GROUNDTECH
CONSULTING

Job title: Neverstitch Road, Skelmersdale

Report type: Preliminary Environmental Risk Assessment

Prepared for: Bellway Homes (NW)

Date: December 2019

Document Control Form	
PROJECT	*NEVERSTITCH ROAD, SKELMERSDALE*
REPORT NAME	*PRELIMINARY ENVIRONMENTAL RISK ASSESSMENT*
REPORT REFERENCE	*19255/1167*
STATUS	*FINAL*
ISSUE DATE	*13 DECEMBER 2019*
REVISION	*1.1 – 26 DECEMBER 2019*
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19255 05	-	Coal Features Plan

1.0 INTRODUCTION

1.1 Project Objectives

Groundtech Consulting Limited have been instructed by Bellway Homes (NW) to undertake a Phase I Preliminary Risk Assessment for a site at Neverstitch Road in Skelmersdale.

The objectives of the Preliminary Environmental Risk Assessment were to establish the site's environmental and geotechnical background in order to generate a Conceptual Site Model to identify any potential constraints and linkages which may affect the redevelopment of the site.

The report has been undertaken to fulfil the requirements of a preliminary risk assessment in accordance with CLR11 "Model Procedures for the Management of Land Contamination".

1.2 Proposed Development

The proposed development is residential end use with associated soft landscaping areas and infrastructure, a development layout is not available at this stage.

1.3 Limitations

This Preliminary Environmental Risk Assessment is based on information obtained from a number of sources, and the information is assumed to be correct.

Other conditions may exist on the site that have not been taken into account in this assessment as they are outside the scope of works. Groundtech Consulting are not responsible for these circumstances that are not outlined in the report.

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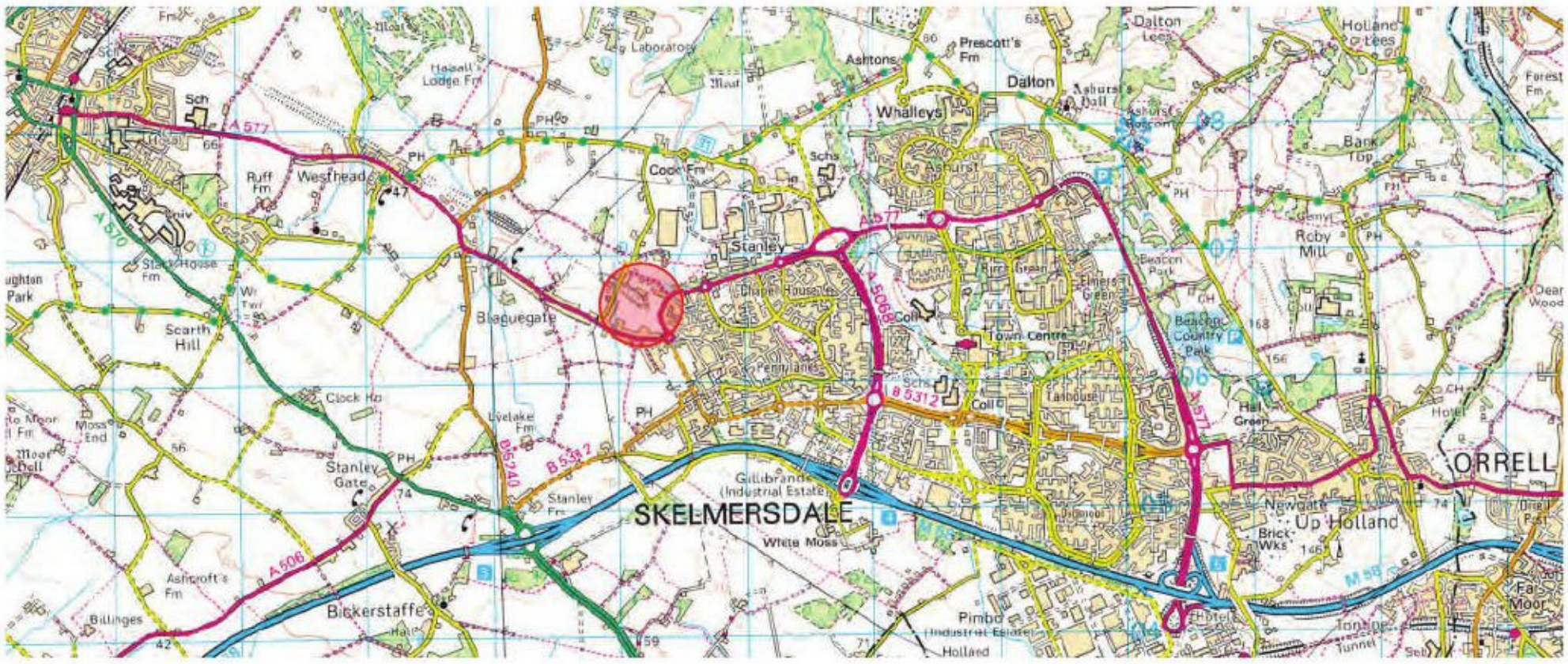
2.0 SITE SETTING

2.1 Location

The site is located circa 2km west of Skelmersdale Town Centre, as shown on the Project Location Plan 19255 01 and is approximately centred on National Grid Reference 346273, 406615.



