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
		V = 80 kPa	Firm orange-brown gleyed grey slightly sandy slightly gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)	0.20	87.65		
		V = 95 kPa					
			Strong brown fine to medium grained SANDSTONE. Recovered as angular tabular cobbles with grey staining on surfaces. (WEATHERED COAL MEASURES)	1.60	86.25		
			Difficult to excavate below 1.8m depth.	1.80	86.05		
			End of trial pit at 1.80 m				

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the sandstone strata.
4. Backfilled with materials arising upon completion.

**Equipment/Methods**

JCB 3CX with 0.6m wide toothed bucket.

**Logged by**

ASw

**JOB**

1792

**FIGURE**

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP15**

DATE 17/12/2013

Co-ords 441776E 382728N

Sheet 1 of 1

Ground Level 86.8mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Stiff orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)	0.30	86.50		
2D	1.00	V = 90 kPa					
			Strong brown fine to medium grained SANDSTONE. Recovered as angular tabular cobbles. (WEATHERED COAL MEASURES)	1.50	85.30		
			Unable to excavate below 1.7m depth. End of trial pit at 1.70 m	1.70	85.10		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the sandstone strata.
4. Backfilled with materials arising upon completion.

**Equipment/Methods**

JCB 3CX with 0.6m wide toothed bucket.

**Logged by**

ASw

**JOB**

1792

**FIGURE**

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP16**

DATE 17/12/2013

Co-ords 441819E 382762N

Sheet 1 of 1

Ground Level 81.5mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.20	81.25		
			Strong brown fine to medium grained SANDSTONE. Recovered as slightly clayey angular tabular cobbles. (WEATHERED COAL MEASURES)				
2D	1.20		Stiff brown gleyed grey CLAY with occasional angular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.80	80.65		
			Strong brown fine to medium grained SANDSTONE. Recovered as angular tabular cobbles. (WEATHERED COAL MEASURES)	1.40	80.05		
			Unable to excavate below 1.5m depth.	1.50	79.95		
			End of trial 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. The sides of the trial pit remained stable during excavation with some overbreak in the sandstone strata.
4. Backfilled with materials arising upon completion.

**Equipment/Methods**

JCB 3CX with 0.6m wide toothed bucket.

**Logged by**

ASw

**JOB**

1792

**FIGURE**

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP17**

DATE 17/12/2013

Co-ords 441858E 382746N

Sheet 1 of 1

Ground Level 81.5mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	1.30	V = 90 kPa	Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.10	81.35		
			Stiff orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
			Stiff brown gleyed grey CLAY with occasional angular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.00	80.45		
			Strong dark grey-black SILTSTONE. Recovered as angular fine to coarse gravel. Occasional subrounded gravel of ironstone. (WEATHERED COAL MEASURES)	2.00	79.45		
			Unable to excavate below 2.4m depth.	2.40	79.05		
			End of trial pit at 2.40 m				

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP18**

DATE 17/12/2013

Co-ords 441828E 382712N

Sheet 1 of 1

Ground Level 84.1mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.20	83.90		
			Stiff orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)				
2D	1.00	V = 110 kPa		1.50	82.60		
			Stiff brown occasionally gleyed grey CLAY with many angular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)				
			Weak brown and grey MUDSTONE. Recovered as slightly clayey angular fine to coarse gravel. (WEATHERED COAL MEASURES)				
			Unable to excavate below 2.8m depth. End of trial pit at 2.80 m	2.80	81.30		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

**Equipment/Methods**

JCB 3CX with 0.6m wide toothed bucket.

**Logged by**

ASw

**JOB**

1792

**FIGURE**

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP19**

DATE 18/12/2013

Co-ords 441804E 382575N

Sheet 1 of 1

Ground Level 90.7mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
		V = 110 kPa	Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Stiff orange-brown gleyed grey slightly gravelly CLAY. Gravel is angular fine to coarse of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.30	90.35		
			Stiff orange-brown gleyed grey very gravelly CLAY with occasional angular tabular cobbles of sandstone. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.40	89.25		
			Very weak brown SILTSTONE. Recovered as clayey angular fine to coarse gravel. (WEATHERED COAL MEASURES) Unable to excavate below 2.2m depth. End of trial pit at 2.20 m	2.00 2.20	88.65 88.45		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASw	JOB 1792	FIGURE
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# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP20**

DATE 18/12/2013

Co-ords 441789E 382622N

Sheet 1 of 1

Ground Level 87.8mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
		V = 85 kPa	Stiff orange-brown occasionally gleyed grey CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.30	87.50		
		V = 130 kPa	Stiff orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.60	87.20		
			Moderately strong brown SILTSTONE. Recovered as angular tabular fine to coarse gravel and cobbles with grey-black staining on surfaces. (WEATHERED COAL MEASURES) Unable to excavate below 2.0m depth.	1.60	86.20		
			End of trial pit at 2.00 m	2.00	85.80		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the siltstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP21**

DATE 18/12/2013

Co-ords 441840E 382632N

Sheet 1 of 1

Ground Level 84.0mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Grey-brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.20	83.75		
			Stiff orange-brown gleyed grey gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
2D	1.00	V = 82 kPa	Stiff orange-brown gleyed grey CLAY with many angular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.80	82.15		
			Weak brown SILTSTONE. Recovered as angular tabular fine to coarse gravel with grey staining on surfaces. (WEATHERED COAL MEASURES)	2.10	81.85		
			Unable to excavate below 2.5m depth. End of trial pit at 2.50 m	2.50	81.45		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the siltstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASw	JOB 1792	FIGURE
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# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP22**

DATE 18/12/2013

Co-ords 441885E 382619N

Sheet 1 of 1

Ground Level 82.3mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.10	82.15		
			Firm brown and orange-brown gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
			Weak brown SILTSTONE. Recovered as slightly clayey angular tabular fine to coarse gravel with grey staining on surfaces. (WEATHERED COAL MEASURES)	1.70	80.55		
			Difficult to excavate below 2.2m depth. End of trial pit at 2.20 m	2.20	80.05		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP23**

DATE 18/12/2013

Co-ords 441881E 382654N

Sheet 1 of 1

Ground Level 81.5mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.20	81.25		
			Firm brown and orange-brown gravelly CLAY with occasional angular tabular cobbles. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
2D	1.30		Stiff orange-brown gleyed grey gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.50	79.95		
			Weak brown SILTSTONE. Recovered as angular tabular fine to coarse gravel with grey staining on surfaces. (WEATHERED COAL MEASURES) Difficult to excavate below 2.4m depth.	2.10	79.35		
			End of trial pit at 2.40 m	2.40	79.05		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP24**

DATE 18/12/2013

Co-ords 441925E 382673N

Sheet 1 of 1

Ground Level 79.4mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend		
1JKD	0.10		Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.20	79.20				
			Stiff orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)						
2D	0.80		Weak brown SILTSTONE. Recovered as clayey angular tabular fine to coarse gravel with grey staining on surfaces. (WEATHERED COAL MEASURES)	0.90	78.50				
			Weak grey SILTSTONE. Recovered as angular tabular fine to coarse gravel and cobbles with red-black staining on surfaces. (WEATHERED COAL MEASURES)				2.10	77.30	
			Difficult to excavate below 2.5m depth. End of trial pit at 2.50 m				2.50	76.90	

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the siltstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASw	JOB 1792	FIGURE
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# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP25**

DATE 18/12/2013

Co-ords 441941E 382731N

Sheet 1 of 1

Ground Level 78.0mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.10		Grey-brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.15	77.85		
			Stiff orange-brown gleyed grey CLAY with some angular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
			Moderately strong brown SILTSTONE. Recovered as clayey angular tabular fine to coarse gravel with grey staining on surfaces. (WEATHERED COAL MEASURES)	1.20	76.80		
			Strong brown fine to medium grained SANDSTONE. Recovered as angular tabular cobbles with grey staining on surfaces. (WEATHERED COAL MEASURES) Unable to excavate below 2.2m depth.	1.80	76.20		
			End of trial pit at 2.20 m	2.20	75.80		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the sandstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

TP26

DATE 18/12/2013

Co-ords 441974E 382711N

Sheet 1 of 1

Ground Level 77.5mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
		V = 70 kPa	Grey-brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.20	77.30		
			Firm brown and orange-brown CLAY. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)				
		V = 100 kPa	Stiff brown and orange-brown CLAY with occasional angular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATHERED COAL MEASURES)	0.60	76.90		
			Moderately weak brown SILTSTONE. Recovered as clayey angular tabular fine to coarse gravel with grey staining on surfaces. (WEATHERED COAL MEASURES)	1.20	76.30		
			Strong grey SILTSTONE. Recovered as clayey angular tabular fine to coarse gravel and cobbles. Occasional subrounded fine to coarse gravel of ironstone. (WEATHERED COAL MEASURES)	2.00	75.50		
			Unable to excavate below 2.2m depth. End of trial pit at 2.20 m	2.20	75.30		

Remarks

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation with some overbreak in the siltstone strata.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP27**

DATE 17/12/2013

Co-ords 441834E 382691N

Sheet 1 of 1

Ground Level 84.3mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	1.00		Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Trial pit excavated within soil mound, final depth approximately level with surrounding ground surface. End of trial pit at 1.80 m	1.80	82.45		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

**Equipment/Methods**

JCB 3CX with 0.6m wide toothed bucket.

**Logged by**

ASw

**JOB**

1792

**FIGURE**

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP28**

DATE 18/12/2013

Co-ords 441743E 382605N

Sheet 1 of 1

Ground Level 90.9mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)	0.20	90.70		
		V = 65 kPa	Firm brown and orange-brown slightly gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)				
			Moderately weak brown SILTSTONE. Recovered as clayey angular tabular fine to coarse gravel with grey staining on surfaces. (WEATHERED COAL MEASURES)	1.90	89.00		
			Unable to excavate below 2.3m depth.	2.30	88.60		
			End of trial pit at 2.20 m				

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP29**

DATE 19/12/2013

Co-ords 441602E 382566N

Sheet 1 of 1

Ground Level 100.3mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.60		Brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
			Stiff brown gleyed grey slightly gravelly CLAY. Gravel is angular to subangular fine of siltstone. Possibly re-worked. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.30	100.00		
			Stiff orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.90	99.40		
			Firm grey and black very gravelly CLAY. Gravel is angular fine to medium of coal and carbonaceous mudstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.70	98.60		
			Stiff orange-brown gleyed grey CLAY with occasional angular fine to coarse gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	2.10	98.20		
			Moderately weak brown fine to medium grained SANDSTONE. Recovered as angular tabular fine to coarse gravel with some red-brown staining on surfaces. (WEATHERED COAL MEASURES) Unable to excavate below 2.6m depth. End of trial pit at 2.60 m	2.50 2.60	97.80 97.70		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASw	JOB 1792	FIGURE
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# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP30**

DATE 19/12/2013

Co-ords 441647E 382556N

Sheet 1 of 1

Ground Level 98.6mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1JKD	0.50	V = 45 kPa	Brown slightly gravelly CLAY with some rootlets. (REWORKED TOPSOIL)	0.10	98.45		
			MADE GROUND: Brown and grey gravelly clay. Gravel is angular fine to coarse of predominantly sandstone, occasionally brick and glass. (COHESIVE MADE GROUND)				
			Firm orange-brown gleyed grey slightly sandy CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.00	97.55		
			Stiff orange-brown gleyed grey CLAY. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.60	96.95		
			End of trial pit at 2.20 m	2.20	96.35		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods

JCB 3CX with 0.6m wide toothed bucket.

Logged by

ASw

JOB

1792

FIGURE

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP31**

DATE 19/12/2013

Co-ords 441720E 382563N

Sheet 1 of 1

Ground Level 93.8mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			Dark brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
		V = 90 kPa	Stiff orange-brown gleyed grey CLAY with occasional angular fine gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.30	93.45		
		V = 85 kPa					
			Strong brown fine to medium grained SANDSTONE. Recovered as angular fine to coarse gravel with some red-brown staining on surfaces. (WEATHERED COAL MEASURES)	1.70	92.05		
			Difficult to excavate below 2.0m depth.	2.00	91.75		
			End of trial pit at 2.00 m				

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

**Equipment/Methods**

JCB 3CX with 0.6m wide toothed bucket.

**Logged by**

ASw

**JOB**

1792

**FIGURE**

# TRIAL PIT LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**TP32**

DATE 19/12/2013

Co-ords 441765E 382565N

Sheet 1 of 1

Ground Level 90.7mAOD

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			Grey-brown slightly gravelly CLAY with some rootlets. (TOPSOIL)				
		V = 72 kPa	Firm orange-brown gleyed grey CLAY with occasional angular to subangular fine gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	0.30	90.35		
		V = 100 kPa					
			Stiff orange-brown gleyed grey CLAY with many angular tabular fine to medium gravel size lithorelicts of siltstone. (COHESIVE COMPLETELY WEATEHRED COAL MEASURES)	1.80	88.85		
			Weak brown SILTSTONE. Recovered as angular tabular fine to coarse gravel with some orange-brown staining on surfaces. (WEATHERED COAL MEASURES)	2.10	88.55		
			Difficult to excavate below 2.5m depth.				
			End of trial pit at 2.50 m	2.50	88.15		

**Remarks**

1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during excavation.
3. The sides of the trial pit remained stable during excavation.
4. Backfilled with materials arising upon completion.

