

Site Details:

Peel Street, Barnsley, S70 2RL

Client Ref: C3547/RT/1807
Report Ref: HMD-283-599238
Grid Ref: 434210, 406250

Map Name: Provisional

Map date: 1951

Scale: 1:10,560

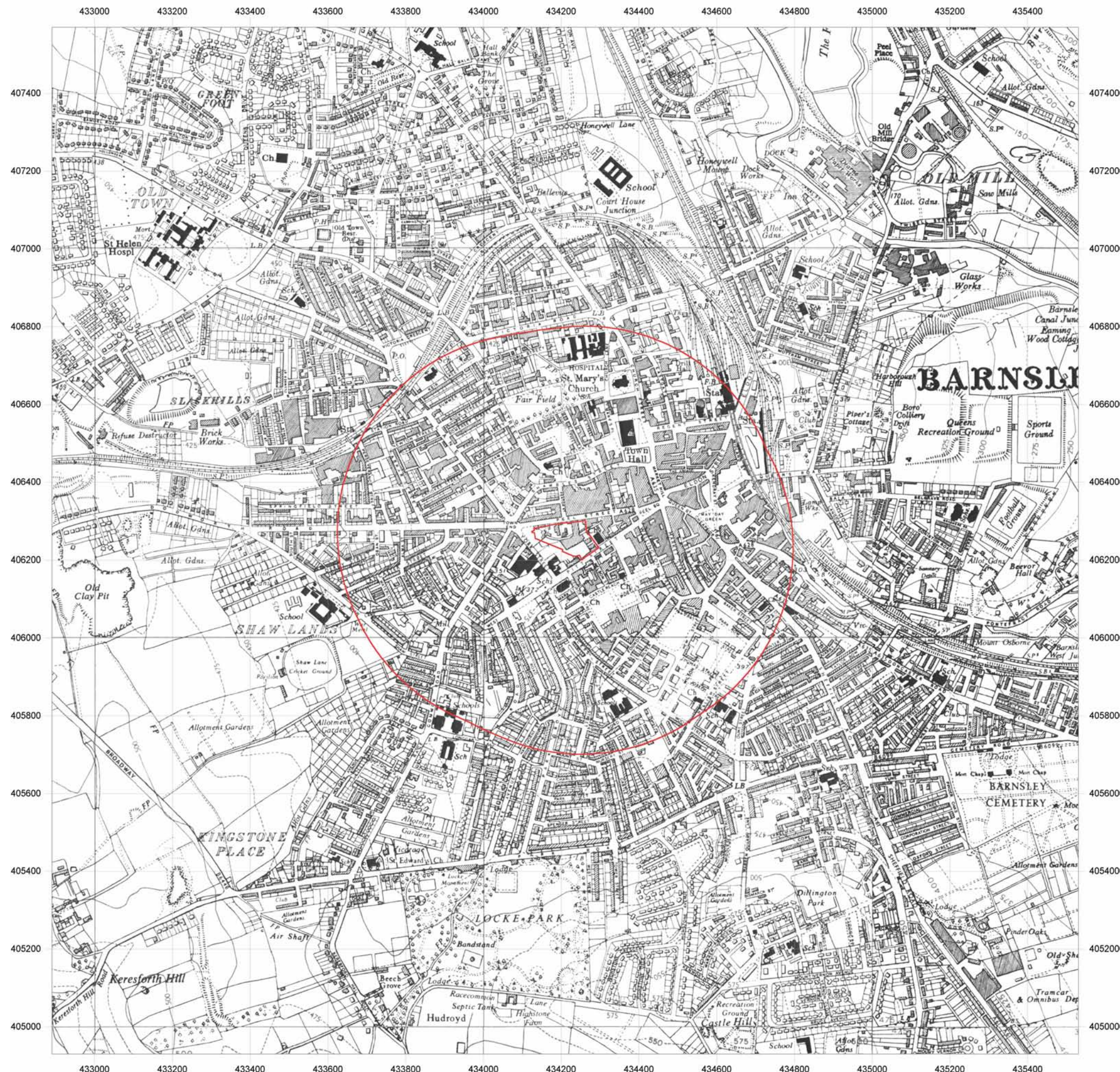
Printed at: 1:10,560

Surveyed 1951
 Revised 1951
 Edition NA
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 Edition NA
 Copyright NA
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 Edition NA
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Site Details:

Peel Street, Barnsley, S70 2RL

Client Ref: C3547/RT/1807
Report Ref: HMD-283-599238
Grid Ref: 434210, 406250

Map Name: County Series

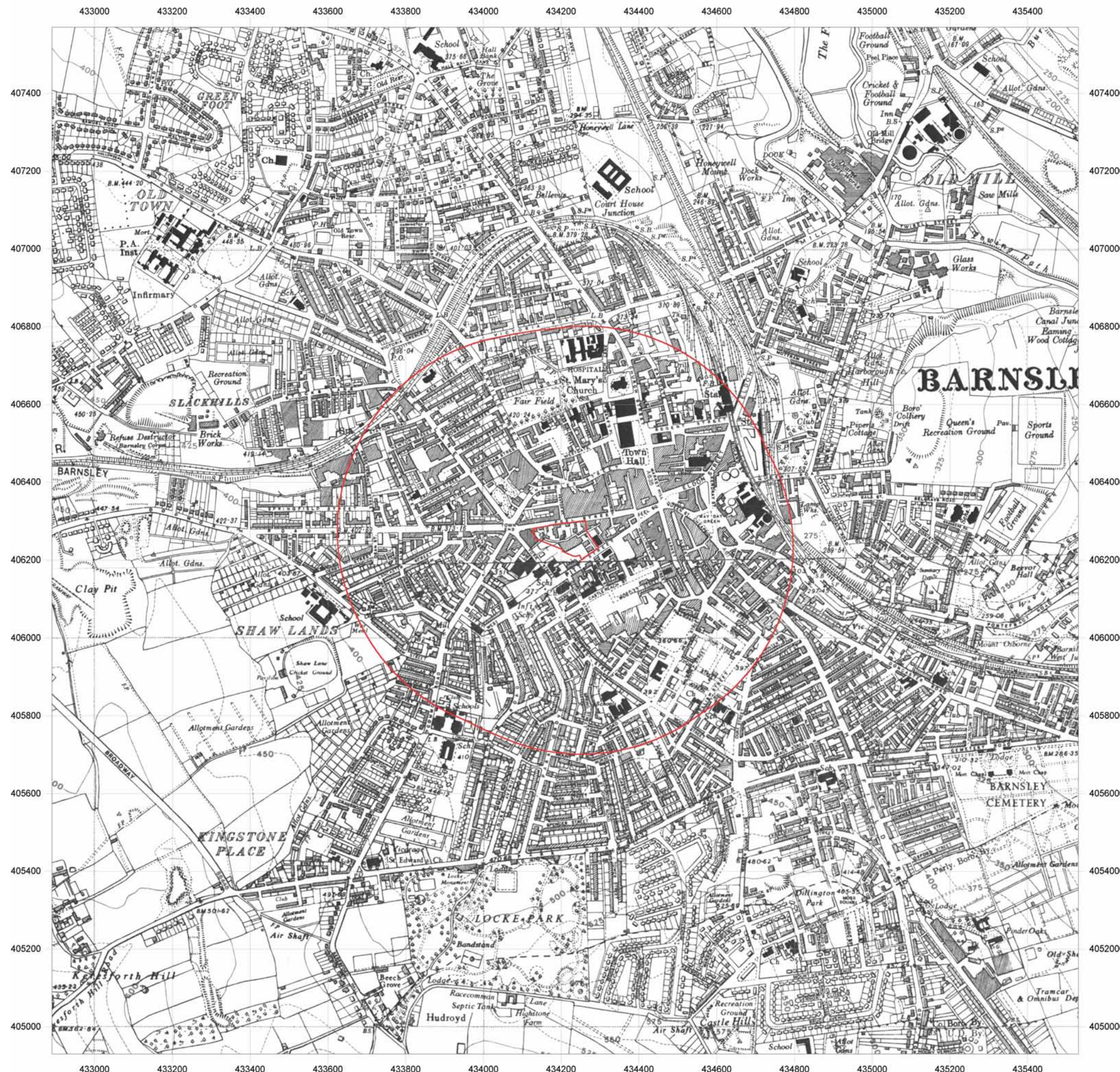
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Site Details:

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Client Ref: C3547/RT/1807
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Grid Ref: 434210, 406250

Map Name: County Series

Map date: 1938

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Surveyed 1851
 Revised 1938
 Edition 1938
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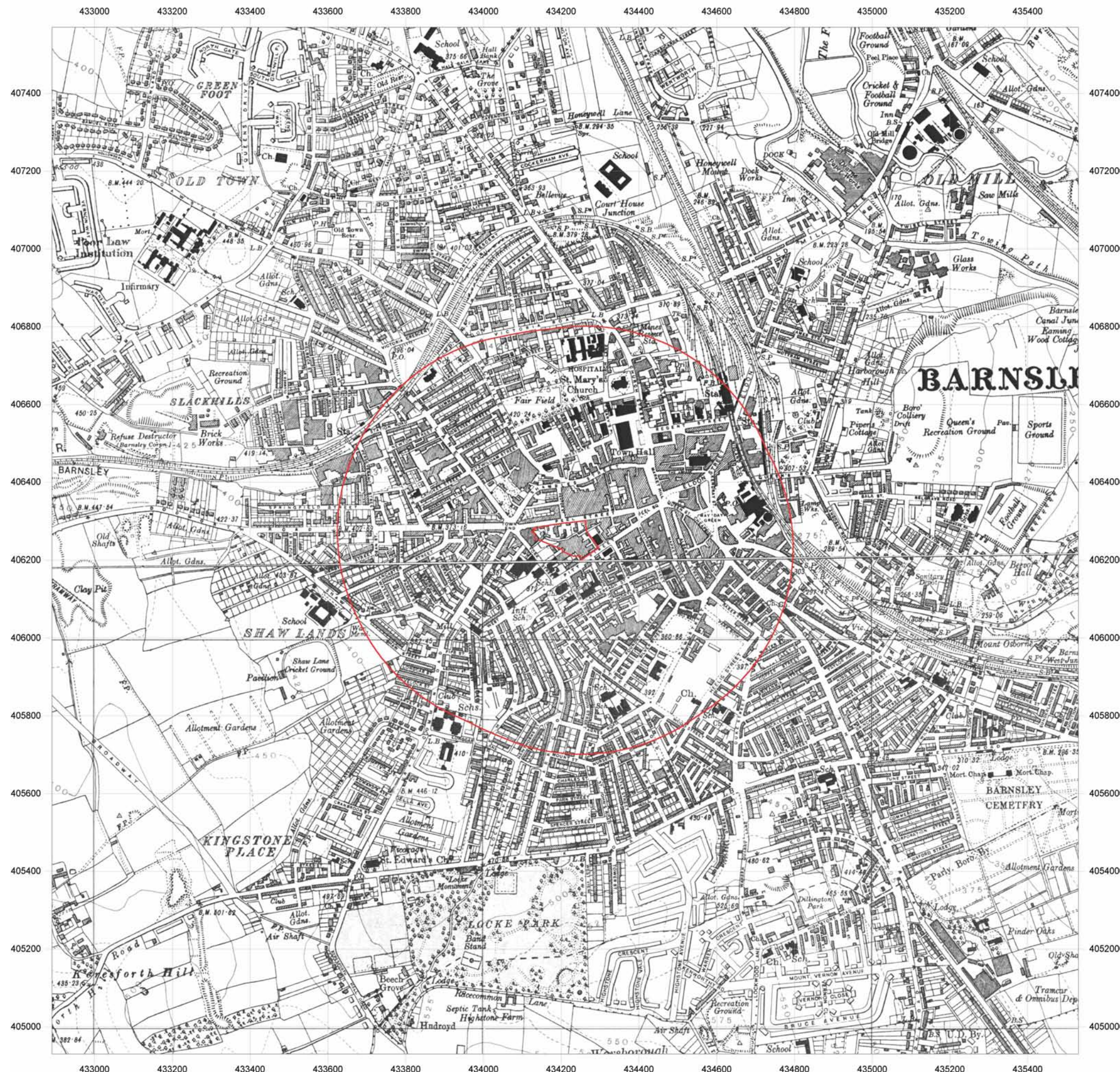
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Site Details:

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Client Ref: C3547/RT/1807
Report Ref: HMD-283-599238
Grid Ref: 434210, 406250

Map Name: County Series

Map date: 1904

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Surveyed 1891
 Revised 1904
 Edition NA
 Copyright NA
 Levelled NA

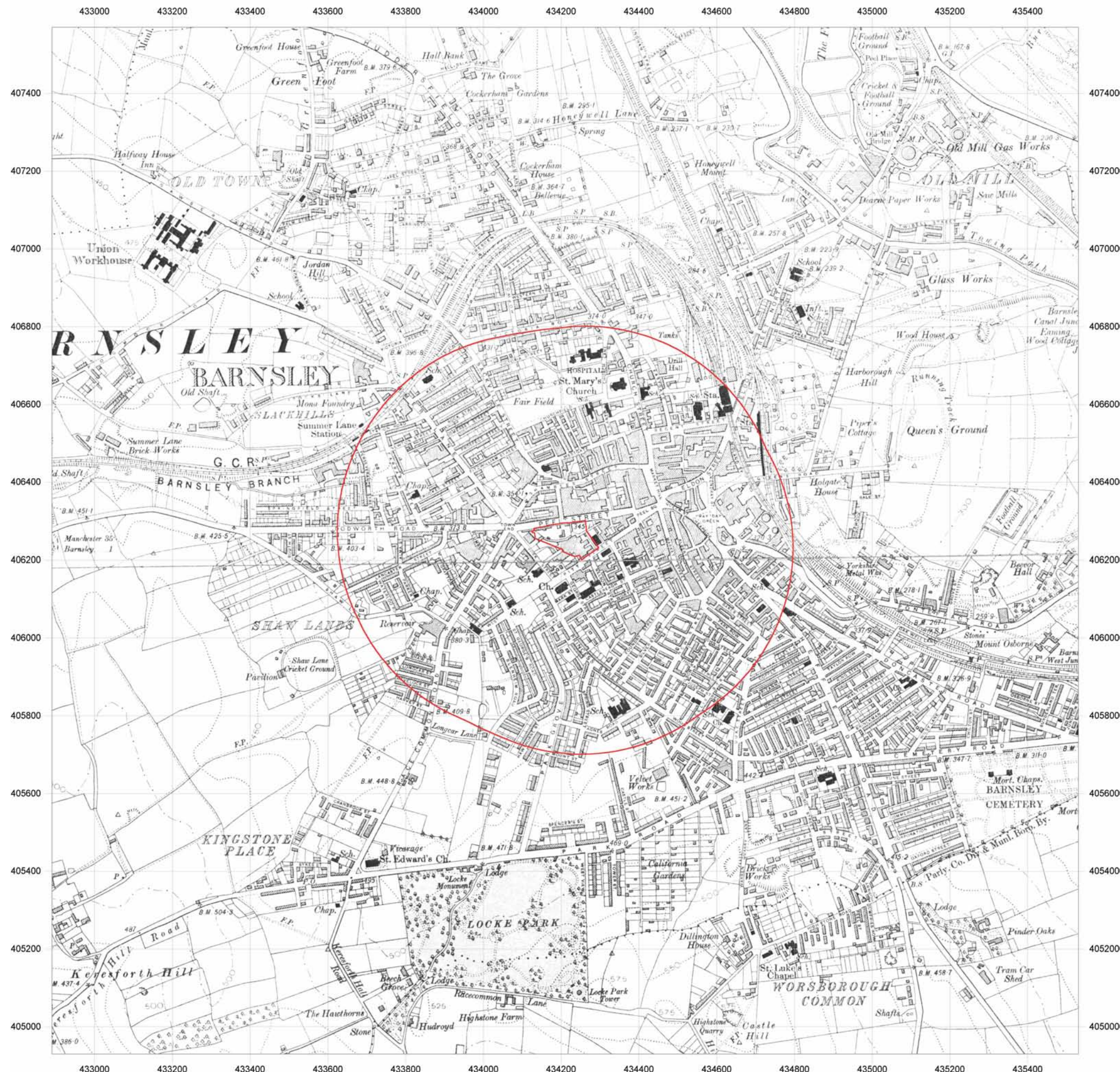
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Client Ref: C3547/RT/1807
Report Ref: HMD-283-599238
Grid Ref: 434210, 406250

Map Name: County Series

Map date: 1890

Scale: 1:10,560

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APPENDIX C

COAL AUTHORITY SEARCH

Issued by:

The Coal Authority, Mining Reports Office, 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire NG18 4RG
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Person dealing with this matter:	Darren Moody
Our reference:	00048155-09
Your reference:	C3547/RT/1808
Electronic Ref:	EME_00012594820001_005
RRUID:	005.00012594820001
Date of your enquiry:	22 October 2009
Date we received your enquiry:	22 October 2009
Date of issue:	26 October 2009

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

Coal and Brine Report

Land Off, Peel Street, Barnsley, 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	Yes
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 1 seam of coal at 100m depth, and last worked in 1875.

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 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 property since 1 January 1984.

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 in an area for which a notice of entitlement to withdraw support was published in 1963.

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.

