



GEOENVIRONMENTAL DESK STUDY REPORT

**Higham Lane North
Dodworth
Barnsley**

Reference

JAM/DS/4173.v1

Date

January 2019

Version

1

5 John Charles Way
LEEDS
LS12 6QA

Tel: 0113 263 1155
admin@jpg.group
www.jpg.group





CONTENTS

Confidentiality Statement

Document History

Executive Summary

1.0	Introduction	1
1.1	Instruction	1
1.2	Objectives	1
1.3	Scope of Works	1
1.4	Location	1
1.5	Site Description and Topography	2
1.6	Development Proposals	2
1.7	Previous Reports	3
1.8	Limitations	3
2.0	Site History	4
3.0	Site Setting	6
3.1	Geology	6
3.2	Coal Mining	9
3.3	Other Mining	10
3.4	Hydrogeology	10
3.5	Hydrology	11
3.6	Pollution Incidents	11
3.7	Landfills and Waste	12
3.8	Environmental Permits, Incidents and Registers	12
3.9	Additional Information	13
3.10	Current Land Use	13
3.11	Radon Risks	13
3.12	Previous Reports	13
4.0	Environmental Risk Assessment	15
4.1	Introduction	15
4.2	Potential Sources	15
4.3	Potential Pathways	16
4.4	Potential Receptors	16
4.5	Pollutant Linkage Assessment	17
4.6	Risk Classification	17
5.0	Preliminary Engineering Assessment	18
5.1	Development Proposals	18
5.2	Mining	18
5.3	Earthworks	18
5.4	Foundations / Ground Floor Construction	19
5.5	Groundwater	19
5.6	Obstructions	19
5.7	Excavations	20
5.8	Roads, Pavements and Hardstanding Surfaces	20
5.9	Chemical Attack on Buried Concrete	20
5.10	Slope Stability	20
6.0	Further Investigations	21



APPENDICES

Appendix A Figures/Drawings

Figure 1 - Site Location Plan

Figure 2 - Aerial Photograph

Figure 3 - Conceptual Site Model

JPG (Leeds) Ltd. Conceptual Geological Ground Model - Landslide Hazard Plan. Higham Lane North, M1 Jct 37. 4173-GC03. Dated January 2019.

JPG (Leeds) Ltd. Conceptual Geological Ground Model - Coal Mining Risks. Higham Lane North, M1 Jct 37. 4173-GC01. Dated January 2019.

The Harris Partnership. Proposed Site Plan. Proposed Industrial Development - Capitol Park, Junction 37 M1, Higham Lane, Barnsley. Job/Dwg: 11138A-002. Dated March 2018. For Sterling Capitol PLC.

Appendix B Site Photographs

Appendix C Historical Maps

Appendix D Coal Authority Mining Reports

Appendix E Historical Exploratory Hole Records

Appendix F Notes on Limitations



CONFIDENTIALITY STATEMENT

This report is addressed to and may be relied upon by the following:

Sterling Capitol PLC
2nd Floor
Victoria Wharf
4 The Embankment
Sovereign Street
LEEDS
LS1 4BA

This report has been prepared for the sole use and reliance of the above named party. This report shall not be relied upon or transferred to any other parties without the express written authorisation of JPG (Leeds) Limited. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party.

DOCUMENT HISTORY

VERSION	PURPOSE/DESCRIPTION	DATE
1	Final – For issue to Client	January 2019



EXECUTIVE SUMMARY

Site Address	Higham Lane North, Dodworth
NGR	Approximate National Grid Reference 431550, 406370.
Current Site Use & Proposed Development	The site generally consists of sloping arable farmland, which is divided into two similar sized fields by mature trees and overgrown hedgerows. A hill is present in the southern field. It is proposed to develop the site for an industrial end use, comprising two large units with service yards, car park spacing and soft landscaping areas.
Site History	The site has remained farmland. Two small ponds were located on the western/north western boundary and later infilled. Farm buildings associated with Lane Head farm were shown in the south from 1850 to 1961 and from 1970 to 2014. A building associated with Lane Side farm possibly encroached on to the site from 1961 to 1991. The surrounding area generally remained farmland. The M1 motorway was constructed in 1970. The land to the southwest was used as a spoil heap associated with Old Silkstone Colliery and Higham Colliery.
Site Setting	Geology – A large area of worked ground associated with the M1 motorway is along the north eastern boundary. Made ground and infilled ground associated with historical spoil heaps and historical opencast coal sites are indicated approximately 32m southwest and 72m north east of the site respectively. The bedrock geology comprises Haigh Moor Rock (sandstone) and the Pennine Middle Coal Measures (mudstone, siltstone, sandstone and coal seams). Mining – The Top Haigh Moor Coal and Low Haigh Moor Coal outcrop on or close to the site and are anticipated to be present at shallow depth below the site. The Coal Authority believes this may have been worked at some point in the past. The site is in a surface area that could be affected by underground mining in six seams of coal at 90m to 290m depth, and last worked in 1966. The recorded underground coal workings are not considered to pose a risk to the surface stability of the site based on their depth and respective thicknesses. There are no known coal mine entries within, or within 20m of, the site boundary. However, the presence of unrecorded mine entries cannot be discounted. Hydrogeology – The bedrock is classified as a Secondary A Aquifer. Hydrology – There are several inland rivers within 250m of the site. Flooding – The site does not lie within a Zone 2 or Zone 3 floodplain. Landfill – There is one record of an Environment Agency historic landfill sites within 500m of the site. Radon Risks – No radon protective measures are required for new properties.
Previous Investigation	Wardell Armstrong carried out an Environmental Appraisal in September 2017. The appraisal concluded that unrecorded mine workings within the Top and Low Haigh Moor coal seams may be present beneath the site.
Environmental Risk Assessment	On the basis of the proposed end use and known history of the site, the following potential pollutant linkages may be present:) Development and maintenance workers and site end users, e.g. employees could come into contact with soils containing elevated concentrations of potential contaminants, asbestos fibres, soils with elevated calorific value and hazardous ground gases/soil vapours.) The underlying Secondary A Aquifer and surface water features adjacent to the site could become contaminated due to the leaching and migration of potential contaminants from any made ground.) Buildings and services could be affected by potential contaminants in the made ground.) Plants in landscape areas could be affected by phytotoxic elements within the made ground.) Development and maintenance workers, site end users, buildings and services could be affected by potentially combustible coal-rich made ground or natural soils including coal seams. These linkages are based on current site conditions and do not consider exposure pathways following any remediation of the site. In lieu of any chemical testing, ground contamination information, or implementation of mitigation measures, the site should be considered to be a low to moderate risk with respect to contamination.
Preliminary Engineering Assessment	Mining -A rotary borehole investigation is required to investigate the coal seams and the presence of coal workings. If any shallow coal workings within influencing depth of the surface are proven beneath the site, then these will require stabilising, e.g. drilling and grouting, or extraction prior to development. A rotary borehole investigation is required to investigate the presence of the infilled opencast in the north and north east of the site. There are no recorded mine entries on the site. However, the possibility of unrecorded mine entries (shafts, adits or bell pits) cannot be discounted. Earthworks - Earthworks, in the form of 'cut and fill', are likely to be required in order to achieve a suitable development platform. An assessment of the suitability of the natural 'cut' soils for re-use