Equipment/Methods JCB 3CX with 0.6m wide toothed bucket.	Logged by ASw	JOB 1792	FIGURE
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**APPENDIX G  
PROBEHOLE LOGS**

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

PH1

DATE 07/01/2014 to  
07/01/2014

Co-ords 441525E 382608N  
Ground Level 100.7mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE (LOWER COAL MEASURES)	1.90	98.80		
				COAL (THIN COAL)	4.10	96.60		
				MUDSTONE (LOWER COAL MEASURES)	5.10	95.60		

*Continued on next sheet*

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE



# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH1A**

DATE 07/01/2014 to 07/01/2014 Co-ords - Ground Level -

Sheet 1 of 1

Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE (LOWER COAL MEASURES)	1.90			
				COAL (THIN COAL)	4.10			
				<i>End of probehole at 5.00 m</i>	5.00			

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Gas/groundwater monitoring well installed on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

PH2

DATE 07/01/2014 to  
07/01/2014

Co-ords 441628E 382658N  
Ground Level 94.1mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE (LOWER COAL MEASURES)	2.30	91.80		
				COAL (THIN COAL)	9.80	84.30		
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	10.40	83.70		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

PH2

DATE 07/01/2014 to  
07/01/2014

Co-ords 441628E 382658N  
Ground Level 94.1mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
			well/backfill	MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				legend
				End of probehole at 30.00 m	30.00	64.10		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



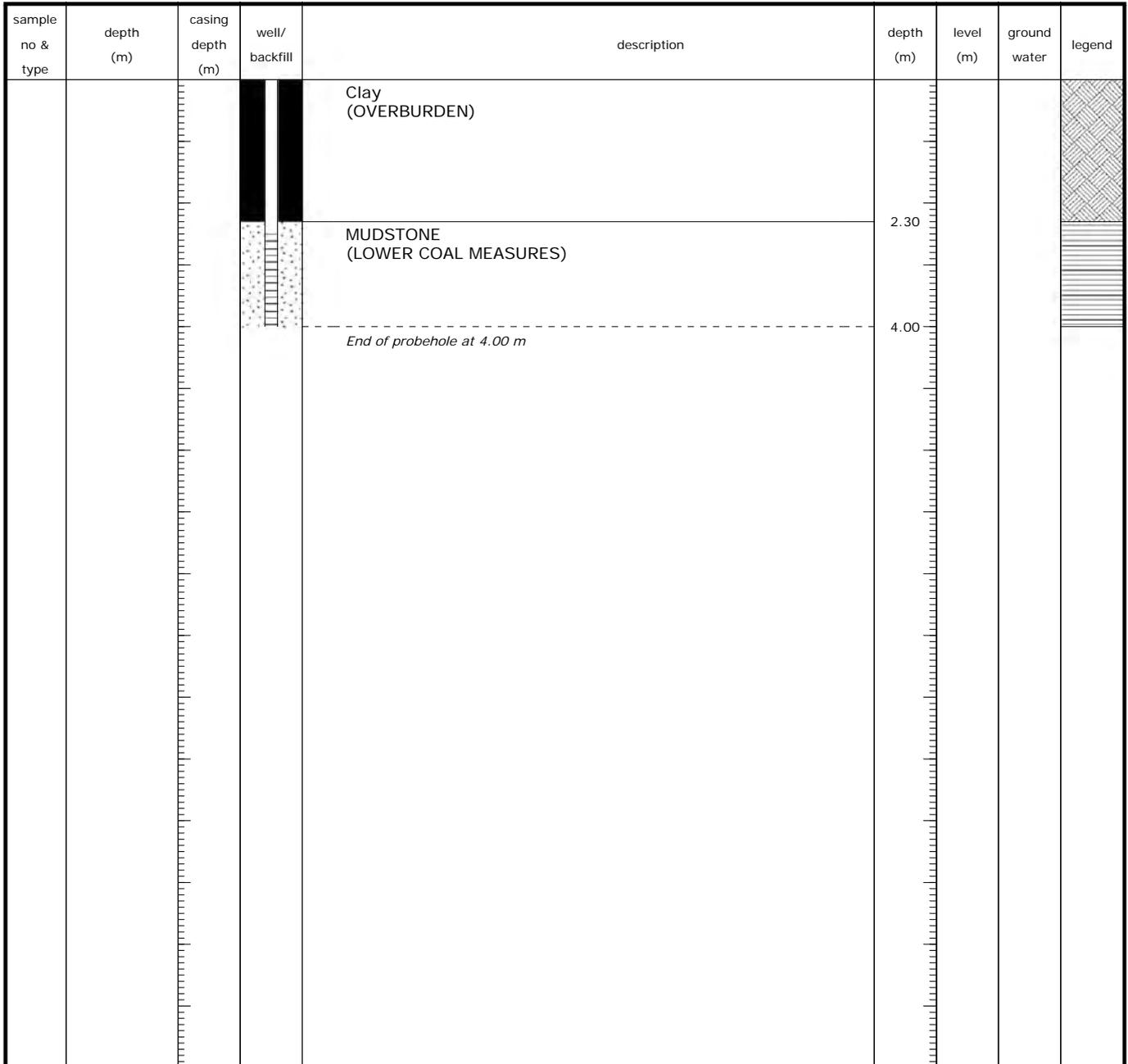
CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH2A**

DATE 07/01/2014 to 07/01/2014  
 Co-ords -  
 Ground Level -

Sheet 1 of 1  
 Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Gas/groundwater monitoring well installed on completion.

Equipment/Methods  
 Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
 ASw

JOB  
 1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH3**

DATE 07/01/2014 to  
07/01/2014

Co-ords 441670E 382696N  
Ground Level 92.8mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE (LOWER COAL MEASURES)	1.40	91.40		
				COAL (SITWELL COAL)	4.80	88.00		
				MUDSTONE (LOWER COAL MEASURES)	5.20	87.60		
				COAL (THIN COAL)	13.30	79.50		
				MUDSTONE (LOWER COAL MEASURES)	13.80	79.00		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH3**

DATE 07/01/2014 to  
07/01/2014

Co-ords 441670E 382696N  
Ground Level 92.8mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
			well/backfill	MUDSTONE (LOWER COAL MEASURES)				legend
				End of probehole at 30.00 m	30.00	62.80		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



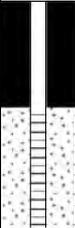
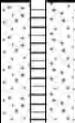
CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH3A**

DATE 07/01/2014 to 07/01/2014 Co-ords - Ground Level -

Sheet 1 of 1  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend	
				Clay (OVERBURDEN)					
				MUDSTONE (LOWER COAL MEASURES)	1.40				
				<i>End of probehole at 3.00 m</i>	3.00				
<p>Remarks</p> <ol style="list-style-type: none"> <li>Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.</li> <li>Groundwater was not apparent during drilling.</li> <li>Gas/groundwater monitoring well installed on completion.</li> </ol>									
<p>Equipment/Methods Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.</p>						<p>Logged by ASw</p>		<p>JOB 1792</p>	<p>FIGURE</p>

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH4**

DATE 07/01/2014 to  
07/01/2014

Co-ords 441746E 382669N  
Ground Level 89.5mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE (LOWER COAL MEASURES)	1.40	88.05		
				COAL (SITWELL COAL)	7.60	81.85		
				MUDSTONE (LOWER COAL MEASURES)	8.20	81.25		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH4**

DATE 07/01/2014 to  
07/01/2014

Co-ords 441746E 382669N  
Ground Level 89.5mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
			well/backfill	MUDSTONE (LOWER COAL MEASURES)	16.40	73.05		
		COAL (THIN COAL)		16.80	72.65			
		MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)						
				End of probehole at 30.00 m	30.00	59.45		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH4A**

DATE 07/01/2014 to 07/01/2014 Co-ords - Ground Level -

Sheet 1 of 1  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE (LOWER COAL MEASURES)	1.40			
				<i>End of probehole at 3.00 m</i>	3.00			

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Gas/groundwater monitoring well installed on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH5**

DATE 07/01/2014 to  
07/01/2014

Co-ords 441756E 382727N  
Ground Level 88.4mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE (LOWER COAL MEASURES)	1.40	86.95		
				COAL (SITWELL COAL)	8.40	79.95		
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	9.30	79.05		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

PH5

DATE 07/01/2014 to  
07/01/2014

Co-ords 441756E 382727N  
Ground Level 88.4m AOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
			well/backfill	MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	16.10	72.25		legend
				COAL (THIN COAL)	16.50	71.85		
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				
				End of probehole at 30.00 m	30.00	58.35		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH5A**

DATE 07/01/2014 to 07/01/2014 Co-ords - Ground Level -

Sheet 1 of 1  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE (LOWER COAL MEASURES)	1.40			
				End of probehole at 4.00 m	4.00			

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Gas/groundwater monitoring well installed on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH6**

DATE 09/01/2014 to  
09/01/2014

Co-ords 441829E 382729N  
Ground Level 84.0mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.80	82.20		

*Continued on next sheet*

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

PH6

DATE 09/01/2014 to  
09/01/2014

Co-ords 441829E 382729N  
Ground Level 84.0m AOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				
				COAL (SITWELL COAL)	17.70	66.30		
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	18.20	65.80		
				COAL (THIN COAL)	25.10	58.90		
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	25.30	58.70		
				End of probehole at 30.00 m	30.00	54.00		

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



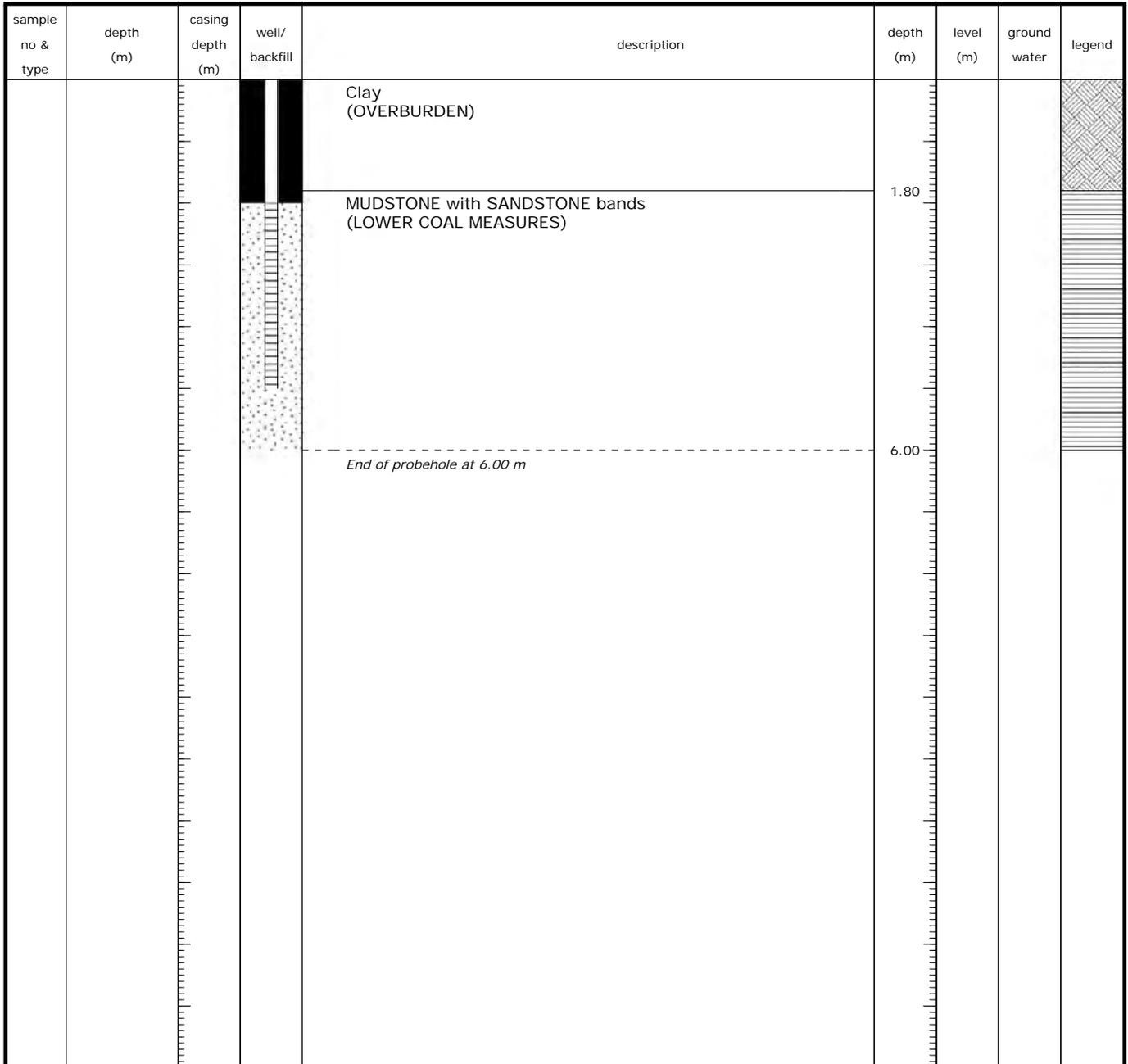
CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH6A**