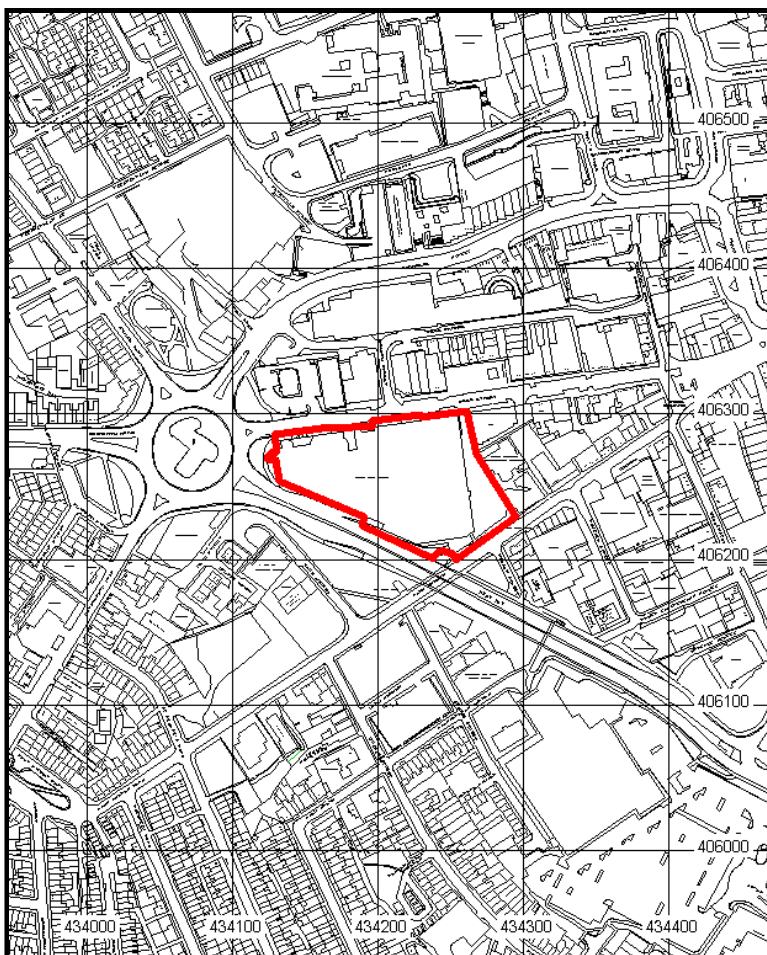
Additional remarks

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 report is compliant with Home Information Pack requirements.

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Approximate position of enquiry boundary shown



PHASE 1 GEOENVIRONMENTAL APPRAISAL**of land off****PEEL STREET, BARNSELEY****Prepared for****LIDL UK GmbH****CONTENTS****EXECUTIVE SUMMARY**

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C4013/01	Site Location Plan	1:50,000
C4013/02	Proposed Development Plan	1:500
C4013/03	Site Features / Historical Overlay	1:500
C4013/04	Preliminary Conceptual Site Model	NTS
C4013/05	Exploratory Hole Location Plan	1:500
C4013/06	Revised Conceptual Site Model	NTS

NTS: Not to Scale

APPENDIX B EXPLORATORY HOLE RECORDS

APPENDIX C LABORATORY TEST RESULTS

APPENDIX D GROUND GAS AND GROUNDWATER MONITORING RESULTS

APPENDIX E SIRIUS GENERIC ASSESSMENT CRITERIA

EXECUTIVE SUMMARY

Introduction	Sirius Geotechnical and Environmental Ltd (Sirius) were commissioned by Lidl UK GmbH (Lidl) to undertake Phase 1 of a geoenvironmental appraisal of land off Peel Street, Barnsley (the “site”). It is understood that Lidl are proposing to redevelop the property with two commercial units within the eastern area, associated car parking within the western area, and peripheral areas of soft landscaping. It is understood that one of the units (Unit 1), located in the south eastern area of the site will be occupied by Lidl, while the other proposed unit (Unit 2), located in the north eastern area, will be occupied by another party. At the time of the ground investigation, demolition/clearance works of an existing property were ongoing at the site. As such the central area of the property was occupied by a large stockpile of demolition rubble. Consequently the intrusive investigation has been undertaken in a phased approach; with this initial phase of intrusive works (Phase 1) undertaken pre-completion of the demolition works. In light of this, the Phase 1 intrusive investigation was restricted to the eastern and western parts of the site. A second phase of intrusive ground investigation works will be undertaken following completion of the demolition works, when access to previously restricted areas (principally the central area of the site) will be available. Sirius have previously completed a preliminary appraisal report (desk study) for the site (report ref. C3547, dated October 2009), on the behalf of Opus Land (North) Ltd. It is understood that this report has subsequently been reassigned to Lidl. This report should be read in conjunction with the previous Sirius desk study.
Site Details	The site is located off Peel Street, approximately 300m to the south west of Barnsley town centre. At the time of the Phase 1 fieldworks, the site was an active demolition site, and the majority of the above ground structures had been cleared, with the exception of the retail façade fronting onto Peel Street. As a result, the site generally comprised open flat land, with the exception of a stockpile of demolition rubble which occupied the central area.
Fieldwork	5 No. trial pits to a maximum depth of 4.10m bgl; 11 No. window sample boreholes to a maximum depth of 5.45m bgl; and 4 No. rotary probeholes to a maximum depth of 30m bgl.
Laboratory Testing	Samples of soil and groundwater were submitted for analysis of a range of metal, other inorganic and organic components. Geotechnical testing was scheduled on selected samples. All testing was undertaken at accredited laboratories.
Ground Conditions	Made ground of variable composition was encountered within all of the exploratory holes to depths of between 0.50m and >3.40m bgl. Alluvial deposits were encountered underlying the made ground within the north eastern and western areas of the site, within the footprints of the former reservoirs and the former channel of Sough Dyke. The alluvial deposits were encountered to depths of between 3.60m and 5.15m bgl, and were generally described as very soft and soft, locally firm, organic clay/silt. The made ground, and alluvial deposits where present, were found to be typically underlain by natural cohesive material to depths of between 1.90m and >5.45m bgl. The natural cohesive deposits were described as firm to very stiff sandy clay with occasional gravel sized fragments of mudstone and sandstone. Within the western area of the site, slightly sandy, slightly clayey gravel of sandstone, siltstone and mudstone was encountered underlying the natural cohesive deposits to a depth of 4.55m bgl. These natural cohesive and granular deposits are considered representative of completely weathered (residual) Middle Coal Measures strata. The residual Middle Coal Measures strata was not encountered within WS2 and WS3,