	in earthworks will be required. The earthworks design will need to take into consideration the presence of shallow coal below the site. Any earthworks should be carried out in accordance with the Manual of Contract Documents for Highway Works, Volume 1 Specification for Highway Works, Series 600 Earthworks. Foundations/Ground Floor Construction - In areas of fill, it is considered that a raft foundation will be the most appropriate foundation solution. The earthworks will be required to provide sufficient bearing capacity and settlement characteristics of the underlying engineered fill. Where the soils/rock are to be cut into natural bedrock strata, then the use of shallow traditional strip or trenchfill foundations and ground-bearing floor slabs are likely to be suitable. If poor ground is encountered or high load areas are required, then consideration could be given to ground treatment options, e.g. vibro -stone columns or a deeper foundation solution, e.g. piles. Foundation design will need to take into account the presence of coal workings below the site, if proven. Groundwater - It may be expected that shallow perched groundwater will be encountered within the made ground and natural competent bedrock. The presence of groundwater will need to be assessed as part of any ground investigation. Obstructions - Based on the site history, the presence of significant obstructions is considered unlikely. Excavations - Excavations through any made ground and natural ground may be unstable and temporary side support may be required. Where the sandstone unit outcrops in the south, significant breaking out will be required in order to reduce levels. Roads, Pavements and Hardstanding Surfaces - It is likely that earthworks/ground improvement will be carried out as part of the redevelopment works. This may result in changes to the sub-grade materials. The earthworks should be designed to achieve a suitable CBR value for the proposed development. Chemical Attack on Buried Concrete - Samples of any made and natural ground should be obtained and submitted to the laboratory for testing in order to assess the sulphate content and acidity and hence the concrete class required for buried concrete. Slope Stability - The GS report indicates a moderate risk of landslide locally on the north western boundary. As it is proposed to raise ground levels in the north of the site in order to create a level development platform, it is anticipated that significant retaining structures will be required in order to ensure that the slope adjacent to the north eastern boundary of the site is not surcharged. Consideration should also be given to potential changes in the hydrology and hydrogeology due to the development including proposed drainage and the consequential effects on the embankment. A slope stability assessment will be required if the proposed development is to affect the slope in this location in any way.
Further Work Required	It is recommended that a ground investigation is carried out in order to further assess the potential environmental and geotechnical constraints to development. It is recommended that the investigation is carried out in a phased approach. The scope of works below is designed to provide a preliminary overview of the site and target significant potential constraints to development. - J Trial pits in order to assess the shallow ground conditions at the site and confirm the composition, extent, depth and nature of the made ground and underlying natural strata. - J Cable percussion or window sampling formed boreholes within in-situ tests to provide geotechnical information in order to assess the nature of the sub-surface and confirm the depth and distribution of any made ground. These boreholes will also facilitate the installation of gas and groundwater monitoring wells. - J Rotary open hole boreholes to investigate possible shallow coal workings and also the possibility of the backfilled opencast site encroaching on the north eastern corner. - J Chemical analysis of soil and water samples in order to determine the concentrations of potential contamination on the site. - J Geotechnical testing to classify materials and inform foundation design and chemical testing to determine the Aggressive Chemical Environment for Concrete classification. - J Monitoring of gas and groundwater wells for hazardous ground gases, methane, carbon dioxide, and oxygen and flow rate to the requirements of the Local Authority.
This sheet is intended as a summary only of the assessment of the site in relation to ground condition. It does not provide a definitive engineering analysis.	



1.0 INTRODUCTION

1.1 Instruction

JPG (Leeds) Limited has been instructed by Sterling Capital PLC to carry out a geoenvironmental desk study for a proposed industrial development at Higham Lane North, Dodworth, Barnsley.

1.2 Objectives

The main objective of the geoenvironmental desk study is to identify potential geotechnical and environmental issues that may represent constraints to the proposed development of the site.

1.3 Scope of Works

The scope of works for the desk study included the following:

-) Site inspection and description.
-) Review of contemporary and historical Ordnance Survey publications.
-) Obtain a Coal Authority Mining Report and Consultants Report and any abandonment plans.
-) Consultations with regulatory authorities, where appropriate.
-) Review of geological publications (including hydrology, hydrogeology and soil survey publications, where appropriate).
-) Review of the radon status of the site.
-) An environmental database search.
-) Review of any previous reports provided.
-) Outline environmental risk assessment.
-) Preliminary recommendations with respect to mining, foundations, ground floor and pavement design.
-) Recommendations for further work, where appropriate; and,
-) Presentation of the findings in a tabular non-technical summary.

1.4 Location

The site is located approximately 3km to the west of Barnsley town centre. The approximate centre of the site is located at NGR 431550, 406370.