DATE 09/01/2014 to 09/01/2014 Co-ords - Ground Level -

Sheet 1 of 1  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Gas/groundwater monitoring well installed on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH7**

DATE 09/01/2014 to  
09/01/2014

Co-ords 441752E 382600N  
Ground Level 90.8mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	2.00	88.80		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH7**

DATE 09/01/2014 to  
09/01/2014

Co-ords 441752E 382600N  
Ground Level 90.8mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
			well/backfill	MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				legend
				End of probehole at 30.00 m	30.00	60.80		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



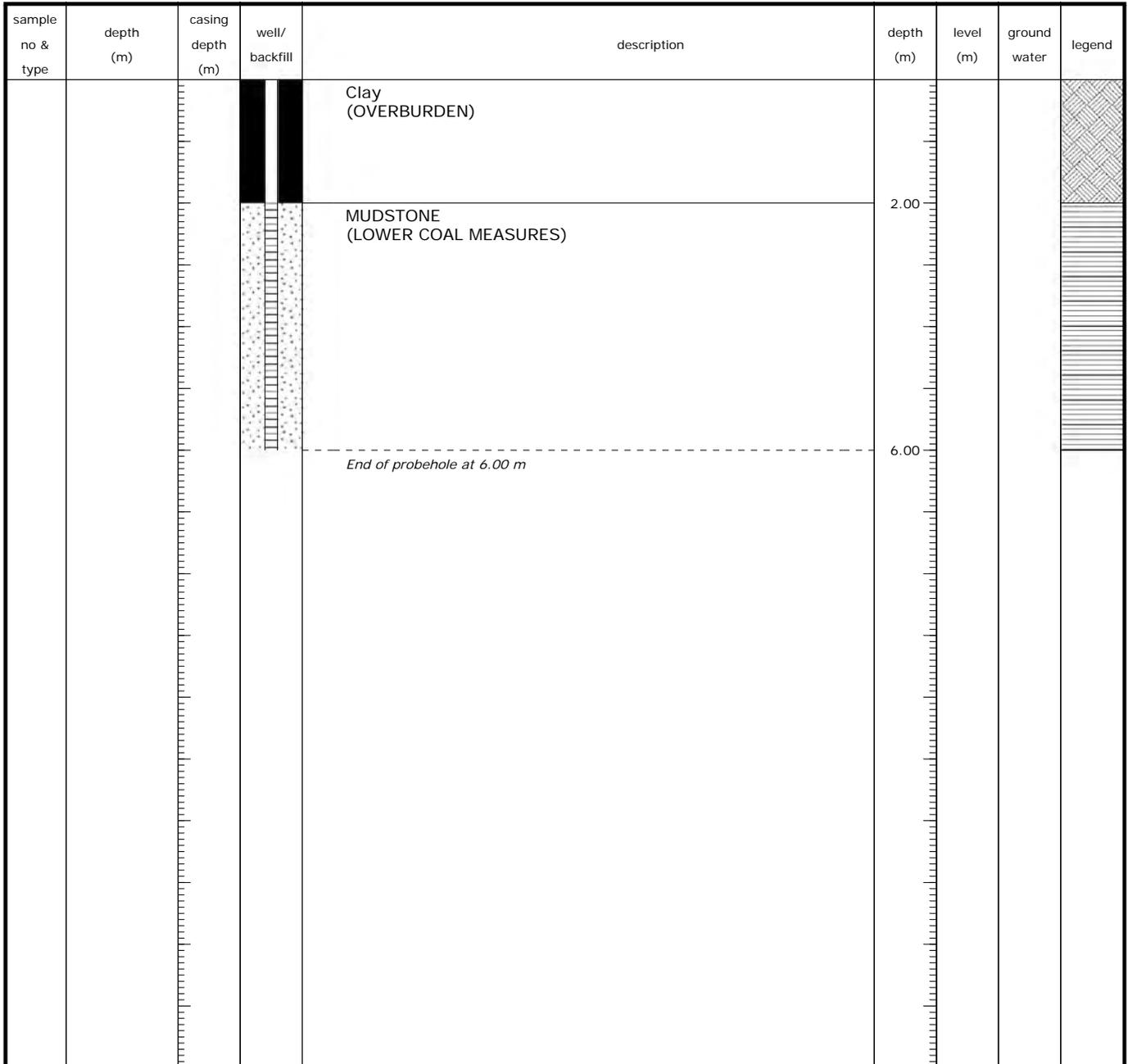
CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH7A**

DATE 09/01/2014 to 09/01/2014  
 Co-ords -  
 Ground Level -

Sheet 1 of 1  
 Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Gas/groundwater monitoring well installed on completion.

Equipment/Methods  
 Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
 ASw

JOB  
 1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH8**

DATE 09/01/2014 to  
09/01/2014

Co-ords 441815E 382623N  
Ground Level 86.2mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.40	84.80		

*Continued on next sheet*

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH8**

DATE 09/01/2014 to  
09/01/2014

Co-ords 441815E 382623N  
Ground Level 86.2mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				
				COAL (SITWELL COAL)	18.90	67.30		
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	19.50	66.70		
				<i>End of probehole at 30.00 m</i>	30.00	56.20		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



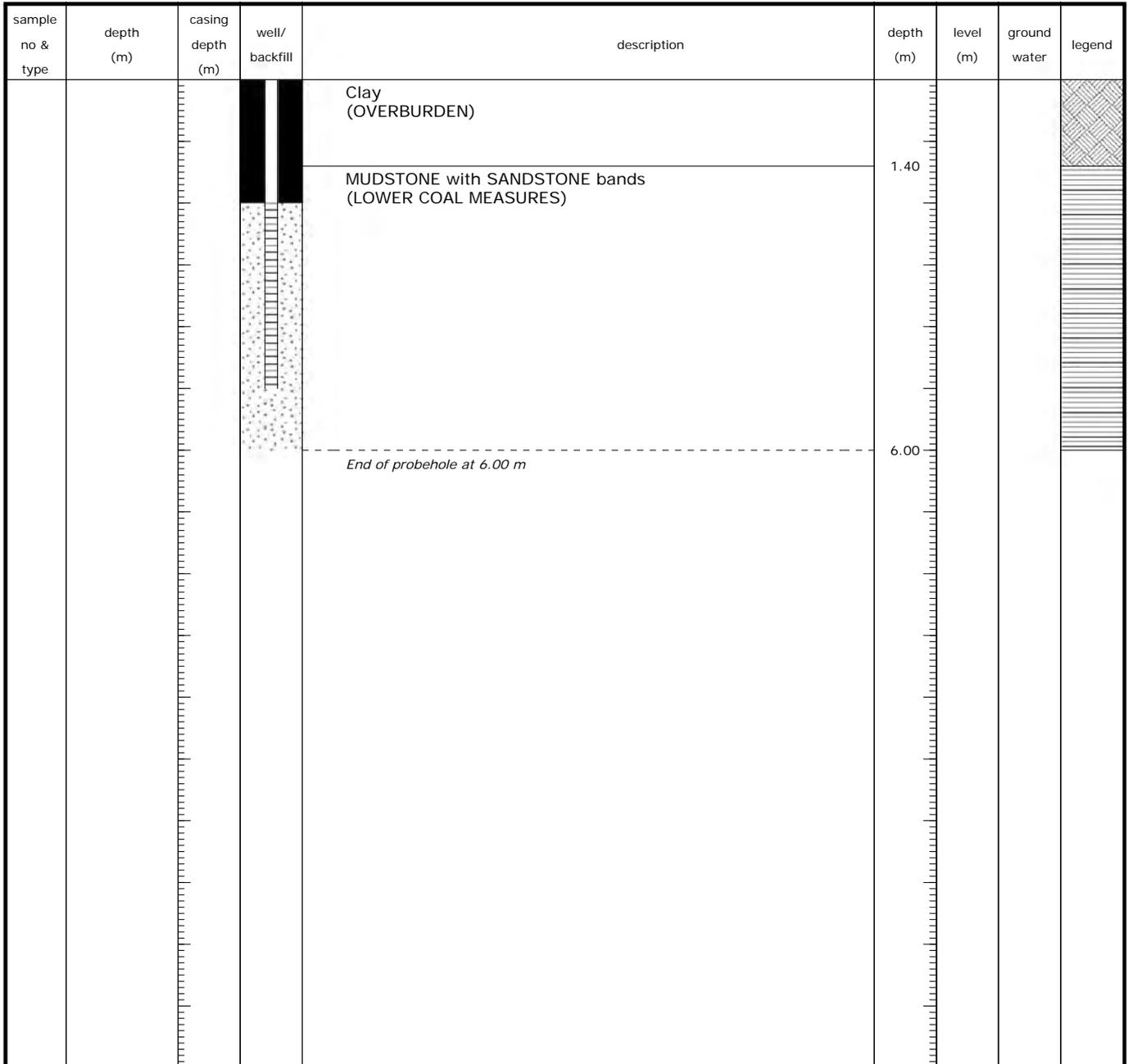
CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH8A**

DATE 09/01/2014 to 09/01/2014 Co-ords - Ground Level -

Sheet 1 of 1  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Gas/groundwater monitoring well installed on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

PH9

DATE 09/01/2014 to  
09/01/2014

Co-ords 441875E 382625N  
Ground Level 82.6mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.70	80.85		

*Continued on next sheet*

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

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JOB  
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FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

PH9

DATE 09/01/2014 to  
09/01/2014

Co-ords 441875E 382625N  
Ground Level 82.6mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				
				COAL (SITWELL COAL)	19.80	62.75		
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	20.40	62.15		
				End of probehole at 30.00 m	30.00	52.55		

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

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ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



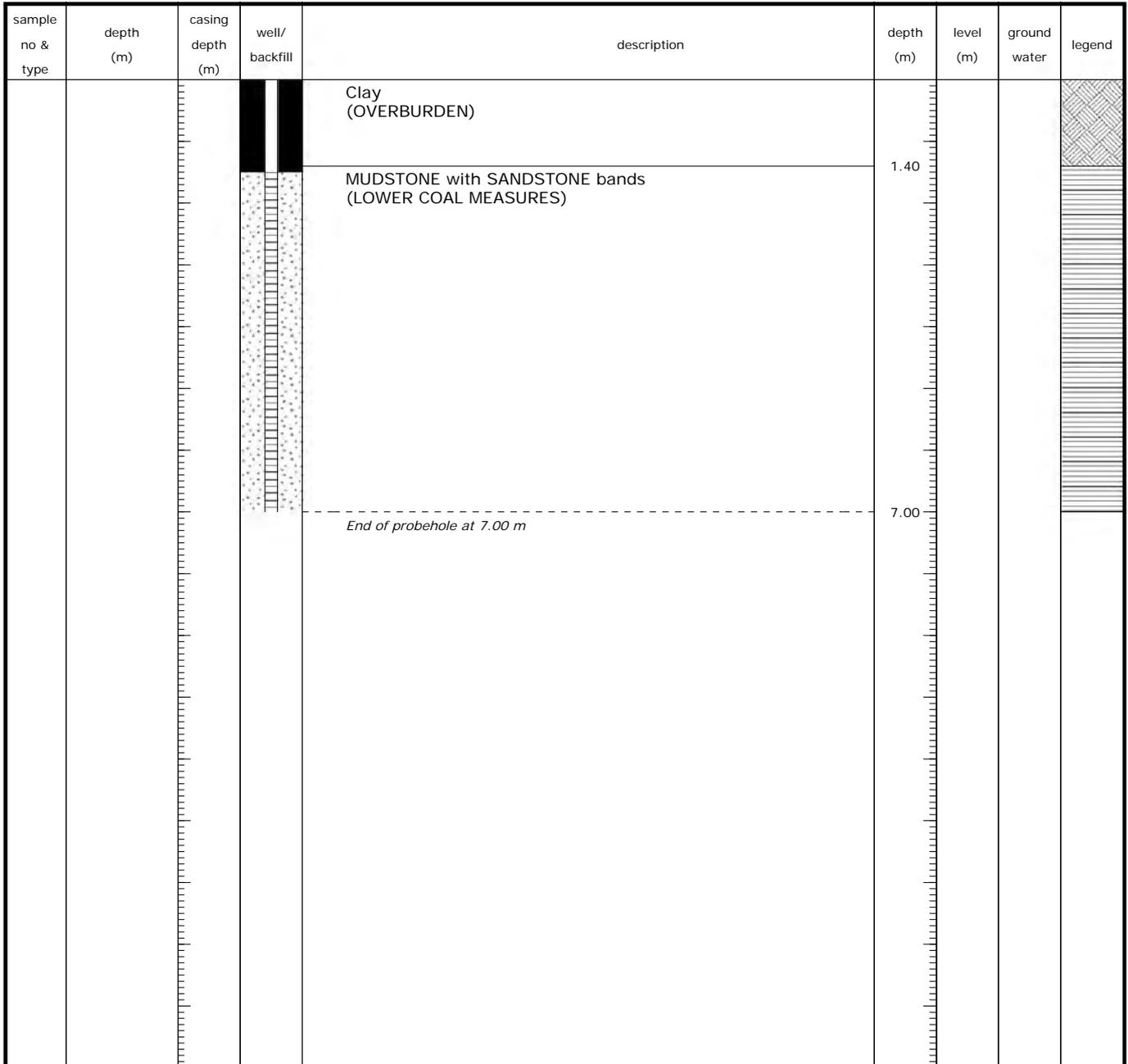
CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH9A**