Access to the site can be gained off the following roads:

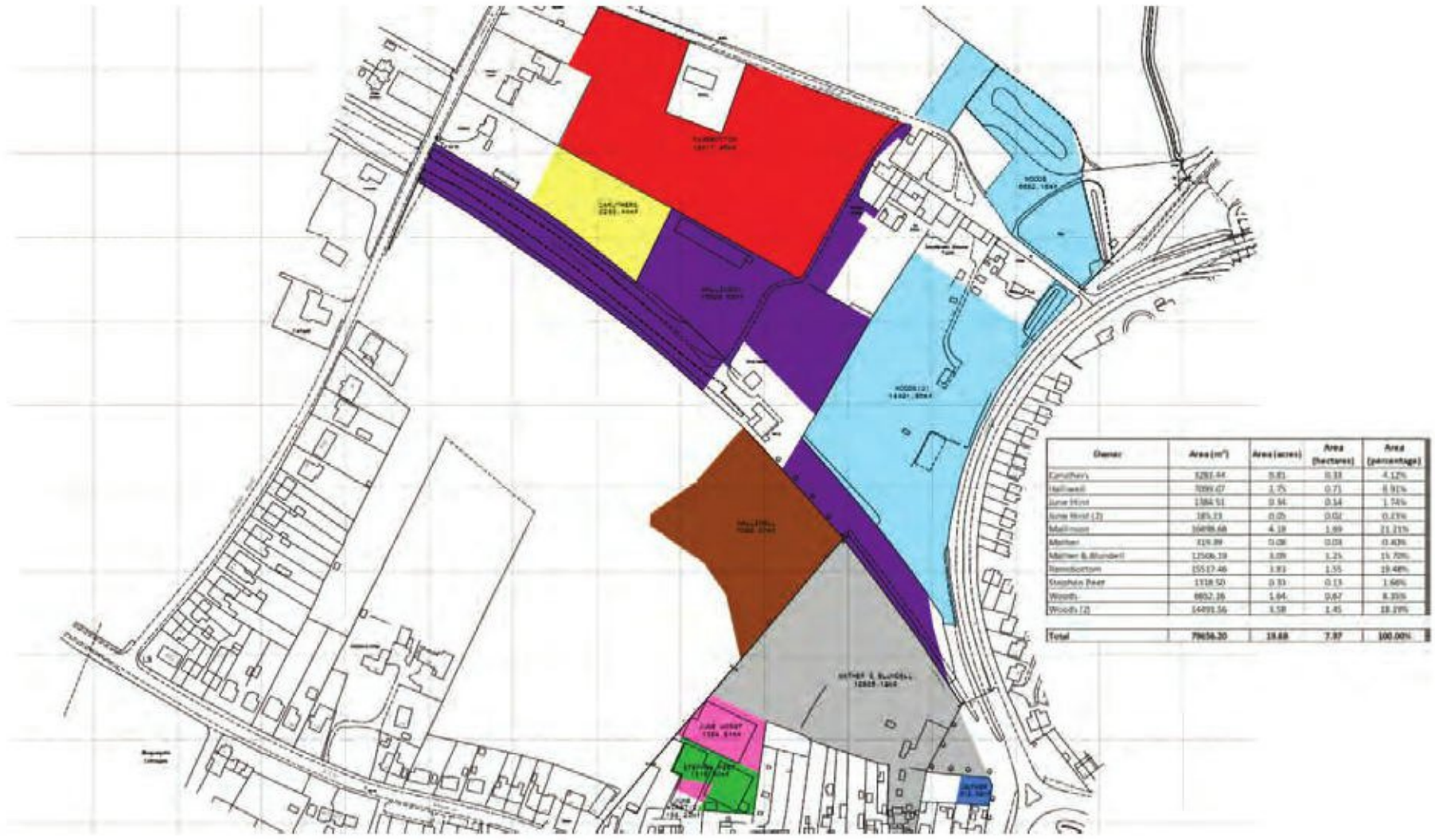
- Neverstitch Road to the east.
- Ormskirk Road to the south.
- Firswood Road to the west.
- Old Engine Lane to the north.

2.2 Site Description

Full Site Area

The full development area comprises approximately 7.9 hectares of land in the western part of Skelmersdale which generally comprises fields, woodland, a pond, greenhouses, and a commercial premise.

For the purpose of the site reconnaissance, the full area has been separated into separate plots and each one has been discussed separately. The various parcels of land are depicted on the Survey Operations Land Parcel Drawing No. 19F052/003, dated September 2019. A copy of this is appended and an extract is below.



Owner	Area (m²)	Area (acres)	Area (hectares)	Area (percentage)
Caruthers	3281.44	0.81	0.33	4.12%
Hallowell	7099.07	1.75	0.71	8.91%
June Hirst	1384.51	0.34	0.14	1.74%
June Hirst (2)	185.23	0.05	0.02	0.23%
Mallinson	16498.68	4.19	1.69	21.21%
Marten	819.89	0.08	0.08	0.43%
Marten & Blundell	12506.19	3.09	1.25	15.70%
Ramsbottom	15517.46	3.83	1.55	19.48%
Stephen Beer	1318.50	0.33	0.13	1.66%
Woods	6652.26	1.64	0.67	8.35%
Woods (2)	14493.56	3.58	1.45	18.19%
Total	79656.20	19.68	7.97	100.00%

Ramsbottom Land (Red)
This is located in the northern development area and forms a relatively level field which is accessed off Old Engine Lane to the north.

The field was grass covered at the time of the site reconnaissance. Reeds were present across the central and eastern part of this field where very soft surface conditions were noted. No reeds and firmer ground conditions were observed beneath the western area.

The boundary to this field was formed by dense vegetation consisting of semi-mature and mature trees, hedgerows, brambles and bushes.

Caruthers Land (Yellow)
This area is formed by a rectangular grassed paddock which is accessed from a neighbouring property along its north west boundary, the topography is generally level.

An overhead powerline crosses the paddock towards its southern boundary.

The boundary is formed by a mixture of wooden fencing and post and wire fencing.

The paddock is slightly higher than the Ramsbottom field to the north by c.0.5m and the Mallinson land to the east by 1m to 2m.

Mallinson Land (Purple)
The southern proportion of this parcel of land forms a cutting where a former railway line used to run in an east to west orientation. The cutting is generally overgrown with vegetation and several semi-mature and mature trees are established along the crest of the cutting. Some waste materials are present in the base of the cutting including old tyres. The former railway line extends to the east, almost to Neverstitch Road along the eastern boundary, and comprises a grassed wooded area.