	located within the south eastern area of the site. This is assumed to be associated with the level of the south eastern area of the site being reduced and regraded as part of the previous development of the site. Competent bedrock, comprising mudstone, siltstone and sandstone, was encountered at depths of between 0.50m and 6.50m bgl, within the trial pits, window samples and rotary probe holes. The depth to rockhead was generally shallower in the south eastern part of the site, becoming deeper towards the north. A coal seam, recorded to be between 2.00m and 2.30m thick, was encountered at depths of between 6.70m and 14.50m bgl, within the rotary probeholes.
Ground Stability	Excavations into made ground and the underlying natural soils should be assumed to be unstable.
Foundations and Floor Slabs	<u>The recommendations below assume that mining will not affect surface stability. If this is not proven to be the case modification to foundation design may be required.</u> Given the variable ground profile encountered during this intrusive investigation, the proposed foundations for each of the commercial units, are discussed separately below. For Unit 1 (located within the south eastern area of the site) it is recommended that structural loads are supported upon a competent and consistent stratum, in this case the Middle Coal Measures bedrock (MCM). In the east and much of the central part of the unit, rockhead is sufficiently shallow to allow structural loads to be supported upon spread foundations such as strips or pads. The load that can be applied to a foundation is dependent on its shape and size. However, by way of example, for a 1m square pad founded on shallow MCM bedrock (Class B 'partially weathered') at 0.90m bgl, a design load of 200kN could be assumed. Towards the western part of the unit, this investigation indicates competent strata at depths of >2.45m bgl (WS1). In this case it may be possible to consider a trench fill/mass concrete pier solution. However, the actual depth to bedrock is not proven. Consequently it may be prudent to utilise a piled foundation solution within this part of the unit. For Unit 2 (located within the northern eastern part of the site) foundations should be extended through made ground, alluvial and residual soils to bear into the underlying competent strata, in particular Middle Coal Measures strata, via end-bearing piles. <u>If shallow abandoned mine workings are proven, they will be required to be drilled and pressure grouted. Foundation design will thus be subject to the thickness of competent cover above the treated workings. It is likely that if workings are proven, piles will need to be extended through the treated seam over some, if not all of the building footprint.</u>
Sulphate Class	With regard to the made ground and residual Middle Coal Measures strata, a Design Sulphate Class of DS-1 and an ACEC Class of AC-1 should be used for buried concrete structures. For buried concrete in contact with the alluvial soils a Design Sulphate Class of DS-2 and an ACEC Class of AC-2 should be used.

Contamination	Locally elevated concentrations of benzo(a)pyrene have been detected within the made ground. It is considered that should the material be placed under areas of proposed hardstanding (whether it be buildings or car parking/roadways) no further remedial action is considered necessary to protect end users from direct contact with the identified contamination. Where made ground is left in place in areas of soft landscaping, a subsoil/topsoil “cap” will be required to provide a suitable growing medium for shallow rooted plants; a capping thickness of 450mm is suggested, subject to regulatory approval. Deep rooted plants will need to be potted in a suitable depth of clean inert fill. It is recommended that a clean cap specification be agreed with the local authority before development begins. Locally marginally elevated concentrations of TPH were detected within the perched and natural groundwater. In addition, locally marginally elevated concentrations of sulphate and ammonium were also recorded within the natural groundwater. No significant sources of organic or inorganic contamination have been identified within the made ground or shallow natural soils during the Sirius site investigation and it is considered that the elevated concentration of TPH detected may be due to historical on-site and/or off-site activities. Given the localised distribution and low concentrations of the determinands detected in the groundwater encountered, these components are considered to pose a low risk to controlled waters and do not require remedial action. This conclusion may need to be revised if, during Phase 2 site investigation works or enabling works, any visual/olfactory evidence of significant hydrocarbon contamination is detected.
Gas Protection	Gas monitoring undertaken to date (one visit) has revealed no/low detectable concentrations of methane and carbon dioxide, coupled with no positive gas emission rates. Based on the monitoring data obtained to date, the ground gas regime for the proposed retail units has been provisionally assessed as Characteristic Situation (CS) 1, based on Situation A presented in CIRIA C665. However, areas of deep made ground and alluvial deposits were encountered on site during the intrusive works, and the possibility of mines’ gas associated with the underlying Middle Coal Measures strata, cannot be ruled out at this stage. Consequently, it may be necessary to make an allowance for gas protection measures to be increased from CS 1 to CS 2. <u>The above assessment should be regarded as interim only, pending completion of the gas monitoring programme.</u> Radon protection measures are not required for the proposed development on this site.
Further Works	Following the completion of the demolition works at the site, it is recommended that an ‘infill’ intrusive investigation (Phase 2) be undertaken within previously inaccessible areas (namely the central area of the site where the stockpile of the demolition material is currently located). It is anticipated that this will comprise one day’s trial pitting, within the central part of the site, in order to investigate shallow ground conditions and the presence/absence of the Kent’s Thick coal seam at shallow depth, which is conjectured to outcrop in this part of the site. It is also recommended that the building footprint be proof drilled as part of the enabling works to confirm whether “pillars” were encountered as part of this intrusive investigation, and the need for ground stabilisation.

1. INTRODUCTION

Sirius Geotechnical and Environmental Ltd (Sirius) were commissioned by Lidl UK GmbH (Lidl) to undertake a phased geoenvironmental appraisal of land off Peel Street, Barnsley (the “site”).

It is understood that Lidl are proposing to redevelop the property with two commercial units within the eastern area, associated car parking within the western area, and peripheral areas of soft landscaping. It is understood that one of the units (Unit 1), located in the south eastern area of the site will be occupied by Lidl, while the other proposed unit (Unit 2), located in the north eastern area, will be occupied by another party.