DATE 09/01/2014 to 09/01/2014 Co-ords - Ground Level -

Sheet 1 of 1  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Gas/groundwater monitoring well installed on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH10**

DATE 09/01/2014 to  
09/01/2014

Co-ords 441918E 382683N  
Ground Level 79.7mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.60	78.10		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

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FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH10**

DATE 09/01/2014 to  
09/01/2014

Co-ords 441918E 382683N  
Ground Level 79.7mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				
				COAL (SITWELL COAL)	20.70	59.00		
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	21.20	58.50		
				End of probehole at 30.00 m	30.00	49.70		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

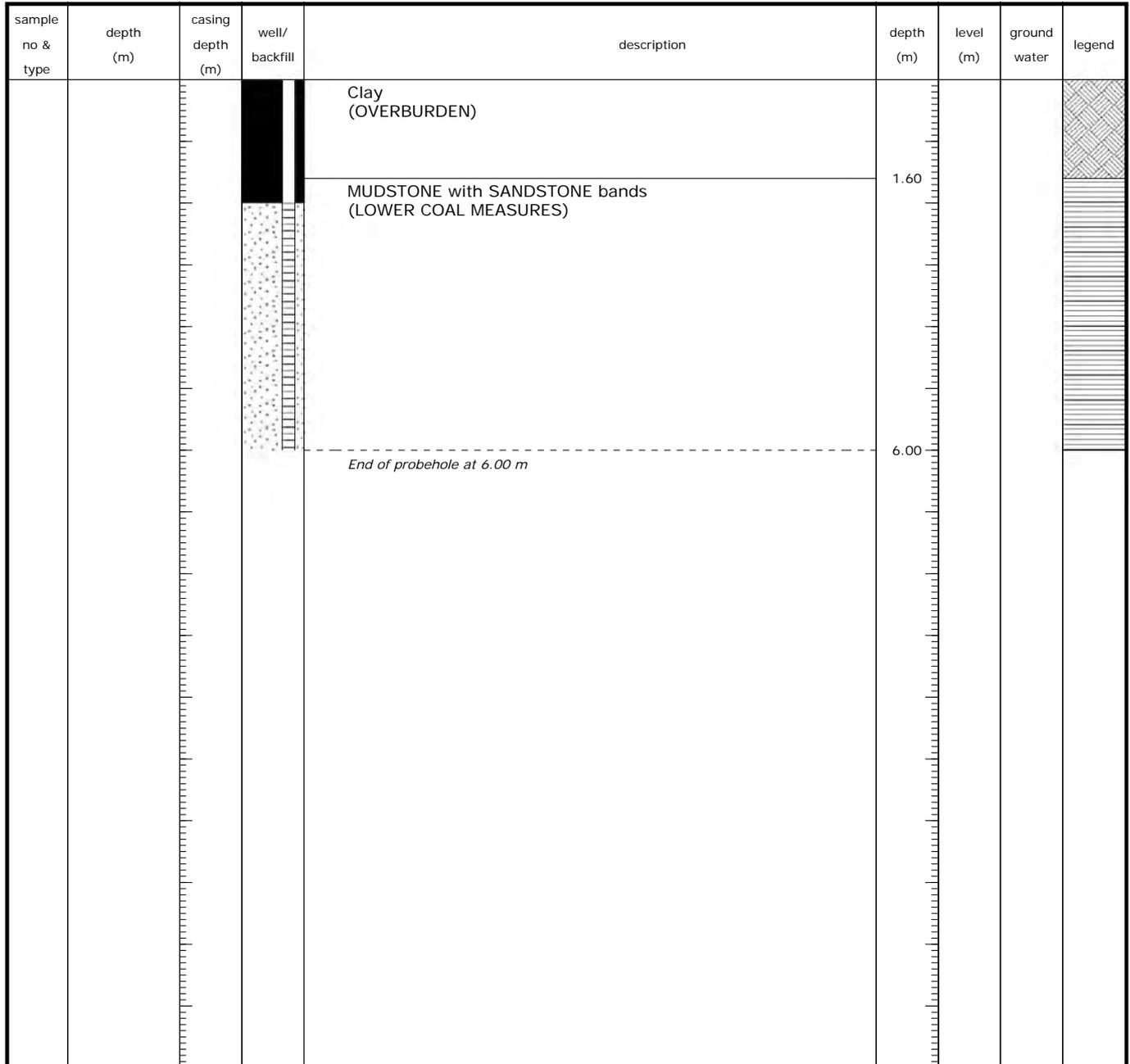
SITE Moorthorpe Way, Owlthorpe

**PH10A**

DATE 09/01/2014 to 09/01/2014 Co-ords - Ground Level -

Sheet 1 of 1

Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Gas/groundwater monitoring well installed on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

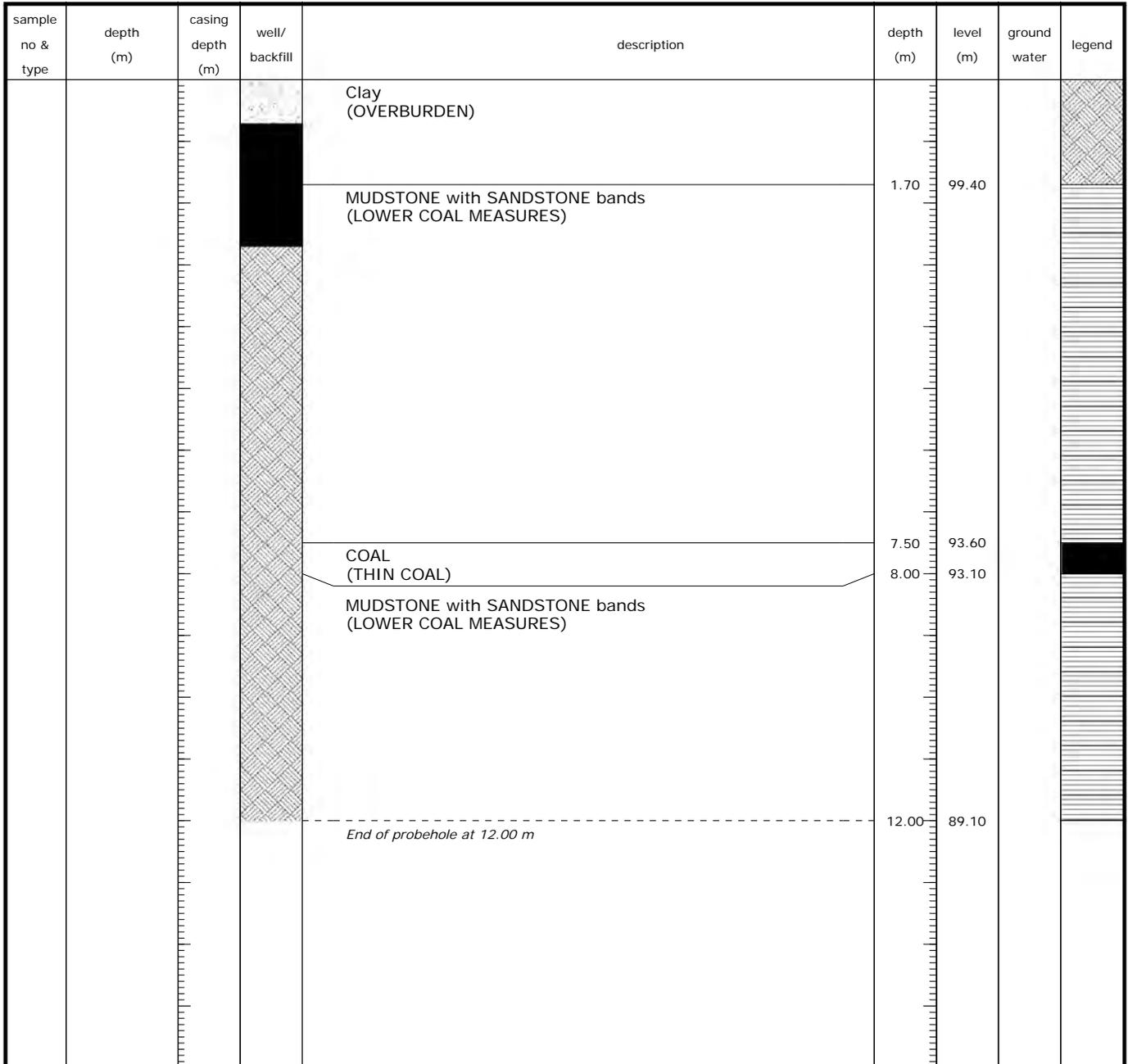
SITE Moorthorpe Way, Owlthorpe

**PH11**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441558E 382586N  
Ground Level 101.1mAOD

Sheet 1 of 1  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

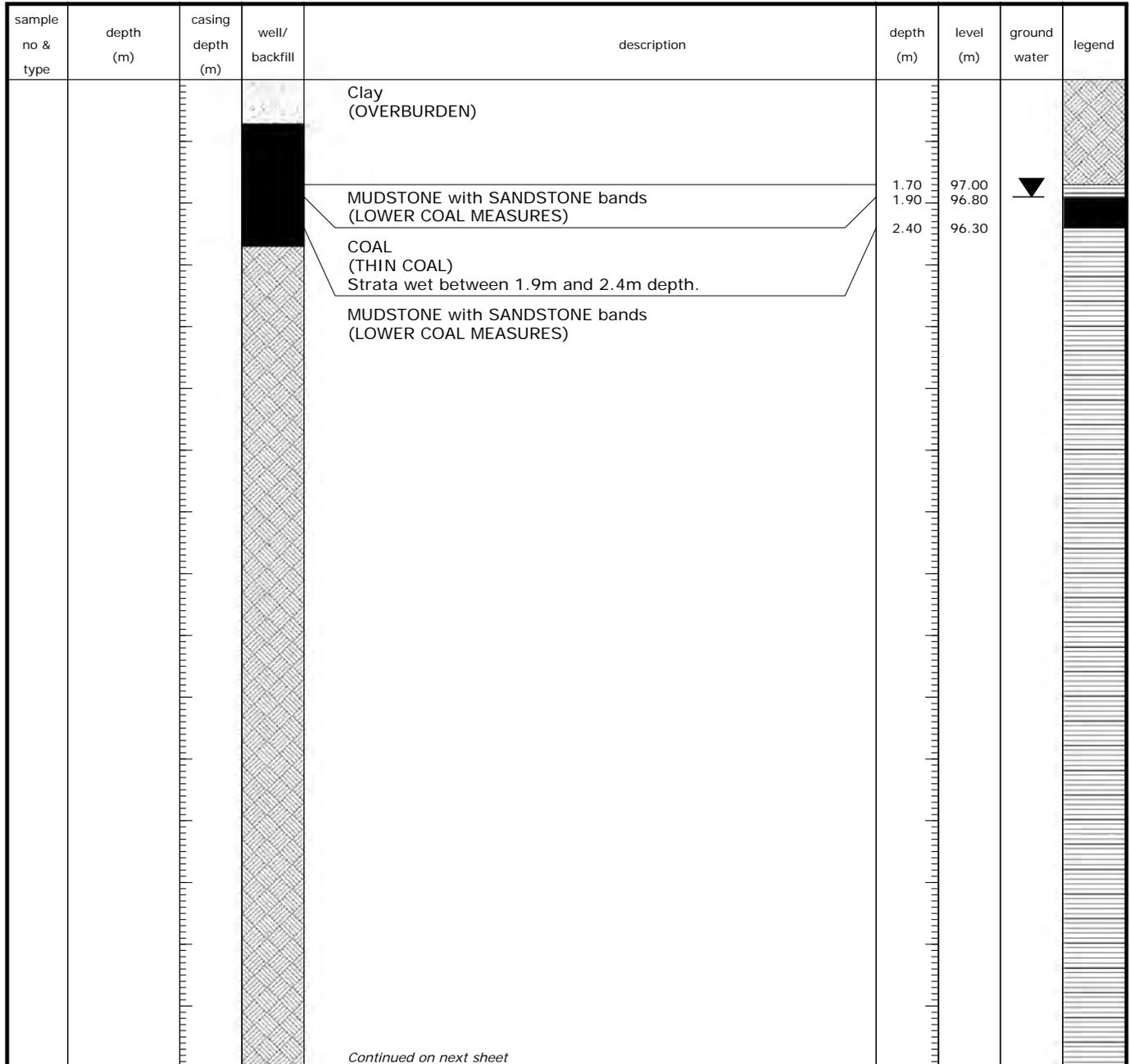
SITE Moorthorpe Way, Owlthorpe

**PH12**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441517E 382626N  
Ground Level 98.7mAOD

Sheet 1 of 2  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater noted between 1.9m and 2.4m during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH12**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441517E 382626N  
Ground Level 98.7mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
			well/backfill	MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				legend
				----- <i>End of probehole at 21.00 m</i>	21.00	77.70		
<p>Remarks</p> <ol style="list-style-type: none"> <li>Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.</li> <li>Groundwater noted between 1.9m and 2.4m during drilling.</li> <li>Probehole backfilled on completion.</li> </ol>								
<p>Equipment/Methods Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.</p>					<p>Logged by ASw</p>		<p>JOB 1792</p>	<p>FIGURE</p>