The central area of this parcel contains a hardsurfaced yard and an elongate unit of single storey construction with roller shutter doors. Old farm machinery is stored around the perimeter of the concrete surfaced yard. Above ground fuel storage tanks are present along the southern elevation of the shed.

A grassed lawn area is present in the western area associated with a residential dwelling which is located just to the south off the subject site. A strip of hardstanding is in the north east part of the lawn which leads to a performing stage where a steel frame structure is present.

The northern area consists of an access track leading from Old Engine Lane.

Woods and Woods (2) (Pale Blue)
Limited access was possible into this area at the time of the site reconnaissance.

A heavily wooded area to the north of Old Engine Lane is located in the north east corner of the site containing a pond in its eastern corner.

The Woods (2) area appears to be formed by grassland with numerous semi-mature and mature trees being present.

Halliwell (Brown)
This area comprises an almost rectangular piece of land that was heavily overgrown with vegetation and limited access was possible. This parcel is bordered by wooden panel fencing associated with a new residential development to the west and vegetation in the form of semi-mature and mature trees.

Mather and Blundell (Grey)
Access to this parcel of land is gained off Ormskirk Road along the southern boundary where there is a gap in the wooden fencing and is currently blocked off with heras fencing. This area forms the south eastern extent of the site and is irregular in shape.

The entire area is overgrown with vegetation and a number of semi-mature and mature trees are spread sparsely.

Hirst and Peet (Green and Pink)
This parcel, which is in the south west part of the site, is approximately rectangular with access off Ormskirk Road to the south. Numerous greenhouses and sheds are present and are surrounded by soft grass landscaping and hardsurfacing.

Surrounding Areas
The site is generally surrounded by residential properties and occasional commercial premises to the east and south. Fields are to the west and north.

Site photographs are presented in Appendix 2 and any relevant features are recorded on the Preliminary Development Constraints Plan 19255 02.

3.0 ENVIRONMENTAL SETTING

3.1 Site History

Available historical maps have been obtained, a list of dates and scale are listed in the table below:

Scale	Date
1:1,250	1974, 1977/78, 1978/79, 1979, 1982, 1984, 1984/87, 1984/89, 1989/93, 1991/94, 1993, 1989/94, 1993/95, 1994, 1995, 2003.
1:2,500	1891, 1891-92, 1908, 1927, 1959, 1960/61, 1975/77, 1977, 1977/82, 1982, 1983, 1983/88, 1985, 1993, 1994.
1:10,000/10,560	1849, 1891/92, 1907, 1926, 1938, 1947, 1955, 1970/74, 1982, 1990/92, 2001, 2010, 2019.

The plans were examined and potential issues have been identified and summarised in the table below:

Date	Site	Surrounding Area
1849	Predominantly formed by fields. ***Coal pit*** and water feature in north east corner with building adjacent. ***Railway line*** crosses central part of site from north west to south east. Residential property with well in south east part off Blaguegate Lane.	Generally surrounded by fields. ***Railway line*** extends to the north west and south east. ***Old pits*** c.50m south west. Numerous ***ponds*** within 250m including directly to the north. Watercourse, later depicted as Slate Brook, c.50m north east flowing northerly.
1891-92	***Mound*** in the north east corner. Football pitch on area to the north of the railway line.	***Mineral railway line*** along eastern boundary. Urbanisation of Skelmersdale to the east and south. Old Engine Cottages to immediate north east.
1907	Reservoir in the north east corner. Tramway crosses the northern area to a Sand Wash, presumably associated with quarrying activities, located in the eastern area where several buildings are present. ***Railway lines*** inside the eastern boundary in the area of the Sand Wash. Football pitch no longer shown.	***Merdale factory*** c.50m to the south. ***Gas Works*** c.200m to the east.
1926	No change.	Merdale factory now ***Orm Mill (Cotton)*** with a reservoir adjacent to it.
1938	No change.	Mineral railway line along the eastern boundary no longer shown.
1959	Large rectangular building in south west corner. ***Allotment gardens*** in central area.	***Garage*** c.50m south west. ***Allotment gardens*** in c.125m south west. Mill to the south is disused.
1970-74	Railway line passing through the site and along the eastern boundary dismantled and the tramway no longer shown. Sand Wash also not indicated. Several buildings constructed within the field to the south of the former railway line including ***glasshouses***. Buildings in south west corner including a glasshouse.	Increased urbanisation to the east and south. Gas Works no longer shown to the east.
1974	Several small rectangular ***outbuildings*** in eastern area associated with Sand Wash Farm. Drain present to the south of these buildings.	***Garage*** c.125m south east.

1982	No change.	*Depot* c.150m north east.
1984	Elongate building constructed in the central northern area.	No change.
1990-92	Fewer buildings on southern area presumably *demolished*.	No change.
2001	Increased number of buildings in south west corner.	No change.
2019	No change.	No change.

The historical plans are presented in Appendix 3.

3.2 Geology

The following British Geological Survey (BGS) records and other available information were inspected to accurately determine the geology underlying the site:

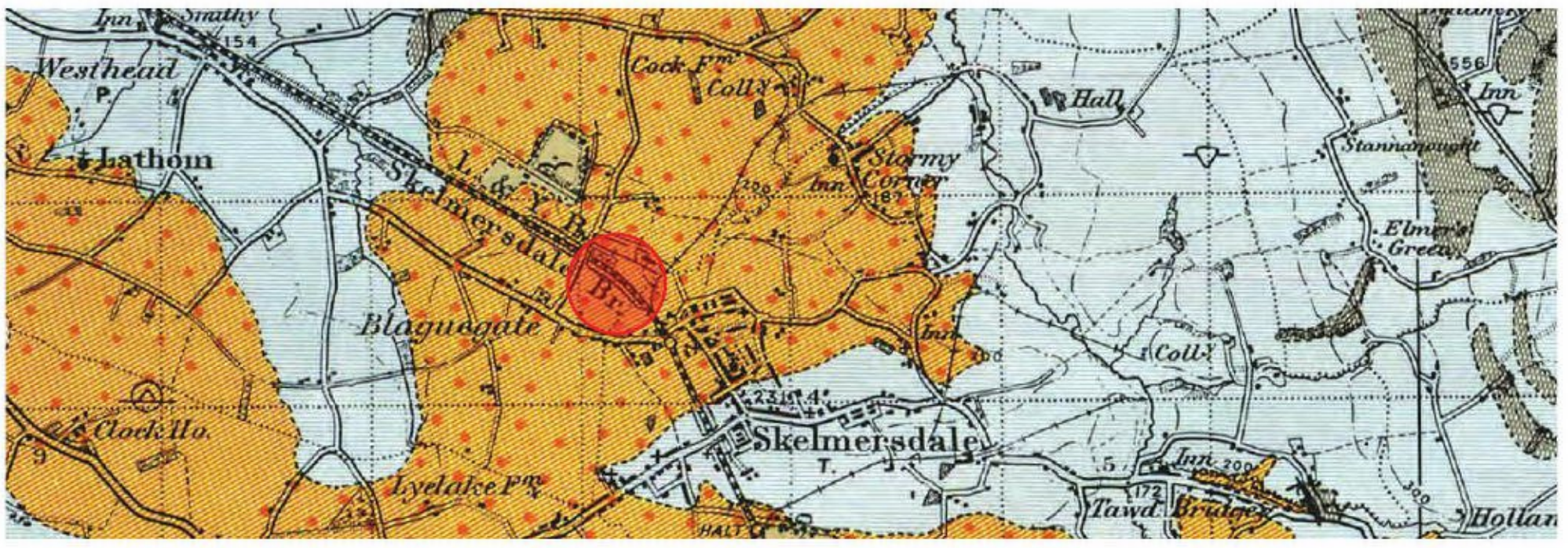
- 1:50,000 Scale Geological Sheet 84, Wigan - Solid and Drift Editions.
- Memoir.
- BGS Records.
- GroundSure GeoInsight Ref. EMS-581520_780200 (copy presented in Appendix 4).

Made Ground
No Made Ground is indicated beneath the site on the available geological plans. However, the GeoInsight Report indicates there to be artificial ground within 250m.

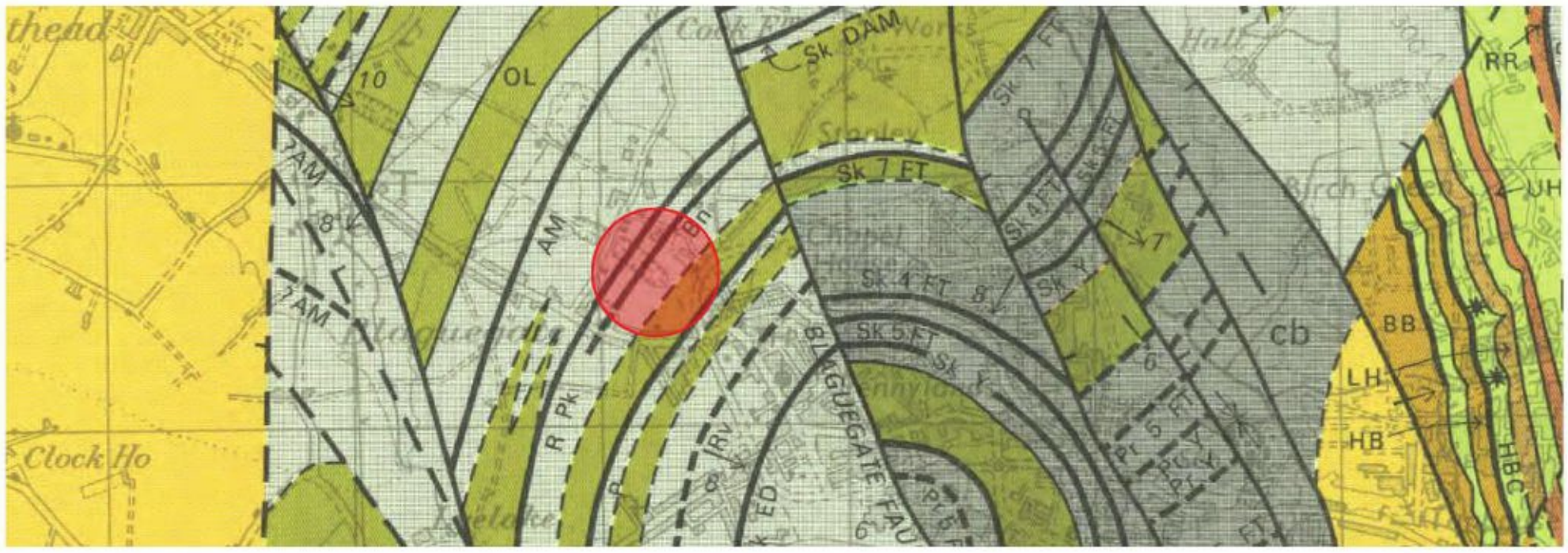
Area 1 is Made Ground 42m to the east and Area 2 is Worked Ground 100m to the north west.

In addition, Ground Workings are shown on site and relate to a railway cutting, unspecified heap and a pond/reservoir.

Superficial Deposits
The site is indicated to be underlain by the Shirdley Hill Sand Formation with Glacial Till deposits beneath generally comprising clay to sandy clay, unsorted with common pebbles, cobbles and some boulders.



Solid Geology
The solid geology is formed by the Lower Coal Measures strata of Westphalian age and typically comprises mudstone, sandstone and coal seams.