The site is located to the south west of the M1 motorway and to the north of Higham Lane. A site location plan is presented as Figure 1 in Appendix A.



1.5 Site Description and Topography

A site inspection was carried out by a JPG engineer on 9 January 2019.

The site is irregular in shape and occupies an area of approximately 5.96 hectares. It generally consists of sloping arable farmland, which is divided into two similar sized fields by mature trees and overgrown hedgerows.

Access is gained via a farm track off Higham Lane. The northern field falls gradually to the northwest, with ground levels of approximately 155m AOD in the south falling to approximately 145m AOD in the north. A hill is present in the southern field, the highest point of which is at approximately 163m AOD.

A bungalow, surrounded by a stone wall and a wooden post and chain link fence, is located in the southern corner of the site.

An overhead telecoms line crosses the northern field from the northwest to the east, before continuing to follow the eastern boundary of the southern field. There is also a telecoms transmitter, surrounded by a metal post and chain link fence, in the eastern corner of the site.

The north-eastern boundary of the site comprises a wooden fence running parallel to the M1 motorway, which is located within a cutting adjacent to the site. Higham Lane abuts the south-western boundary of the site. Higham Lane is raised on an embankment adjacent to the northwest of the site before being bridged over the M1. The eastern, southern and western boundaries consist of mature trees and overgrown hedgerows.

Higham Manor and Lane Side Farm are large residential properties halfway along the south-western boundary of the site. Higham Manor and Lane Side Farm are surrounded by a stone walls, wooden fences and thick hedgerows, separating them from the site. Capitol Park, a commercial/office development is present to the east.

An aerial photograph of the site is provided as Figure 2 in Appendix A and selected photographs of the site are provided in Appendix B.

1.6 Development Proposals

It is proposed to develop the site for an industrial end use, comprising two large units with service yards, car park spacing and soft landscaping areas. A drawing of the proposed development has been provided, which is referenced below, and a copy is contained in Appendix A.

) The Harris Partnership. Proposed Site Plan. Proposed Industrial Development - Capitol Park, Junction 37 M1, Higham Lane, Barnsley. Job/Dwg: 11138A-002. Dated March 2018. For Sterling Capitol PLC.



1.7 Previous Reports

As part of this desk study, a section of the Environmental Appraisal referenced below has been reviewed:

) Wardell Armstrong. Sterling Capitol, Capitol Park, Barnsley. Environmental Appraisal. Job No: SH11957/0001, dated September 2017.

A review of this report is provided in Section 3.12.

1.8 Limitations

The general limitations to the nature of the investigation are outlined in Appendix H.



2.0 SITE HISTORY

Historical maps for the site were obtained from GroundSure (GS). These have been reviewed in order to establish any former uses of the site and identify any potentially contaminative historical uses or potential geotechnical constraints to the proposed development.

A summary of the relevant map information is presented in Table 2.0 and copies of relevant maps are contained in Appendix C.

Table 2.0 – Summary of Relevant Historical Map Information

Date(s) & Scale	Feature
1850 1:10,560	The site comprises several parcels of undeveloped fields. Multiple field boundaries are shown trending north to south and east to west. Dodworth Lane cuts across the north west of the site. A building presumed to be associated with an adjacent farm is shown in the southern corner of the site. A small pond is shown on the north-western boundary. Higham Lane is annotated as Dodworth Lane. The site is located to the north of Dodworth and north of the Sheffield and Lincolnshire railway, which is shown approximately 450m to the south of the site. Lane Head farm is shown adjacent to the southern corner of the site. Lane Side farm is shown adjacent to the south western boundary of the site. The surrounding land generally comprises fields with areas of woodland.
1890 – 1891 1:10,560 1893 1:2,500	A farm track is shown to extend along the western boundary. A pump is shown at Lane Head farm, approximately 15m to the south of the site. A small pond is shown to encroach on the north-western most part of the site, beyond which there is some potentially infilled ground. Higham colliery is shown approximately 500m to the north west of the site. Church Lane Colliery (Old Silkstone Collieries on later plans) with associated reservoirs, coke ovens (labelled on later plans) and spoil heaps, is shown approximately 550m to the south west of the site.
1904 1:10,560 1906 1:2,500	No significant changes to the site. Higham Colliery is now labelled as disused. Church Lane Colliery is now referred as Old Silkstone Collieries.
1929 1:10,560	No significant changes to the site. Reservoirs and spoil heaps associated with Higham Colliery are shown approximately 500m to the north west of the site. Higham Pumping Station is shown approximately 700m north west of the site. The coke ovens and large reservoir at Old Silkstone Colliery are no longer presented on the plans. However, the spoil heaps (assumed to be colliery waste) have increased in size to approximately 400m to the south west of the site. The pump at Lane Head farm is no longer shown on the plans.
1938 1:10,560	No significant changes to the site or the surrounding area.
1948 1:10,560	No significant changes to the site or the surrounding area.
1956 1:10,560	No significant changes to the site. The spoil heap (slag heap on later plans – assumed to be colliery spoil) associated with Old Silkstone Colliery has continued to increase in size, it is now shown approximately 200m to the south west of the site.
1961 1:2,500 1966 1:10,560	The ponds on the western boundary and in the north western corner are no longer shown on the plans. The building in the southern corner associated with Lane Head farm is no longer shown and a track is shown in this location. A building associated with Lane Side Farm is shown to the north of the farm, with the north eastern corner of the building possibly extending into the site. The spoil heap at Old Silkstone Colliery (now referred to as a Mine) is shown as a slag heap (presumed colliery spoil) and is approximately 150m to the south of the site. A long linear feature (referred to as a conveyor on later plans) is shown approximately 400m to the west of the site connecting Old Silkstone Colliery and a 'mine' shown in the area of the disused Higham Colliery. Large opencast workings are shown approximately 400m to the north of the site. Smaller opencast workings are shown approximately 750m to the northeast of the site (adjacent to Pogmoor). A second Lane Head (shown as a farm) is located approximately 200m to the south of the site.
1970 1:2,500 1973 1:10,000	There is now only one field boundary shown on site, trending east to west. A small building (presumed dwelling) is shown in the southern corner of the site, adjacent to Lane Head (now also labelled as a farm). The raised section (embankment) of Higham Lane is shown along the western boundary of the site. The M1 motorway (shown as a cutting) bounds the north eastern boundary of the site. The slag heap (presumed colliery spoil) associated with the south western mine (Old Silkstone Colliery) is approximately 50m to the south west of the site. The opencast workings are no