A proposed development layout plan (Humphreys Teal Partnership Drawing No. 747.19, rev. D, dated December 2010) was provided to Sirius by Lidl, and is presented as Drawing No. C4013/02, within Appendix A to this report.

Sirius have previously completed a preliminary appraisal report (desk study) for the site (report ref. C3547, dated October 2009), on the behalf of Opus Land (North) Ltd. It is understood that this report has subsequently been reassigned to Lidl. The desk study included an assessment of information provided by GroundSure Ltd, the British Geological Survey (BGS), the Coal Authority (CA) and the Environment Agency (EA).

Based on the findings of the desk study, an intrusive investigation was scoped and subsequently undertaken by Sirius.

At the time of the ground investigation, demolition/clearance works of an existing property were ongoing at the site. As such the central area of the property was occupied by a large stockpile of demolition rubble. Consequently the intrusive investigation has been undertaken in a phased approach; with this initial phase of intrusive works (Phase 1) undertaken pre-completion of the demolition works. In light of this, the Phase 1 intrusive investigation was restricted to the eastern and western parts of the site. A second phase of intrusive ground investigation works will be undertaken following completion of the demolition works, when access to previously restricted areas (principally the central area of the site) will be available.

This report summarises the findings of the previous desk study, details the results of the Phase 1 intrusive investigation and, based on this information, makes recommendations relating to the proposed redevelopment.

This report should be read in conjunction with the Sirius desk study report, which contains the environmental setting and initial conceptual site model (CSM) from which the investigation rationale was derived.

The objectives of this appraisal were:

- To investigate near surface soil and groundwater conditions within accessible areas.
- To determine the potential risks posed by any ground contamination and provide recommendations on remedial measures to manage such risks.
- To establish the risks associated with hazardous ground gas.
- To provide advice relating to geotechnical issues associated with the site.
- To determine whether past mining or other extractive industries could have an influence on the surface stability of the site.
- To provide recommendations for foundation, floor slab and highway/pavement design for the proposed development.

The Phase 1 fieldwork was carried out on 17th and 18th January 2011 and comprised the excavation of 5 No. trial pits to a maximum depth of 4.10m bgl; the boring of 11 No. window sample boreholes to a maximum depth of 5.45m bgl; and the sinking of 4 No. rotary probeholes to a maximum depth of 30m bgl.

This report, which was designed to meet the requirements of all relevant current guidance, presents the factual information available during this appraisal, interpretation of the data obtained and recommendations relevant to the defined objectives.

It has been assumed in the production of this report that the site is to be redeveloped for a commercial end-use. In addition, it is assumed that ground levels will not change significantly from those described in this report. If this is not the case, amendments to the recommendations made in this report may be required.

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

The comments and opinions presented in this report are based on the findings of the desk study previously undertaken by Sirius, ground conditions encountered during the Phase 1 intrusive investigation works performed by Sirius and the results of tests carried out by one or more laboratories. There may be other conditions prevailing on the site which have not been revealed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for any conditions not revealed by this investigation. Any diagram or opinion on the possible configuration of strata, contamination or other spatially variable features between or beyond investigation positions is conjectural and given for guidance only. Confirmation of ground conditions between exploratory holes should be undertaken if deemed necessary. Evaluation of ground gas and groundwater is based on observations made at the time of the investigation and monitoring visits. It should be noted that ground gas and groundwater levels and quality may vary due to seasonal and other effects.

This report has been prepared for the sole use of Lidl UK GmbH. No other third party may rely upon or reproduce the contents of this report without the written approval of Sirius. If any unauthorised third party comes into possession of this report, they rely on it entirely at their own risk and the authors do not owe them any Duty of Care or Skill.

2. SITE DETAILS AND DESCRIPTION

Table 2.1 Current Site Overview

Location	The site is located off Peel Street, approximately 300m to the south west of Barnsley town centre. A site location plan is included as Drawing No. C4013/01 within Appendix A.
National Grid Reference	E 434259, N 406274.
Topography and Features	At the time of the Phase 1 fieldworks, the site was an active demolition site, and the majority of the above ground structures had been cleared, with the exception of the retail façade fronting onto Peel Street. As a result, the site generally comprised open flat land, with the exception of a stockpile of demolition rubble which occupied the central area. Within the south eastern part of the property, the level appears to have been reduced and regraded as a result of historical development of the site. Consequently, the south eastern site boundary is formed by a sandstone block retaining wall, approximately 7m high, which supports Pitt Street. It would appear that in parts a reinforced concrete wall has been constructed against the original sandstone block retaining wall, in order to reinforce and stabilise the original structure. Where the original sandstone block retaining wall is exposed, spalling is evident locally with some sandstone blocks missing.
Approximate Site Area	0.97 hectares (2.4 acres).
Site Boundaries	The northern boundary of the site is formed by Peel Street, and the south east and south west by Pitt Street and the West Way (A628), respectively. The eastern boundaries of the site are formed by the external wall of a nightclub and the boundary wall of the former Pitt Street Methodist Church.
Current Land Use	Active demolition site (at the time of the Phase 1 intrusive investigation).

Invasive Plant Species	None noted.
Adjacent Land Uses	Predominantly commercial and light industrial. The car park and grounds of the former Pitt Street Methodist Church located beyond the site's eastern boundary is now a childcare centre. The former channel of Sough Dyke is evident immediately beyond the sites eastern boundary, and it is apparent that the watercourse has been dry for some time.

The main site features, including historical features, are shown on Drawing No. C4013/03 within Appendix A.

3. PREVIOUS INVESTIGATION FINDINGS

A desk study was previously undertaken for the site by Sirius (Report Ref. C3547, dated October 2009) on the behalf of Opus Land (North) Ltd. It is understood that the desk study has subsequently been reassigned to Lidl.

As part of the previous desk study, published environmental, geological and historical data relating to the site, including a Groundsure Report and Coal Authority Mining Report, were reviewed. A summary of salient information is provided below. However, the previous Sirius report should be referred to for a more detailed assessment of the site's environmental setting.