Summary of Coal Seams

The following coal seams have been identified beneath and in the general vicinity of the site:

Coal Seam	Subcrop	Depth beneath site (m)	Thickness	Details
Arley	300m east	-	1m to 1.45m	First class quality coal throughout the area. Over the greater part of the exposed coalfield this seam is exhausted.
Rushy Park Coal	Site	12 - 32	0.6 to 0.9m	Overlain by several feet of mudstone. Seam was of workable thickness in the Skelmersdale area and was a high quality coal which was commonly split by dirt bands however this was not often thick enough to prevent the extraction of the whole coal. Most of this coal has been won.
Bone Mine (or Half Yard)	Site	2.4 to 18.5	0.4m to 1.3m	The Bone Mine seam attains a workable thickness only in the north of the field. It consists mainly of durain and hence is a dull hard coal. The quality is good and the ash content is low.
Park (or Yard)	50m south east	Subcrops to the south east of the site.	6 ft	The Park Mine seam (or Yard) is a valuable seam over the Skelmersdale coal field. With an average thickness of 6ft in the Skelmersdale area, great tonnages of first-class coal have been obtained.

The geological map indicates that all of these seams dip to the south east by approximately 8°.

A band of sandstone is shown to subcrop beneath the south eastern part of the site.

Information from the Memoirs for Sheet 84, Wigan indicates that the Skelmersdale coal field has been extensively worked.

Information from a neighbouring site to the immediate west developed by Bellway Homes (NW) indicates that recorded mine workings associated with the Bone Mine seam are close to western boundary of the proposed development assessed as part of this report.

The nearest fault is shown c.370m to the east of the site trending almost northwest to south east with strata downthrown to the north east.

BGS Records

There are no relevant BGS boreholes relating to the site.

3.3 Hydrogeology

The superficial Shirdley Hill Formation in this area is classified by the Environment Agency as a Secondary A Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The superficial Glacial Till deposits on the site are classified by the Environment Agency as a Secondary Aquifer (undifferentiated layers). These layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the soil type.

The Coal Measures bedrock is also classified as a Secondary A Aquifer.

The deposits beneath the site are described as being a Minor Aquifer of high leaching potential. The granular soils are assumed to be highly permeable in the absence of site-specific information.

The site is not within 500m of a Source Protection Zone, and there are no groundwater or potable water abstraction licences within 2km of the site.

3.4 Hydrology

The nearest watercourse relates to a drain that is present on the eastern area of the site. A pond is also present onsite in the north east corner.

The nearest named watercourse is the Slate Brook which is c.55m to the east.

The site is not located within a Zone 2 or Zone 3 floodplain. Environment Agency information indicates that the Risk of Flooding from Rivers and Seas is very low.

There are no active surface water abstraction licences within 2km and no licenced discharge consents within 500m.

3.5 Environmental Consultations

A request has been submitted to the Contaminated Land Officer at West Lancashire Borough Council for information pertaining to the site. This information is presented in Appendix 5 and a summary is below.

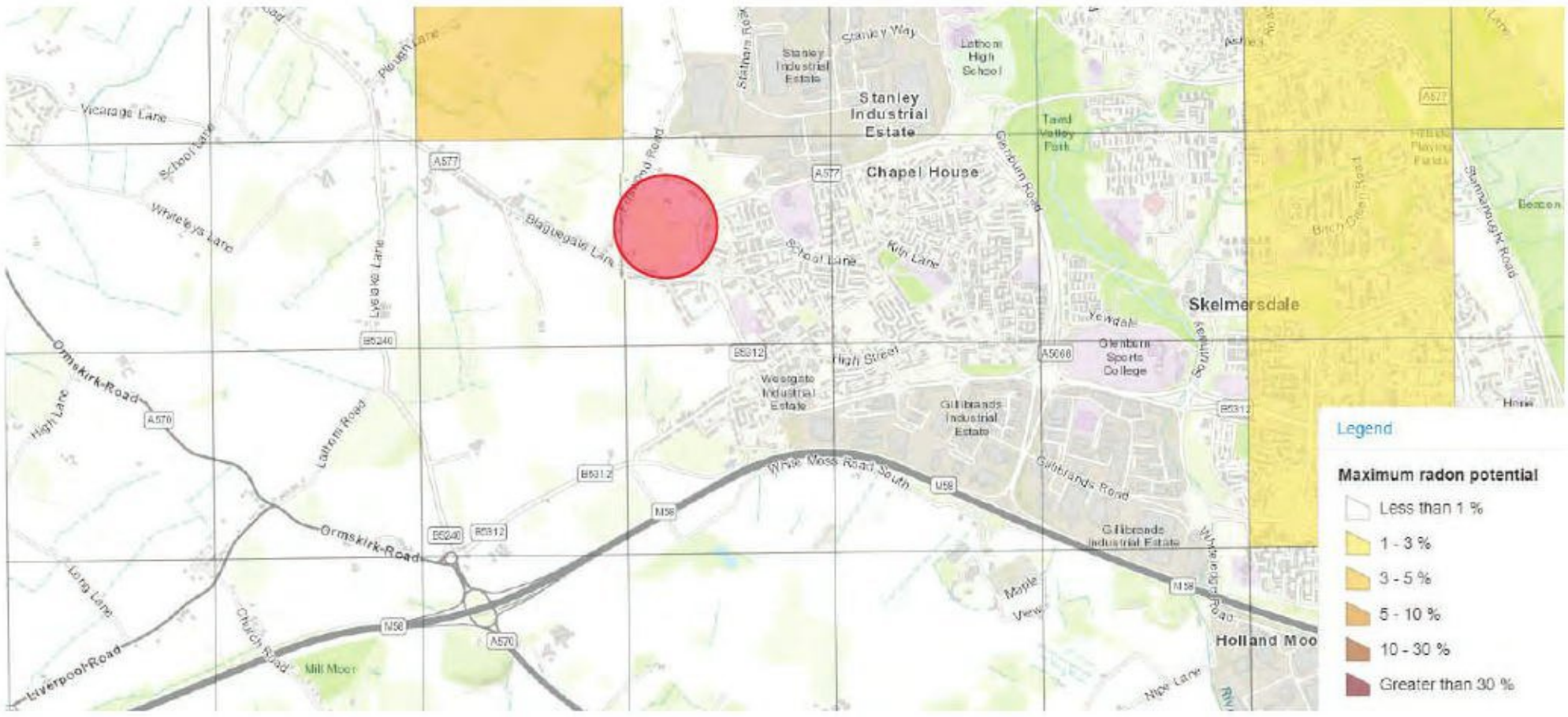
- There are no environmental issues or land reclamation schemes that would affect the site.
- The local authority has not declared the as being contaminated land and has no plans to investigate it further under Part IIA of the EPA 1990.
- The site is not expected to be classified as a Special Site.
- There are no landfill sites, either current or historical within 250m.
- There are no records relating to pollution incidents at the site.
- Historical mapping indicates a disused railway track running through the site and bordering the eastern part; located to the north east is a sand works with associated buildings and a tramway; and an unspecified earth mound to the north of the former sand works.