	longer shown on the plans. Part of the Sheffield and Lincolnshire Railway is shown to be dismantled, approximately 400m to the south east of the site.
1982 1:2,500 & 1:10,000	No significant changes to the site. Both Lane Head Farms are shown as one large farm. The southern part of the former slag heap (presumed colliery spoil) appears to have been landscaped. The conveyor only extends to the start of the slag heap, approximately 400m to the north west of the site. A disused tip assumed to be associated with Higham Colliery is shown approximately 500m north west, with the associated 'mine' no longer shown on the plans.
1991 1:2,500 1993 1:10,000	The building associated with Lane Side Farm which extended into the site no longer appears on the plans. The slag heap to the west is now referred to as disused workings. The south western mine (Old Silkstone Colliery) is no longer shown on the plans, with Fall Bank Industrial Estate being developed in that area, approximately 750m to the south west of the site.
2002 1:10,000	No significant changes to the site. Dodworth Business Park has been built over the former Old Silkstone Colliery, between approximately 500m and 750m to the south west of the site.
2014 1:10,000	No significant changes to the site. Several small units are shown immediately to the east of the site.

In summary, the site has remained farmland. Two small ponds were located on the western/ north western boundary and later infilled. Two separate buildings associated with Lane Head (referred to as Lane Head Farm on later maps) were shown in the south from 1850 to 1961 and from 1970 to 2014. A circular structure assumed to be a pond was shown partially on site from 1850 to 1890. A building associated with Lane Side Farm was shown to possibly encroach onto the site from 1961 to 1991.

The surrounding area has generally remained farmland. However, the M1 motorway was constructed in 1970 adjacent to the north eastern boundary. The land to the south west was used as a spoil heap associated with the Old Silkstone Colliery and Higham Colliery. Old Silkstone Colliery (Originally known as Church Lane Colliery) was active until approximately 1993 and was later redeveloped as Dodworth Business Park by 2002. Higham Lane colliery, located to the northwest, was active until approximately 1982.



3.0 SITE SETTING

3.1 Geology

The GS Report and the following geological publications have been consulted:

- J British Geological Survey (BGS), Sheet 87, Barnsley, 1:50,000 scale, Solid and Drift Edition, published 2008.
- J BGS, Sheet SE30NW, Barnsley 1:10,000 scale, dated 2005.
- J BGS, The Pennine Lower and Middle Coal Measures formations of the Barnsley district, Internal Report IR/06/135, dated 2006.

A large area of worked ground, associated with the M1 motorway, is indicated along the north eastern boundary of the site. Further made ground and infilled ground associated with historical spoil heaps and historical opencast coal sites are indicated approximately 32m to the south west and 72m to the north east of the site respectively.

No superficial deposits are recorded on the site.

The bedrock geology comprises the Haigh Moor Rock, consisting of sandstone, and also the Pennine Middle Coal Measures Formation consisting of undifferentiated mudstone, siltstone, sandstone and coal seams. The overall dip of the solid geology is shown as 5 degrees to the north east. The hill in the south of the site corresponds with the sandstone unit shown to outcrop on the geological maps in this part of the site.

No faults are recorded on the site.

Historical borehole records have been obtained from the BGS Geoindex Onshore website. A summary of the boreholes records is provided below. Copies of the borehole logs are presented in Appendix E.

Development Site Junction 37 M1 Motorway Dodworth TP50, on site.

Borehole Reference: SE30NW544

Depth: 1.50m bgl

NGR: 431650 406220

Depth (m bgl)	Geology
Surface to 1.50m bgl	
0 – 0.15	DISTURBED GROUND: friable/stiff, brown silty clay topsoil containing straw.
0.15 – 0.85	Stiff/friable, grey/orange-brown very gravelly sandy CLAY containing sandstone gravels and cobbles.
0.85 – 1.25	Weak, black COAL (highly weathered bedrock).
1.25 – 1.50	Very stiff/friable, grey/grey-brown silty CLAY.



M1 Aston-Leeds Motorway B184, 20m northwest of the site.

Borehole Reference: SE30NW343

Depth: 18.60m bgl

NGR: 431383 406591

Depth (m bgl)	Geology
Surface to 18.59m bgl	
0 – 0.18	Grey clayey silty TOPSOIL.
0.18 – 1.82	Stiff mottled grey and brown silty CLAY.
1.82 – 4.60	Soft, massive, pale grey SILTSTONE, with silty mudstone laminations at base, hard below 2.74m.
4.60 – 7.19	Moderately hard, mid grey silty MUDSTONE, less silty at base; mainly unbroken with closed vertical joints.
7.19 – 7.62	COAL, with bands of carbonaceous mudstone.
7.62 – 9.32	Soft, black carbonaceous, shaley MUDSTONE, with fragments of coal and hard ironstone.
9.32 – 10.90	Moderately hard, mid grey, silty MUDSTONE, with closed vertical joints.
10.90 – 13.41	Hard, pale grey, SILTSTONE massive, with open and closed near vertical joints.
13.41 – 16.03	Hard, massive, mid grey very silty MUDSTONE, with thin ironstone bands.
16.03 – 18.59	Hard, pale grey, slightly ironstained SILTSTONE, with silty mudstone laminations towards base; massive with open vertical joints.

M1 Aston-Leeds Motorway B185, 49m northwest of the site.