# PROBEHOLE LOG



CLIENT Kier Services

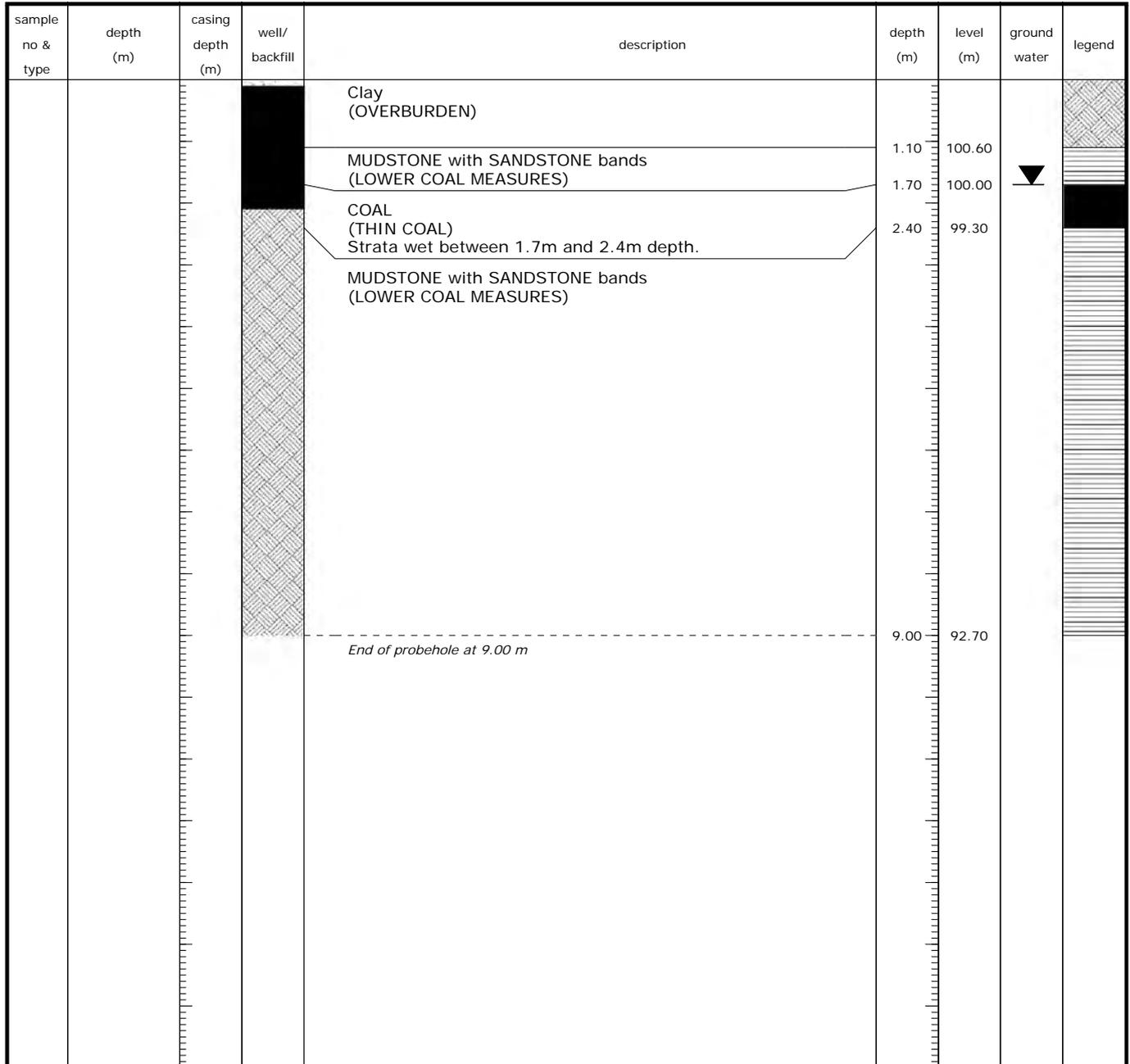
SITE Moorthorpe Way, Owlthorpe

**PH13**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441491E 382601N  
Ground Level 101.7m AOD

Sheet 1 of 1  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater noted between 1.7m and 2.4m during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASW

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

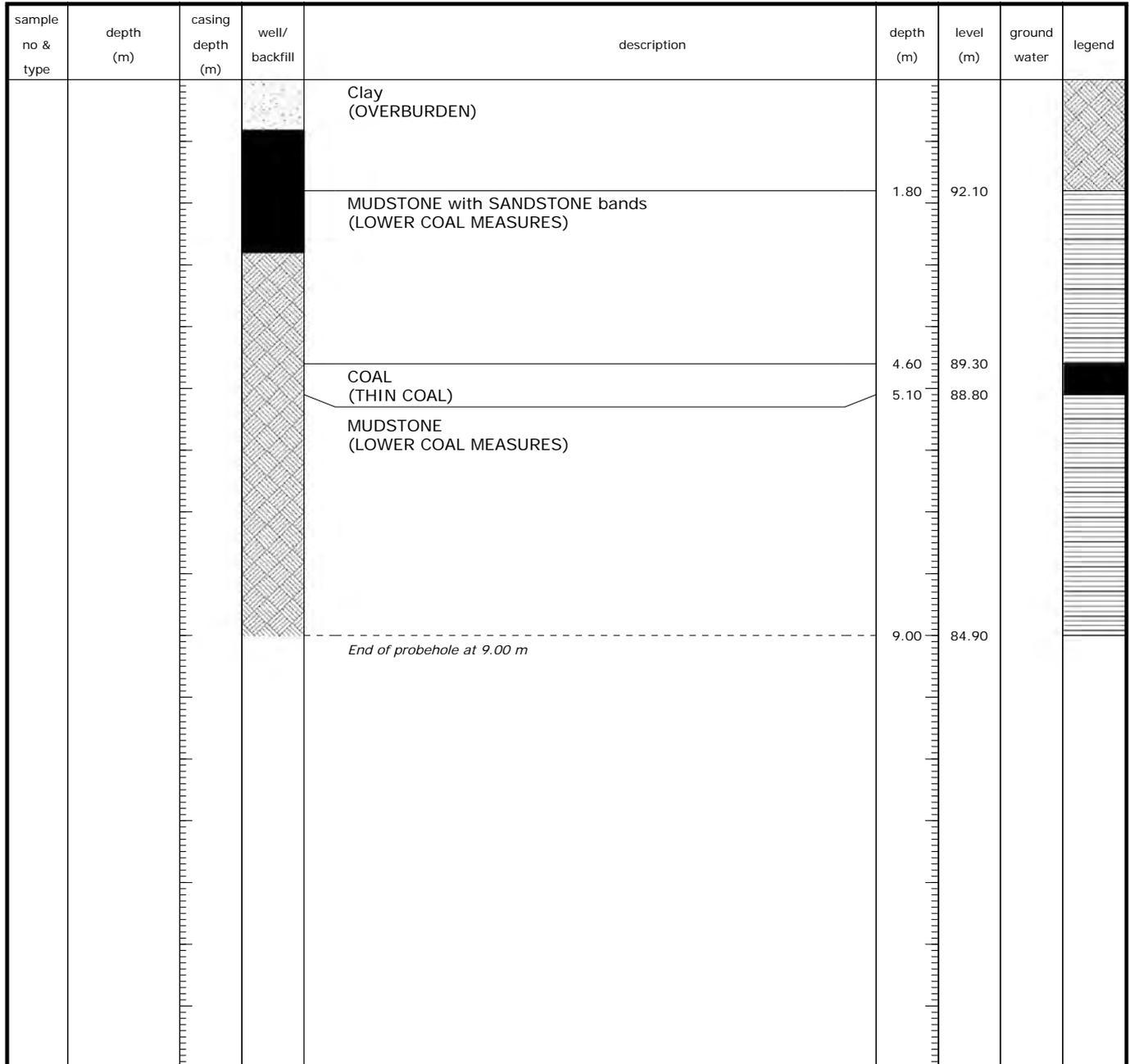
SITE Moorthorpe Way, Owlthorpe

**PH14**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441586E 382686N  
Ground Level 93.9mAOD

Sheet 1 of 1  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

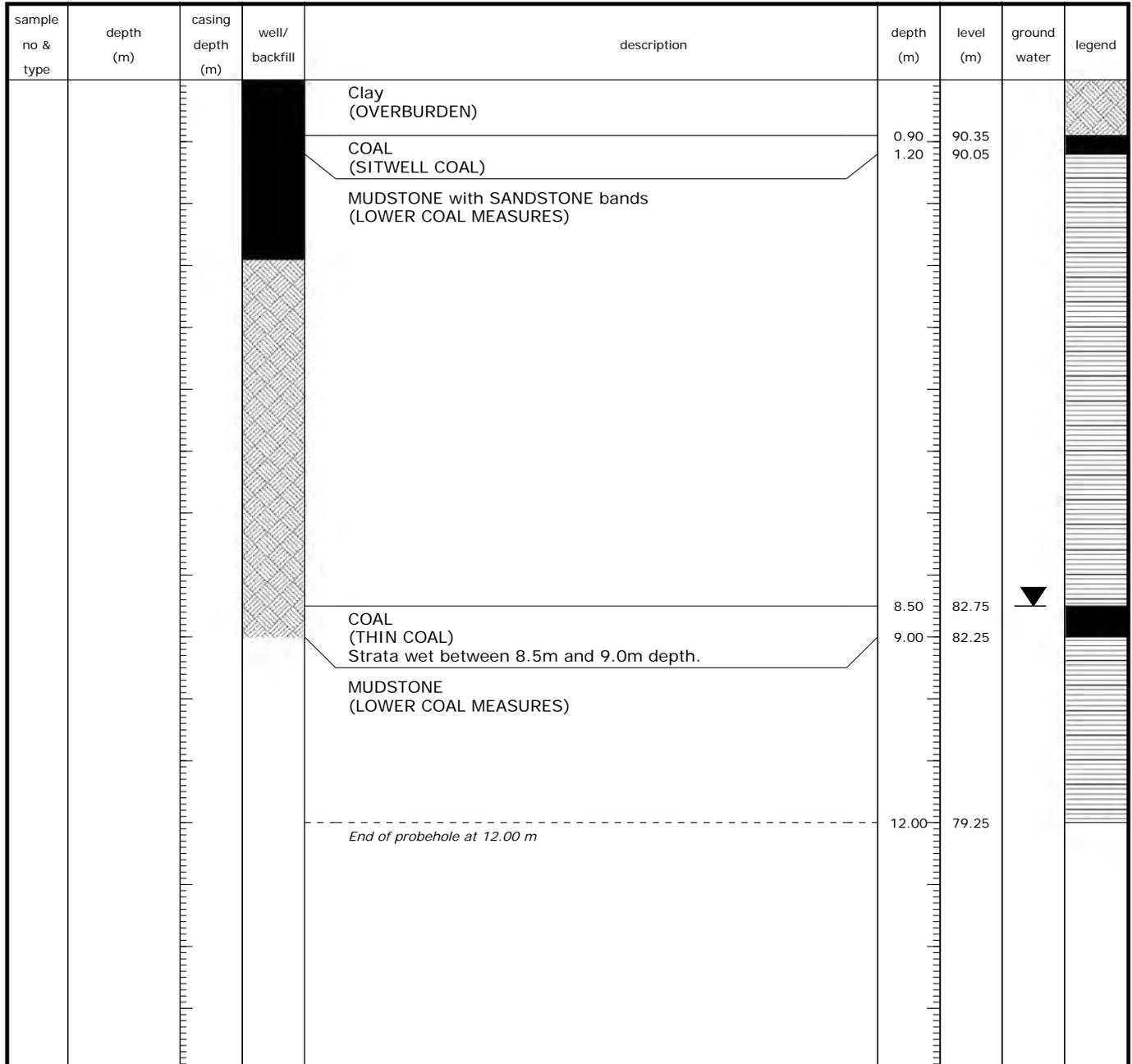
SITE Moorthorpe Way, Owlthorpe

**PH15**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441639E 382720N  
Ground Level 91.3mAOD

Sheet 1 of 1  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater noted between 8.5m and 9.0m during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH16**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441705E 382721N  
Ground Level 90.5mAOD

Sheet 1 of 1  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.10	89.35		
				COAL (SITWELL COAL)	5.00	85.45		
				MUDSTONE (LOWER COAL MEASURES)	5.50	84.95		
				COAL (THIN COAL)	13.20	77.25		
				MUDSTONE (LOWER COAL MEASURES)	13.80	76.65		
				<i>End of probehole at 15.00 m</i>	15.00	75.45		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH17**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441685E 382674N  
Ground Level 92.5m AOD

Sheet 1 of 1  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	2.00	90.45		
				COAL (THIN COAL)	13.00	79.45		
				MUDSTONE (LOWER COAL MEASURES)	13.80	78.65		
				<i>End of probehole at 15.00 m</i>	15.00	77.45		

**Remarks**

- Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
- Groundwater was not apparent during drilling.
- Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