An environmental search has been conducted through Groundsure, which accesses British Geological Survey and Environment Agency databases. The complete EnviroInsight Report can be found in Appendix 6, a summary of the more relevant points is presented in the table below.

Record	<250m	250 – 500m	Description
Authorised Processes	1	1	The nearest is a Part B Permit for unloading of petrol into storage at a Service Station 120m south east. The other is a historic permit relating to dry cleaning 439m south east.
Pollution Incidents	1	0	This relates to soil/clay causing a minor impact to waters in 2003, 153m to the north east.
Landfill and Waste Treatment	0	0	-
Petrol Filling Stations	2	0	Fuel filling station 120m south east.
Current industrial Uses	21	-	Electricity substation 4m north and 51m south. Generic tank 55m south. Orm Works 133m south.

3.6 Radon

Map 13 'Northern Welsh Marches and Liverpool' BRE 211 and HPA were examined which defines areas requiring radon protective measures. The probability is less than 1% and Skelmersdale is not an area requiring radon precautions in foundations in accordance with BRE Report 211 'Radon – Guidance on protective measures for new dwellings' 2015 Edition.



The radon data in the Groundsure report is supplied by the BGS/Public Health England and is the definitive map of Radon Affected Areas in Great Britain and Northern Ireland and confirms the recommendations of the radon maps.

The dataset was created using long-term radon measurements in over 479,000 homes across Great Britain and 23,000 homes across Northern Ireland, combined with geological data. The dataset is considered accurate to 50m to allow for the margin of error in geological lines, and the findings of this report supersede any answer given in the less accurate Indicative Atlas of Radon in Great Britain, which simplifies the data to give the highest risk within any given 1km grid square.

3.7 Coal Authority Consultation

The site lies in an area where the Law Society and Coal Authority recommends a mining search is undertaken due to past or current mining possible affecting the site.

A search was carried out with the Coal Authority, the Consultant's report is presented in Appendix 7, the main findings are outlined below.

Past Mining
The Rushy Park coal seam is indicated to have been worked at a depth of 12m and 32m beneath the site. The records indicate the thickness of the seam was 0.6m dipping 5.7° to 9.5° to the south, the seam was last worked in 1933.

In addition, the Arley coal seam is described as being worked beneath the site at depths of between 62m and 74m bgl. The seam is indicated as being 1.50m in thickness, dipping to the south by 9.5° and last worked in 1895.

There are probable unrecorded workings beneath the site.

There are no spine roadways recorded at shallow depth beneath the site.

Present Mining
The site is not within the zone of influence of any present underground coal workings.

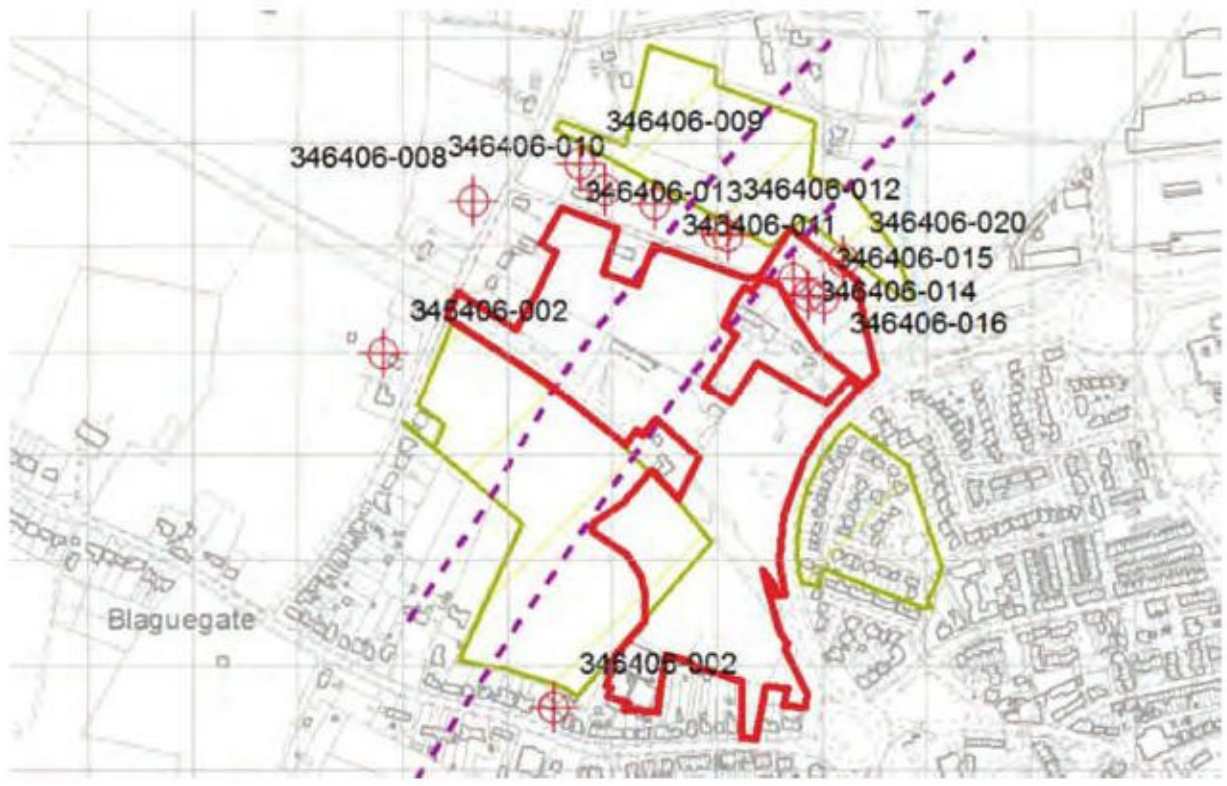
Future Mining
The property is not in an area where the Coal Authority are determining whether to grant a licence to remove coal by underground workings.