Borehole Reference: SE30NW344

Depth: 18.59m bgl

NGR: 431370 406617

Depth (m bgl)	Geology
Surface to 18.59m bgl	
0 – 0.18	Grey clayey silty TOPSOIL.
0.18 – 2.13	Stiff mottled grey and brown silty CLAY.
2.13 – 4.14	Hard unbroken pale brown ironstained SILTSTONE with silty mudstone laminations.
4.14 – 6.71	Moderately hard, mid grey silty MUDSTONE, less silty at base, with closed vertical joints.
6.71 – 7.92	COAL, with bands of soft shaley mudstone.
7.92 – 8.72	COAL.
8.72 – 8.84	Soft shaley MUDSTONE (Seatearth).
8.84 – 11.00	Hard, mid grey silty MUDSTONE with plant debris and occasional siltstone laminations.
11.00 – 13.30	Hard, massive pale grey SILTSTONE with wispy carbonaceous and silty mudstone laminations at base.
13.30 – 16.20	Hard unbroken mid grey very silty MUDSTONE.
16.20 – 18.30	Hard massive SANDSTONE, with silty mudstone laminations at top.
18.30 – 18.59	Moderately hard, very silty MUDSTONE.



M1 Aston-Leeds Motorway R 238, 58m northeast of the site.

Borehole Reference: SE30NW423

Depth: 3.23m bgl

NGR: 431671 406433

Depth (m bgl)	Geology
Surface to 3.23m bgl	
0 – 0.18	TOPSOIL.
0.18 – 2.93	Grey silty mudstone and ironstained siltstone fragments in a matrix of silty CLAY of variable stiffness. (FILL).
2.93 – 3.23	Brown SANDSTONE.

M1 Aston-Leeds Motorway R 239, 42m northeast of the site.

Borehole Reference: SE30NW424

Depth: 2.44m bgl

NGR: 431583 406617

Depth (m bgl)	Geology
Surface to 2.44m bgl	
0 – 0.30	TOPSOIL.
0.30 – 2.13	Very soft becoming soft (weathered) mottled grey brown silty MUDSTONE with siltstone and carbonaceous mudstone bands.
2.13 – 2.44	Moderately hard grey ironstained silty MUDSTONE.

M1 Aston-Leeds Motorway R 240, 33m northeast of the site.

Borehole Reference: SE30NW425

Depth: 2.44m bgl

NGR: 431495 406547

Depth (m bgl)	Geology
Surface to 2.44m bgl	
0 – 0.30	Dark grey clayey silty TOPSOIL and roots.
0.30 – 1.83	Stiff grey brown mottled silty CLAY.
1.83 – 2.44	Soft (weathered) grey ironstained silty MUDSTONE.

The following coal seams outcrop on or close to the site and are anticipated to be present at shallow depth below the site (youngest to oldest):

-) Top Haigh Moor Coal.
-) Low Haigh Moor Coal.

Based on the generalised vertical section included on the 1:10,000 scale geological map, the Top Haigh Moor coal seam has a recorded thickness of 0.69m to 1.19m and is separated from the Low Haigh Moor coal seam by approximately 10m; this latter coal seam has a recorded thickness of between 0.42m and 1.02m and is indicated to be present as two distinct leaves.

The coal mining legacy is summarised in Section 3.2 below.



3.2 Coal Mining

A Mining Report and Consultants Report have been obtained from the Coal Authority (CA), these are presented in Appendix D and pertinent information is detailed below.

- J The property is in a surface area that could be affected by underground mining in 6 seams of coal at 90m to 290m depth, and last worked in 1966. Any movement in the ground due to coal mining activity should have stopped.

Table 3.2.1 – Summary of Recorded Underground Coal Workings

Coal Seam	Depth (m)	Dipping rate of seam worked (degrees)	Extraction Thickness (m)
Flockton Thick	86	3.9	0.61
Top Fenton	127	3.9	0.74
Parkgate	150	2.2	1.37
Wheatley Lime (Silkstone Four-Foot)	192	1.3	1.09
Silkstone	237	4.1	1.47
Whinmoor	272	4.1	1.07

The recorded underground coal workings are not considered to pose a risk to the surface stability of the site based on their depth and respective thicknesses.

- J *In addition, the property is in an area where the Coal Authority believes there is coal at or close to the surface. This coal may have been worked at some time in the past. The potential presence of coal workings at or close to the surface should be considered, particularly prior to any site works or future development activity, as ground movement could still be a risk.*

It is considered that the above comment relates to the presence of the Top Haigh Moor and Low Haigh Moor coal seams at shallow depth below the site. The next named coal seam below the Low Haigh Moor is the Lidget. Based on the coal seam separation, the Lidget coal seam is not considered to pose a risk to the surface stability of the site.

The Coal Authority Interactive Map indicates:

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

However, the presence of unrecorded mine entries (shafts or adits as well as bell pits) cannot be discounted:

- J The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.
- J The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.



However, a historical opencast site (known as the Hunters Cottage) is indicated immediately to the north east of the site's north eastern corner, beyond the M1 motorway. Abandonment plans indicate that the Swallow Wood and Top Haigh Moor coal seams were extracted by opencast methods. There is the potential that this infilled opencast including associated highwalls encroaches below the north east of the site.

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

However, there is a risk to the site from ground gas due to infilled ground and coal/mines gas and a ground gas investigation and risk assessment will be required.

A drawing showing the coal mining risks, including a cross section of the site, has been prepared, which is referenced below, and a copy is contained in Appendix A.

) JPG (Leeds) Ltd. Conceptual Geological Ground Model – Coal Mining Risks. Higham Lane North, M1 Jct 37. 4173-GC01. Dated January 2019.

A Coal Mining Risk Assessment has been prepared by JPG, which is referenced below:

) JPG (Leeds) Ltd. Coal Mining Risk Assessment and Coal Recovery Report. Higham Lane North – Proposed Industrial Development at Dodworth. Report Ref. JAM/CMRA/4173.v1. Dated January 2019 for Sterling Capitol PLC.