At the time of the walkover survey, undertaken as part of the desk study, the site was occupied by a disused retail unit (supermarket) within the eastern half, with car parking access over the western half, which lead to a roof car park over the entire plan of the former building. The former retail unit has since been demolished.

Table 3.1 Summary of Environmental Setting

Site History	Prior to 1889, the southern part of the property was occupied by a linen mill with two reservoirs, assumed to be associated with the mill, located within the north eastern and south western areas. In addition, a watercourse, Sough Dike, crossed the central site area, flowing from south west to north east. By 1948 the mill buildings and associated reservoirs had been demolished/infilled, and the site had been redeveloped with a number of commercial properties, including a cinema and builders yard. As a result of the redevelopment of the property, Sough Dike was partially culverted beneath the site. By 1983 the majority of the site was occupied by retail premises with rooftop car parking. Information provided to Sirius by Lidl indicates that Sough Dike was diverted away from the site, prior to the construction of the retail premises referenced above, and the associated culvert located beneath the site is understood to be redundant. Potentially contaminative sources identified in the vicinity of the site include
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	mills, infilled ponds/reservoirs, works, and warehouses. In addition, a garage/possible petrol filling station (PFS) was located immediately beyond the north eastern boundary of the site, which by 2002 was subsequently demolished/cleared and redeveloped with a public house/club. A historical overlay has been prepared for the site, and shows the outline of the former reservoirs, mill buildings, Sough Dike, as well as the inferred outline of the former retail units historically located on the site. The historical overlay is presented as Drawing No. C4013/03, contained within Appendix A of this report.
Geology and Mining	The BGS 1:50,000 and 1:10,000 scale geological maps (Sheet 87 – Barnsley, and SE 30 NW, respectively) indicate that the site is underlain by strata of the Middle Coal Measures, comprising Kent's Rock (sandstone) within the eastern part, and undifferentiated mudstone, sandstone, siltstone and coal within the western part. Review of the BGS plans of the area indicate that the Kent's Thick and Kent's Thin coal seams outcrop, striking approximately north east/south west, within the central and south eastern areas of the site, respectively. The Kent's Thick and Kent's Thin coal seams are recorded to dip 5° to the south east, and to be between 0.91m and 1.22m, and 0.24m and 0.76m thick, respectively, with the Kent's Thin overlying the Kent's Thick by approximately 26m. No superficial deposits are reported to underlie the site. However, it is anticipated that soft ground/alluvial deposits associated with the former reservoirs/watercourse (Sough Dike) will be present locally beneath the site. Localised deep made ground, associated with the infilled reservoirs, located in the north eastern and south western areas of the site, is also anticipated. The Coal Authority Mining Report obtained as part of the previous Sirius desk study states: <i>"The property is in the likely zone of influence from workings in one seam of coal at 100m depth and last worked in 1875. In addition the property is in an area where the CA believe there is coal at or close to the surface. This coal may have been worked at some time in the past."</i>

	<i>“There are no known mine entries on, or within 20m of, the site.”</i> No quarrying/opencast coal activities are known to have taken place on site. However, a brick works with associated quarry is shown on the historical OS plans between 150m and 280m to the south west of the site. No further evidence of mining/quarrying has been noted.
Landfills	According to the GroundSure Report there is one Environment Agency (EA) recorded landfill site within 500m of the property, located off Spring Street, approximately 291m to the south. Review of historical OS plans indicate that from before 1889 two reservoirs, assumed to be associated with a former linen mill, were located within the north eastern and south western areas of the site. These reservoirs were subsequently infilled some time between 1951 and 1959. It is possible the reservoirs were backfilled with materials that could give rise to ground gas emissions.
Hydrogeology and Hydrology	There are no EA GQA Classified Watercourses located within 500m of the site. The nearest surface water feature is recorded within the GroundSure report to be located 50m to the east of the site. However, it is considered that this relates to the former channel of Sough Dyke, located immediately beyond the eastern site boundary, which was noted to be dry during the Phase 1 intrusive works. It is understood that Sough Dike, was diverted away from the site prior to the construction of the former commercial development on the site, and it is currently unknown where the redirected watercourse is located. There are no licensed surface water abstractions within 1km of the site. It is reported within the Sirius desk study that the Middle Coal Measures underlying the site are classified as a Minor Aquifer (variably permeable). Under the new EA aquifer classification the Middle Coal Measures strata are classified as a Secondary A Aquifer; these are defined as ‘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’.

	According to the GroundSure Report there are four records of potable groundwater abstraction licences within 1km of the site. These relate to two boreholes located approximately 474 and 503m to the south west of the site. The site is not recorded to be within 500m of a Source Protection Zone. According to the GroundSure Report and the EA website, the site is not located in a fluvial indicative floodplain.
Other Issues	No radon protective measures are required within new buildings at the site. There are sixty five contemporary trade directory entries within 250m of the site including warehouses, engineering works, electricity substations and unspecified works buildings.

4. PRELIMINARY CONCEPTUAL MODEL

A preliminary conceptual site model and conceptual exposure model (CSM) was developed for the proposed future land use (commercial), as part of the preliminary investigation (desk study) undertaken by Sirius in October 2009. This CSM was developed prior to the demolition of the above ground structures on site and has subsequently has been updated to reflect the site at the time of the Phase 1 intrusive fieldwork.

The CSM summarises the understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors in order to assess potential pollutant linkages. In assessing the likely contaminants present at the site, reference has been made to the Industry Profile report series issued by the Department of the Environment and other relevant supporting documentation.

A qualitative risk assessment has also been made of the likelihood of any pollutant linkage operating and its potential significance.

The updated preliminary CSM is presented in schematic form as Drawing No. C4013/04 in Appendix A.