The property is not in an area likely to be affected at the surface by any planned underground workings.

Reserves of coal exist in the local area that may be worked in the future.

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

Mine Entries
There are twelve recorded mine entries located on or within 20m of the site. An extract is presented below.



Three of the shafts are located on the north eastern area of the site and are referenced as follows:

- 346406-014 - No record of treatment
- 346406-015 - No record of treatment
- 346046-016 - No record of treatment

The other nine shafts are located to the north, west and south west of the site. Three of these shafts have been located but not treated at present according to Coal Authority records.

Coal Mining Geology
The Bone Mine (Half Yard) and Rushy Park coal seams are indicated to subcrop beneath the site and are workable seams.

Geological Faults, Fissures and Breaklines
No faults, fissures or breaklines are recorded.

Opencast Mines
None recorded within 500m of the enquiry boundary.

Coal Authority Managed Tips
None recorded within 500m of the enquiry boundary.

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

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

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

Mine Gas
No issues relating to mine gases recorded within 500 metres of the enquiry boundary.

Mine Water Treatment Schemes
None recorded within 500 metres of the enquiry boundary.

Future Underground Mining
None recorded.

Subsidence
The Coal Authority has not received a damage notice or claim for the subject property or within 50m since 31 October 1994.

Withdrawal of Support
The property is not in an area where a notice to withdraw support has been given.

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

Coal Authority Interactive Map

Inspection of the online Interactive Coal Authority map indicates the following:

- A large part of the site lies within a Development High Risk Area.
- Past shallow coal mine workings are shown beneath the north eastern part of the site.
- Probable shallow coal mine workings are indicated beneath the majority of the site.
- Two coal seams are indicated to subcrop beneath the site.

Recent Ground Investigation Works

A ground investigation was carried out on a neighbouring piece of land to the west for Bellway Homes (NW) and a summary is provided below.

A total of 765 No. rotary open hole boreholes were drilled to determine the presence of shallow coal mine workings.

Within the Rushy Park seam a total of 130 No. boreholes were drilled and grouted on a 6m grid. The maximum depth of drilling was 30m although most were typically less than 13m and comprised probe holes drilled to confirm the presence/absence of seams which may pose a cumulative risk to the proposed development.

Within the Rushy Park seam, no signs of shallow mine workings such as voids, broken ground or loss of flush were encountered in any of the 130 No. primary boreholes. Grout takes were very low and ranged from 0.04 Tonnes to 0.06 Tonnes, essentially filling the boreholes. Consequently, no secondary or tertiary boreholes were required to be drilled.

Within the Bone Mine Seam, a total of 612 No. boreholes were drilled to a depth of up to 40m although the majority were typically no more than 18m deep. These boreholes consisted of mainly primary boreholes drilled on a 6m grid. When loose/soft ground or elevated grout takes were recorded within the primaries, typically greater than 5 tonnes of grout, secondary boreholes were drilled. When secondary boreholes encountered loose/soft ground or grout takes were greater than 1 tonne, a tertiary borehole was drilled. Both secondary and tertiary boreholes were drilled on a 3m grid.

Within the Bone Mine seam, workings were identified 78 No. boreholes recorded a combination of either; loss of flush, loose/soft ground or elevated grout take, these boreholes corresponded with where the mine abandonment plans showed workings beneath the site. No open voids were encountered in any of the boreholes, indicating that the workings had been progressively backfilled with goaf (mine waste) from other areas of the mine, this was a common practice rather than taking it to the surface.

The drill and grout holes confirmed Coopers original conclusion that although the mine abandonment plans for the site referred to the 'Rushy Park Mine', the plan was actually a record of the workings within the 'Bone Mine seam'.

4.0 PRELIMINARY COAL MINING RISK ASSESSMENT

The online Interactive Coal Authority Map shows probable shallow coal mine workings beneath the site and based on this the site is classified as a Development High Risk Area. Therefore, a Coal Mining Risk Assessment is required to determine the level of risk from the legacy of coal mining activities.

A preliminary Coal Mining Risk Assessment is presented below based on desk-based information, a detailed assessment will be carried out as part of the intrusive Ground Investigation works.

Previous Ground Investigation Works

A previous Ground Investigation was carried out on land to the west and south as part of a residential development being developed by Bellway Homes (NW).

The investigation indicated that there are workings in 2 seams of coal at between 30m and 90m bgl, last worked in 1933. Abandonment plans show pillar and stall workings in the Bone Mine 15m to 30m below rockhead. Also, the Arley Mine is 90m below rockhead to south east of the site.

Generally, topsoil was encountered to between 0.25m and 0.85m bgl locally overlying Shirdley Hill Sand which is between 0.25m and 0.50m thick. Glacial Till comprising firm to very stiff Clay was recorded between 0.30m and 7.50m bgl.