3.3 Other Mining

The GS report refers to the underground abstraction of bedded iron ore on a small scale. The BGS indicate that 'localised small scale underground mining may have occurred. Potential for difficult ground conditions are unlikely or localised and are at a level where they need not be considered'.

3.4 Hydrogeology

The bedrock geology below the site is classified as a Secondary A Aquifer. These are described 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. These are generally aquifers formerly classified as minor aquifer'.

There are no active recorded groundwater abstraction licences within 1km of the site.

The site does not lie within 500m of an Environment Agency Groundwater Source Protection Zone.



3.5 Hydrology

The site is located within the Don and Rother catchment area. There are several Inland Rivers within 250m of the site, the nearest is 25m southwest of the site, trending northwest to southeast.

There are two active licenced discharge consents to surface water within 250m of the site. These are summarised in Table 3.4 below.

Table 3.4 - Summary of Active Licenced Discharge Consents to Surface Water

Distance & Direction	Permit Number	Address	Effluent Type	Receiving water	Effective Date
11m S	WRA8071	Laneside Farm, Higham Common Lane, Higham, Barnsley, S75 1PN	Sewage Discharge – Final/Treated Effluent	Land	17-Feb-2004
182m W	WRA7173	Dodworth Colliery Tip, Outlets A & B, Dodworth, Barnsley	Trade Discharges – Process Effluent	Tributary of Silkstone Beck	15-Jun-2001

There are no recorded surface water abstraction licences within 2km of the site.

Information on the EA website and presented in the GS report indicates that the site does not lie within a Zone 2 or Zone 3 floodplain. The risk of the site flooding from Rivers and the Sea (RoFRaS) is indicated to be very low.

The GS report indicates that there is the potential for groundwater flooding at the surface due to the underlying geology. The BGS confidence level in their assessment is high, but the actual susceptibility and the risk of groundwater flooding occurring at the site should be assessed based on site specific information.

It is likely that a flood risk assessment will be required by the Local Authority as part of any planning application for the site.

3.6 Pollution Incidents

There are three recorded Environment Agency Recorded Pollution Incidents within 500m of the site. These are summarised in Table 3.5 below.

Table 3.5 – Summary of Environment Agency Recorded Pollution Incidents with Significant Impacts

Distance & Direction	Incident Date	Incident Identification	Pollutant	Impacts
33m SW	20-Feb-2013	1088231	Contaminated Water (chemically contaminated run-off)	Water impact: Category 2 (Significant)
195m W	06-Apr-2018	1603339	Contaminated Water (Minewater)	Water impact: Category 2 (Significant)
452m SW	22-Apr-2002	73573	Contaminated Water (Minewater)	Land impact: Category 3 (Minor)



3.7 Landfills and Waste

The GS report includes information on active and former landfill sites supplied by the Environment Agency, Landmark, Local Authority and the BGS.

There is one record of an Environment Agency historical landfill site within 500m of the site. A summary of these is provided in Table 3.6.1 below.

Table 3.6.1 - Summary of Historical Environment Agency Landfill Sites

Distance & Direction	Site Address	Site Reference	Operator	Waste Type	Licence Issue
376m N	Football Pitch to rear of Mines PH, Higham Common Road, Higham	4400/(156)	Mr J Cooper	Commercial	-

There are no records of BGS/DoE non-operational landfill sites within 500m of the site.

There are no records of landfills from Local Authority and historical mapping records within 500m of the site.

There are three records of waste treatment, transfer or disposal sites taken from historical mapping within 500m of the site. A summary of these is provided in Table 3.6.3 below.

Table 3.6.3 - Records of waste treatment, transfer or disposal sites within 500m

Distance & Direction	Type of Site	Grid Ref	Source
169m S	Ground Workings and Refuse Heap	431401, 405803	1961 Map
411 SW	Ground Workings and Refuse Heap	431335, 405709	1893 Map
427m SW	Ground Workings and Refuse Heap	431305, 405707	1906 Map

There are no EA licensed waste treatment, waste transfer or waste disposal sites within 500m of the site.

3.8 Environmental Permits, Incidents and Registers

There are no active Part A (2) or Part B permitted activities (potential to cause air pollution) within 500m of the site.

There are no records of any historical Integrated Pollution Control (IPC) authorisations within 500m of the site.

There are no recorded historical Part A(1) and Integrated Pollution Prevention Control (IPPC) authorised activities within 500m of the site.

There are no records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the site.

There is no recorded Red List Discharge Consent (potentially harmful discharges to controlled waters) within 500m of the site.



There are no active List 1 Dangerous Substances Inventory Sites and one List 2 Dangerous Substances Inventory Site within 500m of the site. The List 2 authorised substances comprise copper, iron, nickel and zinc, and relates to Dodworth Colliery Tip, approximately 282m southwest of the site.

There are no Category 3 or 4 Radioactive Substances Licences within 500m of the site.

There are no recorded Control of Major Accidents Hazard (COMAH) or Notification of Installations Handling Hazardous Substances (NIHHS) or sites within 500m of the site.

There are no sites determined as Contaminated Land under Part IIA EPA 1990 within 500m of the site.

3.9 Additional Information

There are no records of petrol and fuel filling stations within 500m of the site.

There are no historical electricity substations within 250m of the site.

There are four historical refuse tips within 250m of the site. The closest is approximately 34m south west of the site.

The site is located within the Nitrate Vulnerable Zone and is part of the Barnsley District of the Liverpool, Manchester and West Yorks Greenbelt.

3.10 Current Land Use

There are five records of potentially contaminative sites within 250m of the site, the closest to the site is an electricity substation situated adjacent to the southern corner of the site. One of the sites within 100m are considered to have the potential to affect the contaminative status of the site.

3.11 Radon Risks

The site is located in a radon affected area as defined by the Health Protection Agency, as between 1% and 3% of properties are above the action level. However, in accordance with the Building Research Establishment publication BR211, no radon protective measures are required for new properties constructed on the site.

3.12 Previous Reports

A previous Environmental Appraisal was carried out by Wardell Armstrong in September 2017. This included a geological and hydrogeological assessment, a mining assessment and a conceptual site model.