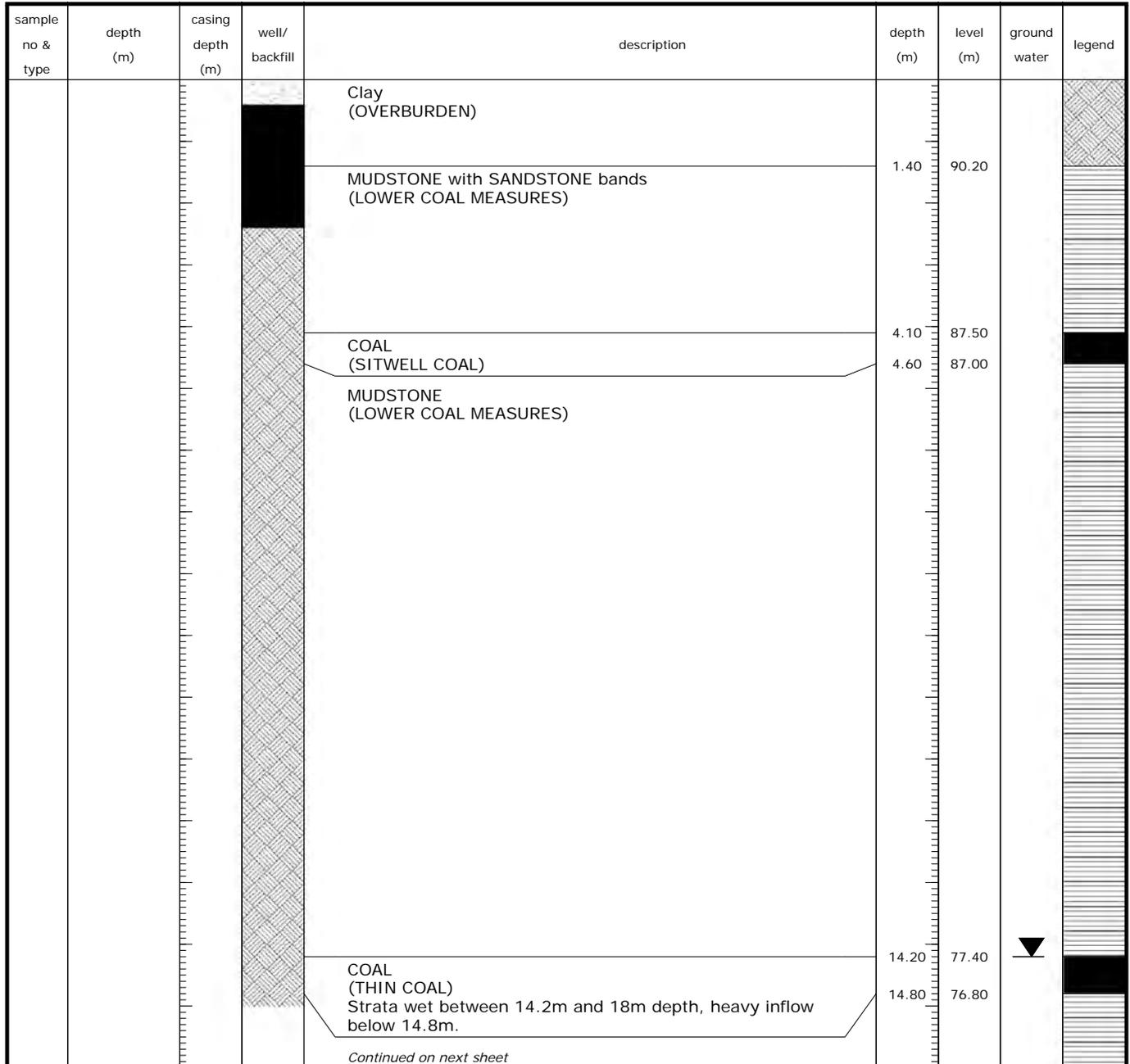
SITE Moorthorpe Way, Owlthorpe

**PH18**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441714E 382675N  
Ground Level 91.6mAOD

Sheet 1 of 2  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater noted between 14.2m and 21m during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

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FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH18**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441714E 382675N  
Ground Level 91.6mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/ backfill	description	depth (m)	level (m)	ground water	legend
				MUDSTONE (LOWER COAL MEASURES)				
				----- <i>End of probehole at 18.00 m</i>	18.00	73.60		
<p>Remarks</p> <ol style="list-style-type: none"> <li>Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.</li> <li>Groundwater noted between 14.2m and 21m during drilling.</li> <li>Probehole backfilled on completion.</li> </ol>								
<p>Equipment/Methods Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.</p>					<p>Logged by ASw</p>	<p>JOB 1792</p>	<p>FIGURE</p>	

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH19**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441734E 382649N  
Ground Level 90.9mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.80	89.05		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH19**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441734E 382649N  
Ground Level 90.9mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
			well/backfill	MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				
				COAL (THIN COAL)	17.00	73.85		
				MUDSTONE (LOWER COAL MEASURES)	17.60	73.25		
				End of probehole at 21.00 m	21.00	69.85		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH20**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441752E 382686N  
Ground Level 88.9mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.80	87.05		
				COAL (SITWELL COAL)	8.10	80.75		
				MUDSTONE (LOWER COAL MEASURES)	8.70	80.15		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater noted between 17.3m and 17.9m during drilling.
3. Probehole backfilled on completion.

**Equipment/Methods**

Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

PH20

DATE 13/03/2014 to  
13/03/2014

Co-ords 441752E 382686N  
Ground Level 88.9mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/ backfill	description	depth (m)	level (m)	ground water	legend
				MUDSTONE (LOWER COAL MEASURES)				
				COAL (THIN COAL) Strata wet between 17.3m and 17.9m depth.	17.30 17.90	71.55 70.95	▼	
				MUDSTONE (LOWER COAL MEASURES)				
				End of probehole at 21.00 m	21.00	67.85		
<p>Remarks</p> <ol style="list-style-type: none"> <li>Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.</li> <li>Groundwater noted between 17.3m and 17.9m during drilling.</li> <li>Probehole backfilled on completion.</li> </ol>								
<p>Equipment/Methods Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.</p>					<p>Logged by ASw</p>		<p>JOB 1792</p>	<p>FIGURE</p>

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH21**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441765E 382706N  
Ground Level 87.5m AOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.70	85.80		
				COAL (SITWELL COAL)	9.10	78.40		
				MUDSTONE (LOWER COAL MEASURES)	9.80	77.70		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater noted between 17.5m and 18.1m during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH21**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441765E 382706N  
Ground Level 87.5mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/ backfill	description	depth (m)	level (m)	ground water	legend
				MUDSTONE (LOWER COAL MEASURES)				
				COAL (THIN COAL) Strata wet between 17.5m and 18.1m depth.	17.50 18.10	70.00 69.40	▼	
				MUDSTONE (LOWER COAL MEASURES)				
				End of probehole at 21.00 m	21.00	66.50		
<p>Remarks</p> <ol style="list-style-type: none"> <li>Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.</li> <li>Groundwater noted between 17.5m and 18.1m during drilling.</li> <li>Probehole backfilled on completion.</li> </ol>								
<p>Equipment/Methods Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.</p>					<p>Logged by ASw</p>		<p>JOB 1792</p>	<p>FIGURE</p>

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH22**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441773E 382727N  
Ground Level 87.1mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.30	85.80		
				COAL (SITWELL COAL)	9.00	78.10		
				MUDSTONE (LOWER COAL MEASURES)	9.60	77.50		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater noted between 16.8m and 17.4m during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

PH22

DATE 13/03/2014 to  
13/03/2014

Co-ords 441773E 382727N  
Ground Level 87.1mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend	
			well/backfill	MUDSTONE (LOWER COAL MEASURES)			▼		
				COAL (THIN COAL) Strata wet between 16.8m and 17.4m depth.	16.80 17.40	70.30 69.70			
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)					
				----- End of probehole at 21.00 m	21.00	66.10			

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater noted between 16.8m and 17.4m during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH23**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441810E 382672N  
Ground Level 85.3mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.60	83.70		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH23**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441810E 382672N  
Ground Level 85.3mAOD

Sheet 2 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)				
				COAL (THIN COAL)	18.80	66.50		
				MUDSTONE (LOWER COAL MEASURES)	19.40	65.90		
				<i>End of probehole at 21.00 m</i>	21.00	64.30		

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
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JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH24**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441874E 382642N  
Ground Level 82.0mAOD

Sheet 1 of 2  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/ backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.80	80.15		
<i>Continued on next sheet</i>								

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Heavy groundwater inflow noted from 20.5m during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

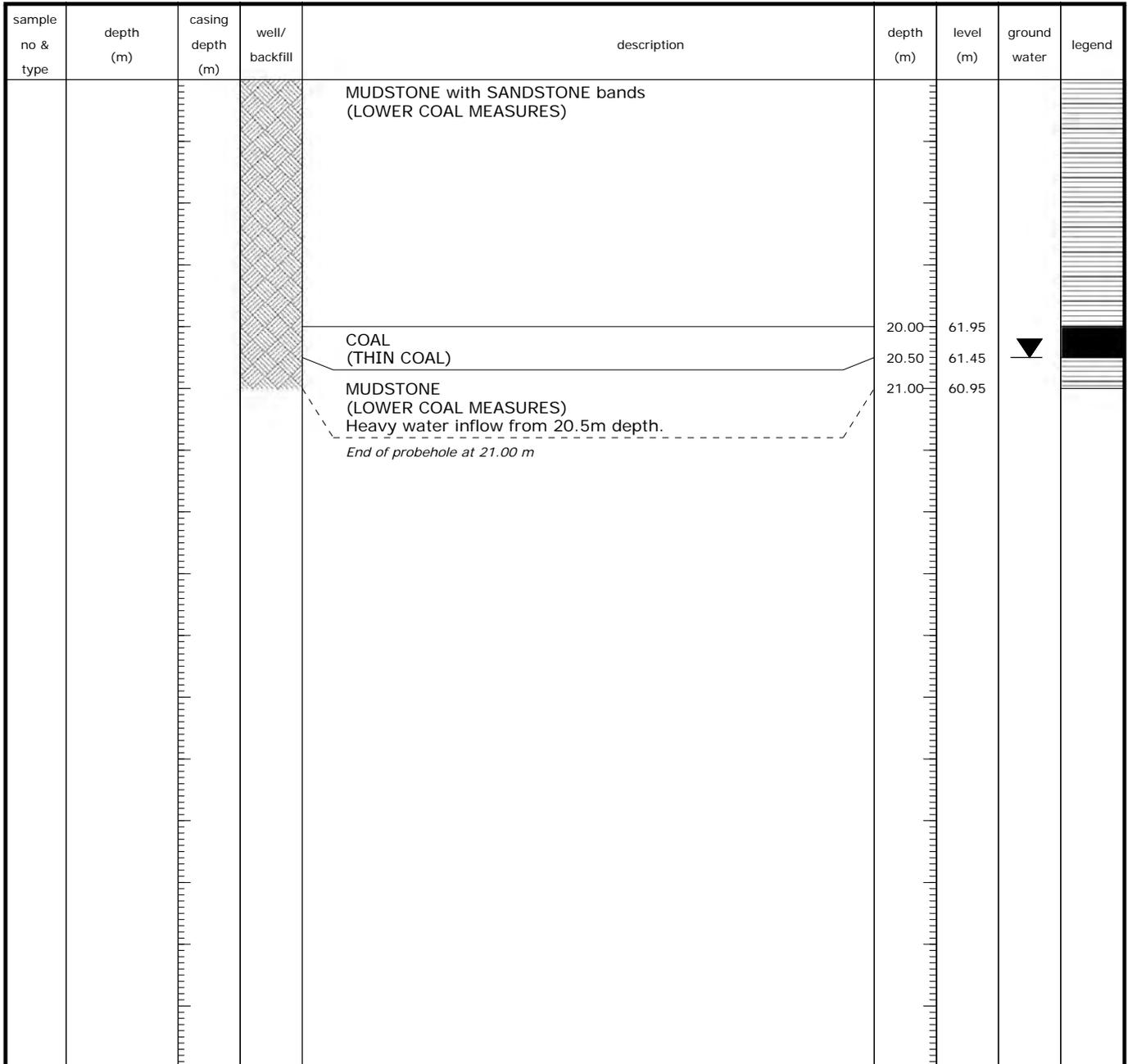
SITE Moorthorpe Way, Owlthorpe

**PH24**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441874E 382642N  
Ground Level 82.0mAOD

Sheet 2 of 2  
Scale 1:100



**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Heavy groundwater inflow noted from 20.5m during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

# PROBEHOLE LOG



CLIENT Kier Services

SITE Moorthorpe Way, Owlthorpe

**PH25**

DATE 13/03/2014 to  
13/03/2014

Co-ords 441758E 382588N  
Ground Level 90.7m AOD

Sheet 1 of 1  
Scale 1:100

sample no & type	depth (m)	casing depth (m)	well/backfill	description	depth (m)	level (m)	ground water	legend
				Clay (OVERBURDEN)				
				MUDSTONE with SANDSTONE bands (LOWER COAL MEASURES)	1.80	88.90		
					15.00	75.70		
				<i>End of probehole at 15.00 m</i>				

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.
3. Probehole backfilled on completion.

Equipment/Methods  
Casagrande C6 tracked drilling rig equipped with 100mm tri-cone bit and air flush.