In summary, the preliminary CSM has identified the following potential pollutant linkages which could result in an unacceptable risk to the proposed end-use, denoted as moderate or higher likelihood on the CSM:

- Ingestion, inhalation of dust and dermal contact with potential heavy metals, inorganic determinands and hydrocarbons (including PAHs) in made ground and/or shallow soils.
- Possible asbestos containing materials (ACMs) within the demolition rubble stockpile/made ground soils.
- Possible leachable heavy metals and hydrocarbons (including PAHs) in made ground and/or shallow soils with the potential to impact controlled waters (Secondary A Aquifer/Sough Dike).
- Possible heavy metals, inorganic determinands and hydrocarbons (including PAHs) within perched/shallow groundwater posing a potential risk to controlled waters (Secondary A Aquifer/Sough Dike).

- Risk from hazardous gas sources, located both on and off site, associated with areas of deep made ground (namely the infilled reservoirs located within the north eastern and south western areas of the site), alluvial deposits, and mines gas associated with the underlying Middle Coal Measures strata.

5. FIELDWORK

5.1. Scope of Investigation

The information contained in this report is limited to areas of land accessible during the investigation within the site boundary, as indicated on the site features drawing, presented in Appendix A as Drawing No C4013/05.

Due to access restrictions associated with a large stockpile of demolition rubble located within the central area of the site, it is understood that a second phase of supplementary intrusive works will be undertaken on completion of demolition works, when access to this area is available.

Sirius scoped the intrusive ground investigation using guidance presented in BS 10175:2001, BS 8485:2007, the CLR series of documents (Defra and Environment Agency, 2002a-2002e) and BS EN 1997:2004 and 2007.

The investigation, which was supervised by a Sirius Geoenvironmental Engineer, took place on 17th and 18th January 2011 and comprised:

- 5 No. trial pits (TP1 to TP5, inclusive) to a maximum depth of 4.10m bgl.
- 11 No. window sample boreholes (WS1 to WS6, WS6A, WS6B, WS6C, WS7 and WS8) to a maximum depth of 5.45m bgl.
- 4 No. rotary probeholes (RO1 to RO4, inclusive) to a maximum depth of 30m bgl.

Permanent monitoring installations for both groundwater and ground gas monitoring were installed within selected rotary probeholes (RO1 – RO3) and window sample boreholes (WS1, WS4 and WS5).

In addition, a gas and groundwater monitoring programme is currently being undertaken, comprising 4 visits over a 1 month period. To date, only one monitoring/sampling visit has been completed. On the second monitoring visit, five out of the six monitoring installations had been damaged or buried due to the ongoing demolition works. Consequently the monitoring wells have been programmed to be reinstated. A full set of monitoring results will be issued in an addendum letter, following completion of the monitoring programme.

5.2. Strata Description

Detailed descriptions of strata and groundwater observations made during investigation works, together with samples recovered, are presented on the engineer's exploratory hole records in Appendix B.

Standard strata descriptions are compliant with BS EN ISO 14688:2002 and 2004 and BS EN ISO 14689:2003. The depths of strata on the record sheets are recorded from current ground levels at each location, unless indicated otherwise.

5.3. Exploratory Hole Locations

The exploratory hole locations were based on the findings of the preliminary conceptual site model, in order to target specific areas of interest and achieve a general site coverage. Procedures and principals recommended in CLR4, BS EN ISO 1997-2: 2007 and BS 10175:2001 were followed when determining exploratory hole locations.

The following table details the exploratory hole rationale:

Table 5.1 Exploratory Hole Rationale

Exploratory Hole	Rationale
TP1 – TP5, WS1 – WS5, WS7	Exploratory holes to provide geotechnical parameters of deeper soils within the footprint of proposed retail units (more specifically WS1 – WS5, and WS7), and target potential and known sources of contamination (i.e. infilled reservoirs).
WS6, WS6A, WS6B, WS6C, WS8	General site coverage within the western site area.
RO1 – RO4	Rotary boreholes to investigate the presence/absence of coal beneath the footprint of the proposed retail units.

Exploratory hole locations are shown on Drawing No. C4013/05 in Appendix A of this report.

5.4. Geotechnical Testing

Geotechnical laboratory testing was carried out on selected samples in accordance with techniques outlined in BS 1377:1990 "Methods of Test for Soils for Civil Engineering Purposes" at Professional Soils Laboratory (PSL), a UKAS accredited laboratory, and Derwentside Environmental Testing Services (DETS), a UKAS and MCERTS accredited laboratory.

Geotechnical and geochemical test results are included within Appendix C of this report.

5.5. Chemical Testing

Selected samples of the soil (made ground and natural soils) and groundwater were tested for a range of potential contaminants under subcontract with DETS.

The potential contaminants of concern identified by the preliminary conceptual site model were selected as the analytes for the samples recovered from the site. The results of soil, leachate, and groundwater analysis, as received from the laboratory, are presented in Appendix C of this report.

6. GROUND CONDITIONS AND MATERIAL PROPERTIES

6.1. Strata Profile

A summary of the strata profile is provided in Table 6.1 below.

It should be noted that rotary open hole drilling techniques only recover small chip samples, brought to the surface by the flush returns. Therefore the depth of strata boundaries within superficial deposits are based primarily on the observations made during the excavation/drilling of the trial pits and window sample boreholes.

Table 6.1 Strata Profile

Strata	Depth Range (Thickness Range)	Description and Comments
Made Ground	Ground Level (0.50 - >3.40m)	The shallow made ground within the south eastern part of the site typically comprised concrete hardstand over granular sub-base to depths of between 0.50m and 1.50m bgl, and was generally found to become deeper towards the north. The concrete hardstand and sub-base were found to be underlain by predominantly granular and locally cohesive fill, generally described as sandy gravel and gravelly clay, with occasional cobbles, respectively. The gravel and cobble sized fractions were recorded to comprise limestone, concrete, ash, clinker and brick. Within the south eastern area of the site the mixed granular fill was generally encountered to depths of between 0.50m and 1.50m bgl, with the exception of WS1 which was terminated within made ground at a depth of 2.45m bgl. It is considered that this area of deep made ground encountered within WS1 may be representative of an infilled basement or other relic structure. In comparison, exploratory holes located within the north eastern area of the site, within the footprint of the former reservoir (TP4, WS5), typically encountered a greater