The appraisal concluded that unrecorded mine workings within the Top and Low Haigh Moor coal seams may be present beneath the site; JPG concur with this assessment.

The conceptual site model identified made ground and coal/mines gas as potentially significant on-site contamination sources. The model also identified *'historical landfill associated with extensive past tipping and reclamation work'* as a potential significant off-site contamination source.



4.0 ENVIRONMENTAL RISK ASSESSMENT

4.1 Introduction

The presence of contaminated materials on a site is generally only of concern if an actual or potentially unacceptable risk exists. Within the context of current UK legislation i.e. Part 2A of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995, the interpretation of a "significant risk" is termed to be one where:

-) Significant harm is being caused, or there is a significant possibility of such harm being caused, (where harm is defined as harm to health of living organisms or other interference with the ecological systems of which they form a part and, in the case of man, includes harm to his property); and/or
-) Pollution of controlled waters is being caused.

The potential for harm to occur requires three conditions to be satisfied:

-) Presence of substances (potential contaminants/pollutants) that may cause harm (Sources).
-) The presence of a receptor which may be harmed, e.g. the water environment or humans, buildings, fauna and flora (Receptors).
-) The existence of a linkage between the Source and the Receptor (The Pathway).

In order to assess the contamination risk at the site, the above rationale has been applied and is discussed in the context of Contamination Sources and Potential Pollutant Linkages.

4.2 Potential Sources

Based on the findings of the desk study, it is evident that the site has been subject to agricultural land uses. In addition, the possibility of shallow coal seams and coal workings within the Top Haigh Moor and Low Haigh Moor coal seam cannot be discounted.

Based on the above, the following potentially contaminative sources may be present on the site:

-) Made ground associated with the adjacent development of the M1 motorway and activity around the existing buildings.
-) Reworked Topsoil made ground associated with agricultural activities on the site.
-) Shallow coal-rich made ground and/or natural ground, including coal seams, having elevated calorific value.
-) Hazardous ground gases/soil vapours associated with the made ground, possible shallow coal and coal workings and localised areas of infilled land/ponds, including adjacent land (colliery spoil heap and backfilled opencast sites).



Potential contaminants which could be present beneath the site, or which could have migrated onto the site from potential sources beyond the site are listed below:

-) Metals, metalloids and their compounds.
-) Inorganic compounds, e.g. arsenic.
-) Asbestos.
-) Pesticides, herbicides.
-) Organic compounds including hydrocarbons (petrol/diesel/oils) and Polycyclic Aromatic Hydrocarbons (PAH).
-) Calorific value associated with coal-rich made ground
-) Hazardous Ground Gases/Soil vapours.

4.3 Potential Pathways

Based on the available information and the proposed development of the site for an industrial end use, the following potential exposure pathways will require consideration, both during the development works and on completion of the construction:

-) Ingestion and dermal contact with contaminated soil and groundwater.
-) Inhalation of asbestos fibres.
-) Inhalation of hazardous ground gases/soil vapours.
-) Leaching/migration of contaminants from soil into surface water and groundwater via surface and groundwater flow.
-) Permeation of water supply pipes and other services by organic and aggressive contaminants.
-) Uptake of contaminants by planting in landscape areas; and
-) Combustion of soils with elevated calorific value.

4.4 Potential Receptors

The potential receptors considered are:

-) Development workers and future maintenance workers involved in excavations, e.g. foundations or where services are being installed or repaired following development.
-) Future end users of the site, i.e. employees.
-) The underlying bedrock strata, i.e. Secondary A Aquifer.
-) Nearby surface water features, i.e. streams adjacent to the site.
-) Buildings and services; and
-) Planting in landscaped areas.



4.5 Pollutant Linkage Assessment

A potential pollutant linkage assessment has been completed and is summarised in the Conceptual Site Model which is presented as Figure 3 in Appendix A. This is based on the proposed development of the site for an industrial end use.

On the basis of the proposed end use and known history of the site, the following potential pollutant linkages may be present:

-) Development and maintenance workers and site end users, e.g. employees could come into contact with soils containing elevated concentrations of potential contaminants, asbestos fibres, soils with elevated calorific value and hazardous ground gases/soil vapours.
-) The underlying Secondary A Aquifer and surface water features adjacent to the site could become contaminated due to the leaching and migration of potential contaminants from any made ground.
-) Buildings and services could be affected by potential contaminants in the made ground.
-) Plants in landscape areas could be affected by phytotoxic elements within the made ground.
-) Development and maintenance workers, site end users, buildings and services could be affected by potentially combustible coal-rich made ground or natural soils including coal seams.

These are based on current site conditions and do not consider exposure pathways following any remediation of the site. If the site can be shown to pose no "significant harm" or pollution to controlled waters, then the site can be considered to be uncontaminated.

4.6 Risk Classification

Based on the potential pollutant linkages present on the site, the site should be considered to be **low to moderate risk with respect to contamination**, prior to any sampling and testing of soils. This designation will be largely dependent on the nature of any made ground or hazardous gases present on or adjacent to the site.

In order to fully assess and classify the risks to human health, groundwater, surface water and buildings/services, additional Phase 2 Intrusive Investigation, including chemical testing of soils and groundwater and ground gas monitoring will be required.



5.0 PRELIMINARY ENGINEERING ASSESSMENT

5.1 Development Proposals

It is proposed to develop the site for an industrial end use with associated hardstanding and soft landscaping areas.

A drawing of the proposed development has been provided, which is referenced below' and a copy is contained in Appendix A.

J The Harris Partnership. Proposed Site Plan. Proposed Industrial Development - Capitol Park, Junction 37 M1, Higham Lane, Barnsley. Job/Dwg: 11138A-002. Dated March 2018. For Sterling Capitol PLC.