Logged by  
ASw

JOB  
1792

FIGURE

**APPENDIX H  
CHEMICAL TEST RESULTS**



# Scientific Analysis Laboratories Ltd

## Certificate of Analysis

Hadfield House  
Hadfield Street  
Cornbrook  
Manchester  
M16 9FE  
Tel : 0161 874 2400  
Fax : 0161 874 2468

Scientific Analysis Laboratories is a  
limited company registered in England and  
Wales (No 2514788) whose address is at  
Hadfield House, Hadfield Street, Manchester M16 9FE

**Report Number:** 369031-1

**Date of Report:** 09-Jan-2014

**Customer:** Lithos Consulting Ltd.  
45 High Street  
South Milford  
Leeds  
LS25 5AF

**Customer Contact:** Mr Alan Swales

**Customer Job Reference:** PO7822/1792/ASw  
**Customer Purchase Order:** PO7822/1792/ASw  
**Customer Site Reference:** Moorthorpe Way, Owithorpe  
**Date Job Received at SAL:** 20-Dec-2013  
**Date Analysis Started:** 03-Jan-2014  
**Date Analysis Completed:** 09-Jan-2014

The results reported relate to samples received in the laboratory  
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation  
This report should not be reproduced except in full without the written approval of the laboratory  
Tests covered by this certificate were conducted in accordance with SAL SOPs  
All results have been reviewed in accordance with QP22



Report checked  
and authorised by :  
Chris Murphy  
Project Manager

Issued by :  
Chris Murphy  
Project Manager

<b>SAL Reference:</b> 369031 <b>Project Site:</b> Moorhorpe Way, Owithorpe <b>Customer Reference:</b> PO7822/1792/ASw  <b>Soil</b> Analysed as Soil <b>MCERTS Preparation</b>									
<b>SAL Reference</b>					369031 001	369031 002	369031 004	369031 005	369031 007
<b>Customer Sample Reference</b>					TP29 0.6	TP30 0.5	TP04 0.1	TP06 0.1	TP09 0.1
<b>Date Sampled</b>					17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013
<b>Depth</b>					0.6	0.5	0.1	0.1	0.1
<b>End Date Sampled</b>					18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013
<b>Type</b>					Topsoil	Topsoil	Topsoil	Topsoil	Topsoil
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>					
Moisture	T277	AR	0.1	%	17	28	29	23	23
Moisture @ 105 C	T162	AR	0.1	%	23	31	29	24	24

<b>SAL Reference:</b> 369031 <b>Project Site:</b> Moorhorpe Way, Owithorpe <b>Customer Reference:</b> PO7822/1792/ASw  <b>Soil</b> Analysed as Soil <b>MCERTS Preparation</b>									
<b>SAL Reference</b>					369031 008	369031 010	369031 012	369031 014	369031 016
<b>Customer Sample Reference</b>					TP10 0.1	TP13 0.1	TP16 0.1	TP18 0.1	TP21 0.1
<b>Date Sampled</b>					17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013
<b>Depth</b>					0.1	0.1	0.1	0.1	0.1
<b>End Date Sampled</b>					18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013
<b>Type</b>					Topsoil	Topsoil	Topsoil	Topsoil	Topsoil
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>					
Moisture	T277	AR	0.1	%	19	20	17	20	16
Moisture @ 105 C	T162	AR	0.1	%	20	24	14	19	17

<b>SAL Reference:</b> 369031 <b>Project Site:</b> Moorhorpe Way, Owithorpe <b>Customer Reference:</b> PO7822/1792/ASw  <b>Soil</b> Analysed as Soil <b>MCERTS Preparation</b>									
<b>SAL Reference</b>					369031 019	369031 020			
<b>Customer Sample Reference</b>					TP25 0.1	TP27 1.0			
<b>Date Sampled</b>					17-DEC-2013	17-DEC-2013			
<b>Depth</b>					0.1	1.0			
<b>End Date Sampled</b>					18-DEC-2013	18-DEC-2013			
<b>Type</b>					Topsoil	Topsoil			
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>					
Moisture	T277	AR	0.1	%	15	18			
Moisture @ 105 C	T162	AR	0.1	%	5.9	19			



<b>SAL Reference:</b> 369031										
<b>Project Site:</b> Moorhorpe Way, Owithorpe										
<b>Customer Reference:</b> PO7822/1792/ASw										
<b>Soil</b> Analysed as Soil										
<b>Miscellaneous</b>										
<b>SAL Reference</b>		369031 001	369031 002	369031 004	369031 005	369031 007	369031 008			
<b>Customer Sample Reference</b>		TP29 0.6	TP30 0.5	TP04 0.1	TP06 0.1	TP09 0.1	TP10 0.1			
<b>Date Sampled</b>		17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013			
<b>Depth</b>		0.6	0.5	0.1	0.1	0.1	0.1			
<b>End Date Sampled</b>		18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013			
<b>Type</b>		Topsoil	Topsoil	Topsoil	Topsoil	Topsoil	Topsoil			
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>						
Asbestos ID	T27	AR			N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Retained on 10mm sieve	T2	M40	0.1	%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic Carbon	T21	M40	0.1	%	9.7	19	4.4	2.7	1.7	3.0

<b>SAL Reference:</b> 369031										
<b>Project Site:</b> Moorhorpe Way, Owithorpe										
<b>Customer Reference:</b> PO7822/1792/ASw										
<b>Soil</b> Analysed as Soil										
<b>Miscellaneous</b>										
<b>SAL Reference</b>		369031 010	369031 012	369031 014	369031 016	369031 019	369031 020			
<b>Customer Sample Reference</b>		TP13 0.1	TP16 0.1	TP18 0.1	TP21 0.1	TP25 0.1	TP27 1.0			
<b>Date Sampled</b>		17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013	17-DEC-2013			
<b>Depth</b>		0.1	0.1	0.1	0.1	0.1	1.0			
<b>End Date Sampled</b>		18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013	18-DEC-2013			
<b>Type</b>		Topsoil	Topsoil	Topsoil	Topsoil	Topsoil	Topsoil			
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>						
Asbestos ID	T27	AR			N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Retained on 10mm sieve	T2	M40	0.1	%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic Carbon	T21	M40	0.1	%	2.4	1.7	3.6	2.5	1.4	2.2

<b>SAL Reference:</b> 369031										
<b>Project Site:</b> Moorhorpe Way, Owithorpe										
<b>Customer Reference:</b> PO7822/1792/ASw										
<b>Soil</b> Analysed as Soil										
<b>Lithos BRE suite</b>										
<b>SAL Reference</b>		369031 001	369031 002							
<b>Customer Sample Reference</b>		TP29 0.6	TP30 0.5							
<b>Date Sampled</b>		17-DEC-2013	17-DEC-2013							
<b>Depth</b>		0.6	0.5							
<b>End Date Sampled</b>		18-DEC-2013	18-DEC-2013							
<b>Type</b>		Topsoil	Topsoil							
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>						
(Water soluble) Cl-	T426	AR	0.01	g/l	<0.01	<0.01				
(Water soluble) Mg	T251	AR	0.1	g/l	<0.1	<0.1				
(Water soluble) NO3	T426	AR	0.01	g/l	<0.01	<0.01				
(Water Soluble) SO4 expressed as SO4	T242	AR	0.01	g/l	<0.01	<0.01				

SAL Reference: 369031													
Project Site: Moorhorpe Way, Owithorpe													
Customer Reference: PO7822/1792/ASw													
Soil													
Analysed as Soil													
Lithos Speciated PAH													
SAL Reference		369031 001		369031 002		369031 004		369031 005		369031 007		369031 008	
Customer Sample Reference		TP29 0.6		TP30 0.5		TP04 0.1		TP06 0.1		TP09 0.1		TP10 0.1	
Date Sampled		17-DEC-2013		17-DEC-2013		17-DEC-2013		17-DEC-2013		17-DEC-2013		17-DEC-2013	
Depth		0.6		0.5		0.1		0.1		0.1		0.1	
End Date Sampled		18-DEC-2013		18-DEC-2013		18-DEC-2013		18-DEC-2013		18-DEC-2013		18-DEC-2013	
Type		Topsoil		Topsoil		Topsoil		Topsoil		Topsoil		Topsoil	
Determinand	Method	Test Sample	LOD	Units									
Naphthalene	T207	M105	0.1	mg/kg	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	T207	M105	0.1	mg/kg	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	T207	M105	0.1	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	T207	M105	0.1	mg/kg	1.2	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Pyrene	T207	M105	0.1	mg/kg	1.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	T207	M105	0.1	mg/kg	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH(total)	T207	M105	0.1	mg/kg	6.3	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1

SAL Reference: 369031													
Project Site: Moorhorpe Way, Owithorpe													
Customer Reference: PO7822/1792/ASw													
Soil													
Analysed as Soil													
Lithos Speciated PAH													
SAL Reference		369031 010		369031 012		369031 014		369031 016		369031 019		369031 020	
Customer Sample Reference		TP13 0.1		TP16 0.1		TP18 0.1		TP21 0.1		TP25 0.1		TP27 1.0	
Date Sampled		17-DEC-2013		17-DEC-2013		17-DEC-2013		17-DEC-2013		17-DEC-2013		17-DEC-2013	
Depth		0.1		0.1		0.1		0.1		0.1		1.0	
End Date Sampled		18-DEC-2013		18-DEC-2013		18-DEC-2013		18-DEC-2013		18-DEC-2013		18-DEC-2013	
Type		Topsoil		Topsoil		Topsoil		Topsoil		Topsoil		Topsoil	
Determinand	Method	Test Sample	LOD	Units									
Naphthalene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1
Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH(total)	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1

## Index to symbols used in 369031-1

Value	Description
M40	Analysis conducted on sample assisted dried at no more than 40C. Results are reported on a dry weight basis.
M105	Analysis conducted on an "as received" aliquot. Results are reported on a dry weight basis where moisture content was determined by assisted drying of sample at 105C
AR	As Received
N.D.	Not Detected
S	Analysis was subcontracted
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

## Notes

Asbestos is subcontracted to REC Asbestos

## Method Index

Value	Description
T426	2:1 Extraction / IC
T2	Grav
T6	ICP/OES
T7	Probe
T85	Calc
T162	Grav (1 Dec) (105 C)
T277	Grav (1 Dec) (40 C)
T21	OX/IR
T207	GC/MS (MCERTS)
T27	PLM
T251	2:1 Extraction/ICP/OES
T242	2:1 Extraction/ICP/OES (TRL 447 T1)

## Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Asbestos ID	T27	AR			SU	001-002,004-005,007-008,010,012,014,016,019-020
Retained on 10mm sieve	T2	M40	0.1	%	N	001-002,004-005,007-008,010,012,014,016,019-020
Total Organic Carbon	T21	M40	0.1	%	N	001-002,004-005,007-008,010,012,014,016,019-020
(Water soluble) Cl-	T426	AR	0.01	g/l	N	001-002
(Water soluble) Mg	T251	AR	0.1	g/l	N	001-002
(Water soluble) NO3	T426	AR	0.01	g/l	N	001-002
(Water Soluble) SO4 expressed as SO4	T242	AR	0.01	g/l	N	001-002
Naphthalene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Acenaphthylene	T207	M105	0.1	mg/kg	U	001-002,004-005,007-008,010,012,014,016,019-020
Acenaphthene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Fluorene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Phenanthrene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Anthracene	T207	M105	0.1	mg/kg	U	001-002,004-005,007-008,010,012,014,016,019-020
Fluoranthene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Pyrene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Chrysene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
PAH(total)	T207	M105	0.1	mg/kg	U	001-002,004-005,007-008,010,012,014,016,019-020
Arsenic	T6	M40	2	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Boron (water-soluble)	T6	AR	1	mg/kg	N	001-002,004-005,007-008,010,012,014,016,019-020
Cadmium	T6	M40	1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Chromium	T6	M40	1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Chromium (trivalent)	T85	AR	2	mg/kg	N	001-002,004-005,007-008,010,012,014,016,019-020
Chromium VI	T6	AR	1	mg/kg	N	001-002,004-005,007-008,010,012,014,016,019-020
Copper	T6	M40	1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Lead	T6	M40	1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Mercury	T6	M40	1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Nickel	T6	M40	1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
pH	T7	AR			M	001-002,004-005,007-008,010,012,014,016,019-020
Selenium	T6	M40	3	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Zinc	T6	M40	1	mg/kg	M	001-002,004-005,007-008,010,012,014,016,019-020
Moisture	T277	AR	0.1	%	N	001-002,004-005,007-008,010,012,014,016,019-020
Moisture @ 105 C	T162	AR	0.1	%	N	001-002,004-005,007-008,010,012,014,016,019-020



**APPENDIX I**  
**GEOTECHNICAL TEST RESULTS**



# LABORATORY REPORT



4043

**Contract Number: PSL14/0026**

Client's Reference:

Report Date: 16 January 2014

Client Name: Lithos Consulting  
45 High Street  
South Milford  
  
North Yorkshire  
LS25 5AF

**For the attention of: Alan Swales**

Contract Title: Moorthorpoe Way, Owlthorpe

Date Received: 3/1/2014  
Date Commenced: 3/1/2014  
Date Completed: 16/1/2014

**Notes: Observations and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson  
(Director)

A Watkins  
(Director)

  
M Beastall  
(Laboratory Manager)

# SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Depth m	Description of Sample
TP04	2	D	0.80	Brown mottled grey gravelly slightly sandy silty CLAY.
TP06	2	D	0.90	Brown gravelly sandy CLAY.
TP08	2	D	0.30	Brown gravelly sandy silty CLAY.
TP08	2	D	1.10	Brown mottled grey slightly sandy silty CLAY.
TP09	2	D	0.60	Brown mottled grey sandy CLAY.
TP10	2	D	1.00	Brown mottled grey slightly sandy silty CLAY.
TP13	2	D	0.70	Brown mottled grey very gravelly sandy CLAY.
TP15	2	D	1.00	Brown gravelly slightly sandy CLAY.
TP18	2	D	1.00	Brown sandy CLAY.
TP21	2	D	1.00	Brown mottled grey slightly gravelly slightly sandy CLAY.
TP23	2	D	1.30	Light brown slightly gravelly sandy CLAY.
TP24	2	D	0.80	Brown mottled grey slightly gravelly sandy CLAY.