5.2 Mining

The Coal Authority reports and the BGS 1:10,000 geological map show that the site is underlain by the Top Haigh Moor and the Low Haigh Moor coal seams at shallow depth. The Top Haigh Moor outcrops across the site, trending roughly north to south. The upper leaf of the Low Haigh Moor coal seam outcrops on/near the western site boundary and the lower leaf is shown to outcrop approximately 150m to the southwest.

The possibility of historical underground workings in the aforementioned two coal seams below the site cannot be discounted. On this basis, a rotary borehole investigation is required to investigate the coal seams and the presence of coal workings.

If any shallow coal workings within influencing depth of the surface are proven beneath the site, then these will require stabilising, e.g. drilling and grouting, or extraction prior to development.

The Top Haigh Moor coal seam has been subject to opencast mining to the north and northeast of the site in the Hunters Cottage opencast coal site. There is the possibility that the infilled opencast workings encroach onto the northeast of the site. A rotary borehole investigation is required to investigate the presence of the infilled opencast in this location.

There are no recorded mine entries on the site. However, the possibility of unrecorded mine entries (shafts, adits or bell pits) cannot be discounted.

5.3 Earthworks

Given the nature of the site, i.e. sloping from the centre of the southern field into the northern corner of the site, earthworks, in the form of 'cut and fill', are likely to be required in order to achieve a suitable development platform. An assessment of the suitability of the natural 'cut' soils for re-use in earthworks will be required. The earthworks design will need to take into consideration the presence of shallow coal below the site.



In order to create the development platforms for the two industrial units, it is likely that soils/rock will be cut from the south of the site and used to raise levels in the north.

If coal workings are identified during the site investigation, there is the potential for extraction of the worked coal seam(s) below the site as part of the earthworks package.

Any earthworks should be carried out in accordance with the Manual of Contract Documents for Highway Works, Volume 1 Specification for Highway Works, Series 600 Earthworks.

5.4 Foundations/Ground Floor Construction

Based on the findings of this desk study, ground conditions are likely to comprise topsoil or reworked natural over a minimal thickness of made ground, underlain by weathered and competent bedrock comprising mudstone, siltstone and sandstone.

It is anticipated that significant earthworks will be required to create development platforms for the proposed industrial units.

In areas of fill, it is considered that a raft foundation will be the most appropriate foundation solution. The earthworks will be required to provide sufficient bearing capacity and settlement characteristics of the underlying engineered fill.

Where the soils/rock are to be cut into natural bedrock strata, then the use of shallow traditional strip or trenchfill foundations and ground-bearing floor slabs are likely to be suitable.

If poor ground is encountered or high load areas are required, then consideration could be given to ground treatment options, e.g. vibro -stone columns or a deeper foundation solution, e.g. piles.

Foundation design will need to take into account the presence of coal workings below the site, if proven.

5.5 Groundwater

It may be expected that shallow perched groundwater will be encountered within the made ground and natural competent bedrock. The presence of groundwater will need to be assessed as part of any ground investigation.

5.6 Obstructions

Based on the site history, the presence of significant obstructions is considered unlikely.



5.7 Excavations

Excavations through any made ground and natural ground may be unstable and temporary side support may be required.

Where the sandstone unit outcrops in the south, significant breaking out will be required in order to reduce levels.

5.8 Roads, Pavements and Hardstanding Surfaces

It is likely that earthworks/ground improvement will be carried out as part of the redevelopment works. This may result in changes to the sub-grade materials. The earthworks should be designed to achieve a suitable CBR value for the proposed development.

5.9 Chemical Attack on Buried Concrete

Samples of any made and natural ground should be obtained and submitted to the laboratory for testing in order to assess the sulphate content and acidity and hence the concrete class required for buried concrete.

5.10 Slope Stability

The GS report indicates a moderate risk of landslide locally on the north western boundary. The affected area appears to coincide with an area of the cutting adjacent to the bridge abutment. Moderate risk is defined as: 'Possibility of slope instability problems after major changes in ground conditions. Consideration should be given to stability if changes to drainage or excavations take place. Possible increase in construction cost to reduce potential slope stability problems.' The remainder of the site is shown to be either very low or low risk in relation to landslides.

As it is proposed to raise ground levels in the north of the site in order to create a level development platform, it is anticipated that significant retaining structures will be required in order to ensure that the slope adjacent to the north eastern boundary of the site is not surcharged. Consideration should also be given to potential changes in the hydrology and hydrogeology due to the development including proposed drainage and the consequential effects on the embankment.

A slope stability assessment will be required if the proposed development is to affect the slope in this location in any way.

A drawing showing the locations of the landslide hazards, based on the GS report, has been prepared, which is referenced below. and a copy is contained in Appendix A.

J) JPG (Leeds) Ltd. Conceptual Geological Ground Model - Landslide Hazard Plan. Higham Lane North, M1 Jct 37. 4173-GC03. Dated January 2019.



6.0 FURTHER INVESTIGATIONS

It is recommended that a ground investigation is carried out in order to further assess the potential environmental and geotechnical constraints to development.

The scope of works below is designed to target significant potential constraints to development.

-) Trial pits in order to assess the shallow ground conditions at the site and confirm the composition, extent, depth and nature of the made ground and underlying natural strata.
-) Cable percussion or window sampling formed boreholes within in-situ tests to provide geotechnical information in order to assess the nature of the sub-surface and confirm the depth and distribution of any made ground. These boreholes will also facilitate the installation of gas and groundwater monitoring wells.
-) Rotary open hole boreholes to investigate possible shallow coal workings and also the possibility of the backfilled opencast site encroaching on the north eastern corner.
-) Chemical analysis of soil and water samples in order to determine the concentrations of potential contamination on the site.
-) Geotechnical testing to classify materials and inform foundation design and chemical testing to determine the Aggressive Chemical Environment for Concrete classification.
-) Monitoring of gas and groundwater wells for hazardous ground gases, methane, carbon dioxide, and oxygen and flow rate to the requirements of the Local Authority.

J. Morley

B.Sc. (Hons), M.Sc., F.G.S

For and on behalf of JPG (Leeds) Limited

January 2019