 <b>Professional Soils Laboratory</b>	Compiled by	Date	Checked by	Date	Approved by	Date	
		16/01/14		16/01/14		16/01/14	
	<b>MOORTHORPE WAY, OWLTHORPE.</b>					Contract No:	PSL14/0026
						Client Ref:	1792

# SUMMARY OF SOIL CLASSIFICATION TESTS

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

Hole Number	Sample Number	Sample Type	Depth m	Moisture Content % <small>Clause 3.2</small>	Bulk Density Mg/m <sup>3</sup> <small>Clause 7.2</small>	Dry Density Mg/m <sup>3</sup> <small>Clause 7.2</small>	Particle Density Mg/m <sup>3</sup> <small>Clause 8.2</small>	Liquid Limit % <small>Clause 4.3/4.4</small>	Plastic Limit % <small>Clause 5.3</small>	Plasticity Index % <small>Clause 5.4</small>	% Passing .425mm	Remarks
TP04	2	D	0.80	25				54	24	30	82	High plasticity CH.
TP06	2	D	0.90	17				40	20	20	74	Intermediate plasticity CI.
TP08	2	D	0.30	13				38	20	18	79	Intermediate plasticity CI.
TP08	2	D	1.10	30				65	28	37	96	High plasticity CH.
TP09	2	D	0.60	24				47	21	26	96	Intermediate plasticity CI.
TP10	2	D	1.00	31				60	25	35	97	High plasticity CH.
TP13	2	D	0.70	14				45	20	25	78	Intermediate plasticity CI.
TP15	2	D	1.00	20				52	22	30	90	High plasticity CH.
TP18	2	D	1.00	19				48	22	26	100	Intermediate plasticity CI.
TP21	2	D	1.00	23				51	24	27	87	High plasticity CH.
TP23	2	D	1.30	24				40	21	19	94	Intermediate plasticity CI.
TP24	2	D	0.80	21				44	22	22	92	Intermediate plasticity CI.

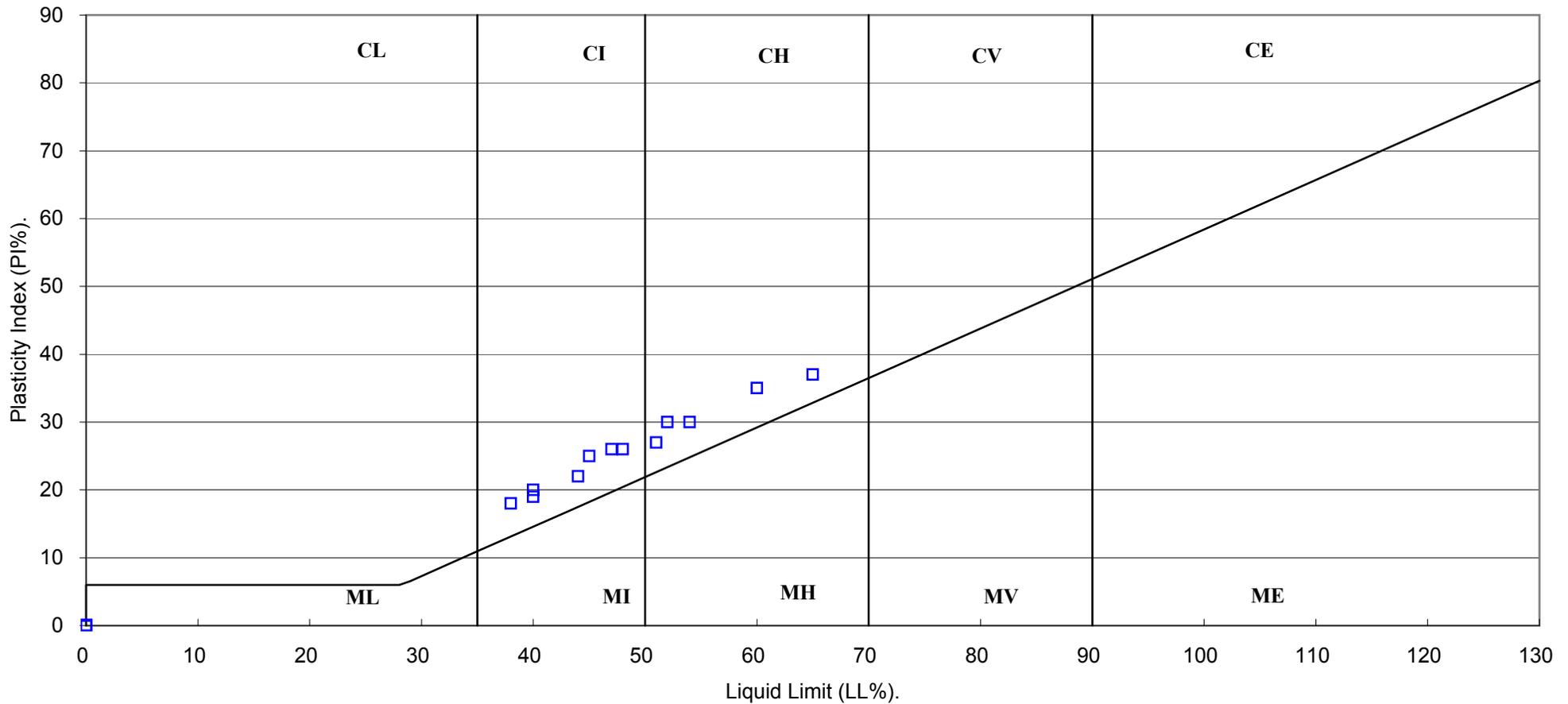
SYMBOLS : NP : Non Plastic

\* : Liquid Limit and Plastic Limit Wet Sieved.

 <b>Professional Soils Laboratory</b>	Compiled by	Date	Checked by	Date	Approved by	Date
	<i>[Signature]</i>	16/01/14	<i>[Signature]</i>	16/01/14	<i>[Signature]</i>	16/01/14
	<b>MOORTHORPE WAY, OWLTHORPE.</b>					Contract No:
					Client Ref:	1792

# PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



Compiled by	Date	Checked by	Date	Approved by	Date
<i>[Signature]</i>	16/01/14	<i>[Signature]</i>	16/01/14	<i>[Signature]</i>	16/01/14
<b>MOORTHORPE WAY, OWLTHORPE.</b>				Contract No:	PSL14/0026
				Client Ref:	1792



## Certificate of Analysis

Certificate Number 14-95664

14-Jan-14

*Client* Professional Soils Laboratory Ltd  
5/7 Hexthorpe Road  
Hexthorpe  
DN4 0AR

*Our Reference* 14-95664

*Client Reference* PSL14/0026

*Contract Title* Moorthorpe Way, Owlthorpe

*Description* 12 soil samples

*Date Received* 10-Jan-14

*Date Started* 10-Jan-14

*Date Completed* 14-Jan-14

*Test Procedures* identified by prefix DETSn (details on request).

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

*Approved By*

Rob Brown  
Business Manager



2139



# Summary of Chemical Analysis

## Soil Samples

Our Ref 14-95664

Client Ref PSL14/0026

Contract Title Moorthorpe Way, Owlthorpe

<b>Lab No</b>	593267	593268	593269	593270	593271	593272	593273	593274	593275	593276	593277	593278
<b>Sample ID</b>	TP04	TP06	TP08	TP08	TP09	TP10	TP13	TP15	TP18	TP21	TP23	TP24
<b>Depth</b>	0.80	0.90	0.30	1.10	0.60	1.00	0.70	1.00	1.00	1.00	1.30	0.80
<b>Other ID</b>												
<b>Sample Type</b>	D	D	D	D	D	D	D	D	D	D	D	D
<b>Sampling Date</b>	n/s											
<b>Sampling Time</b>	n/s											

Test	Method	LOD	Units	593267	593268	593269	593270	593271	593272	593273	593274	593275	593276	593277	593278
<b>Inorganics</b>															
pH	DETS 2008#			6.3	6.9	6.0	7.6	5.1	6.6	7.2	7.1	7.6	7.2	7.2	7.3
Sulphate Aqueous Extract as SO4	DETS 2076#	10	mg/l	99	36	24	33	57	48	< 10	< 10	13	17	11	13

## Information in Support of the Analytical Results

Our Ref 14-95664  
 Client Ref PSL14/0026  
 Contract Moorthorpe Way, Owlthorpe

### Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
593267	TP04 0.80 SOIL		PT 1L (1kg)	Sample date not supplied	
593268	TP06 0.90 SOIL		PT 1L (1kg)	Sample date not supplied	
593269	TP08 0.30 SOIL		PT 1L (1kg)	Sample date not supplied	
593270	TP08 1.10 SOIL		PT 1L (1kg)	Sample date not supplied	
593271	TP09 0.60 SOIL		PT 1L (1kg)	Sample date not supplied	
593272	TP10 1.00 SOIL		PT 1L (1kg)	Sample date not supplied	
593273	TP13 0.70 SOIL		PT 1L (1kg)	Sample date not supplied	
593274	TP15 1.00 SOIL		PT 1L (1kg)	Sample date not supplied	
593275	TP18 1.00 SOIL		PT 1L (1kg)	Sample date not supplied	
593276	TP21 1.00 SOIL		PT 1L (1kg)	Sample date not supplied	
593277	TP23 1.30 SOIL		PT 1L (1kg)	Sample date not supplied	
593278	TP24 0.80 SOIL		PT 1L (1kg)	Sample date not supplied	

Key: P-Plastic T-Tub

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

### Soil Analysis Notes

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

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

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

### Disposal

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

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

**APPENDIX J**  
**GAS MONITORING RESULTS**



<b>Job Title:</b> Moorthorpe Way, Owlthorpe				<b>Job No:</b> 1792	
<b>Client:</b> Kier Services				<b>Sheet :</b> 1 of 1	
<b>Date:</b> 28/01/2014	<b>Arrival Time:</b> 15:10	<b>Depart Time:</b> 17:30	<b>Operator:</b> Martin Thompson		

<b>Gas Monitoring Results:</b>					
<b>Ambient Concentration (% Volume):</b>		<b>CH<sub>4</sub>:</b> 0.0	<b>CO<sub>2</sub>:</b> 0.0	<b>O<sub>2</sub>:</b> 20.9	

Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	litre/hr	litre/hr	secs		
PH01a	0.75	ND	2.0	ND	2.0	19.7	0.1	0.1	30.0	4.87	
PH02a	0.00	NR	NR	NR	NR	NR	ND	ND	ND	3.51	
PH03a	0.62	ND	0.6	ND	0.6	20.2	ND	ND	ND	2.72	
PH04a	0.96	ND	ND	ND	ND	20.9	ND	ND	ND	2.92	
PH05a	1.56	ND	ND	ND	ND	20.6	ND	ND	ND	3.68	
PH06a	2.88	ND	1.4	ND	1.4	19.0	ND	ND	ND	2.87	
PH07a	2.96	ND	1.8	ND	1.8	18.4	0.3	0.3	30.0	5.87	
PH08a	3.63	ND	ND	ND	ND	15.1	ND	ND	ND	4.85	
PH09a	1.98	ND	0.2	ND	0.2	15.9	-12.4	0.0	14.0	6.47	
PH10a	0.37	ND	ND	ND	ND	20.4	3.7	0.0	45.0	3.93	

<b>Notes</b>													
<b>Equipment Used:</b> Gas Data GFM430 Infrared Gas Analyser Geotechnical Instruments Dipmeter						<b>Next Calibration Date:</b> 24/07/2014			<b>Key</b>				
									ND None Detected				
									NR Not Recorded				
									1.0 Recorded value does not breach trigger levels				
									5.0 Recorded value breaches trigger level 1				
									10.0 Recorded value breaches trigger level 2				
		<b>Site Data:</b>			<b>Weather Station Data (Meadowhead Station)</b>								
<b>Temp (°C):</b> 5					<b>Barometric Pressure Trend:</b>				Increasing				
<b>Time:</b>	15:25	16:37	17:18	00:29	07:02	12:04	16:10	20:22	23:43	Trigger level 1	1.0	5.0	16.0
<b>Pressure (mb):</b>	970	971	971	982	978	979	981	984	987	Trigger level 2	5.0	10.0	10.0
<b>Weather Conditions:</b>		Overcast, rainy											
<b>Surface Ground Conditions:</b>		Wet											

**Remarks:**