Bedrock is the Pennine Lower Coal Measures and is dipping at c.10° to the south east. The Bone Mine seam subcrops beneath the site and is 0.4m to 1.3m thick. The Rushy Park Mine also subcrops beneath the site. There was considered to be insufficient cover in Zone 2 and 3 of the Coopers plan and grouting or further investigation was recommended.

There is a risk from combustibility from the coal seams where encountered at shallow depths.

Workings within the Bone Mine seam were grouted up.

Geology Overview

The superficial geology consists of the Shirdley Hill Sand Formation overlying Glacial Till deposits. The average thickness of the superficial deposits on the neighbouring site to the west was 1.8m.

The bedrock consists of Lower Coal Measures strata which comprises mudstone, sandstone and coal seams.

Coal Seams Identified by Consultations

From the consultations, a number of coal seams are indicated to underlie the subject site.

The following coal seams have been identified below the site and in the general vicinity:

- The Arley seams subcrops c.300m west and dips beneath the site. This seam is at 74m to 92m beneath the site and has been worked.
- The Rushy Park coal seam subcrops beneath the north western part of the site and is present at depths of between 12m and 32m bgl and has been worked.
- The Bone Mine (or Half Yard) seam is shown to subcrop c.50m to the south east of the Rushy Park seam.
- The Park (or Yard) subcrops c.50m off-site to the south east.

All of these coal seams are shown to dip to the south east by approximately 8°.

Sources of Information

The information presented within this Coal Mining Risk Assessment was obtained from a number of sources including:

- Coal Authority online interactive map.
- BGS maps.
- Intrusive mining investigation results from a neighbouring site to the west.
- Memoir

The Coal Mining Risk Assessment presented on the following pages has been compiled to assess the risks associated with historic coal mining based on the information obtained from all sources.

- The table below represents the first stage in the risk assessment process based on **desk based information**.
- In order for a development site to be deemed 'suitable' the level of risk needs to be reduced to an acceptable level. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence that the surface of the site is stable for development.

Coal Mining Risk Assessment for a residential development at Neverstitch Road, Skelmesdale				
Issue	Hazard	Site Affected? Yes/ No	Consequences	Recommended Mitigation Measures
Recorded Coal Workings	○ *Ground subsidence.* ○ *Ground instability.*	***Yes** - The Interactive Coal Authority Map indicates that past shallow coal mine workings are present beneath the site associated with the Bone Mine seam, the abandonment plan is on Groundtech Plan 04.*	*Ground subsidence associated with historic mine workings can give rise to levels of damage to the built environment that may affect both serviceability and design life of a structure.*	*Investigation required to determine the depth to potential workings.* *A former coal pit was located in the north eastern part of the site.*
Recorded Mine Entries	○ *Catastrophic collapse of mine entry leading to ground instability or voids at the ground surface.* ○ *Settlement of the ground surface above/adjacent to the mine entry.* ○ *Generation of crown holes at the ground surface.* ○ *Mines gas emissions.*	***Yes** – There are three recorded mine entries on the north eastern area of the site.*	*Ground subsidence associated with mine shafts can give rise to levels of damage to the built environment that may affect both serviceability and design life of a structure. Furthermore, mine shaft entries give a direct pathway for mine gas emissions to migrate to the surface of the site.*	*These features will need to be located and capped.*

Coal Mining Risk Assessment for a residential development at Neverstitch Road, Skelmesdale				
Issue	Hazard	Site Affected? Yes/ No	Consequences	Recommended Mitigation Measures
Unrecorded Coal Workings	○ *Ground subsidence.* ○ *Ground instability.*	***Yes** – There is the potential for unrecorded mine workings beneath the site in the Rushy Park and Arley coal seams at relatively shallow depths.*	*Ground subsidence associated with historic mine workings can give rise to levels of damage to the built environment that may affect both serviceability and design life of a structure.*	*It is recommended that intrusive Ground Investigation works are carried out across the site to target specific seams to determine the presence of any unrecorded workings.* *Trenching methods can be used where superficial deposits are relatively shallow and rotary percussive where the seams are at depth.*
Unrecorded Mine Entries	○ *Catastrophic collapse of mine entry leading to ground instability or voids at the ground surface.* ○ *Settlement of the ground surface above/adjacent to the mine entry.* ○ *Generation of crown holes at the ground surface.* ○ *Mines gas emissions.*	***Yes** – Unrecorded mine entries may be present beneath the site in particular in areas where unrecorded workings are present.*	*Ground subsidence associated with historic mine workings can give rise to levels of damage to the built environment that may affect both serviceability and design life of a structure.*	*It is recommended that intrusive works are carried out across the site in the form of rotary open boreholes and trial trenching.* *If unrecorded workings are identified, it is recommended that a geophysical survey is carried out to determine the presence of any anomalies which could be unrecorded mine entries.*
Coal Mining Geology (fissures)	○ *Ground subsidence.* ○ *Mixtures of noxious of explosive gases reaching the ground surface via faulted/broken strata and*	***No** – Faults are not present across the site, however there is only considered to be a risk if the faults are reactivated due to extensive mining.*	*Not Applicable*	*Not Applicable*

Coal Mining Risk Assessment for a residential development at Neverstitch Road, Skelmesdale				
Issue	Hazard	Site Affected? Yes/ No	Consequences	Recommended Mitigation Measures
	entering buildings, structures, confined spaces etc., when an explosive or asphyxiating hazard may be generated. ○ *Stepped rockhead profiles where there has been subsidence across faults, impacting settlement of proposed structures.*			
Records of mine gas emissions	○ *Mixtures of noxious of explosive gases reaching the ground surface via superficial deposits, faulted/broken strata or poorly filled mine entries and entering structures, confined spaces etc., when an explosive or asphyxiating hazard may be generated.*	***Yes** – Workings are likely to be present beneath the site which could be a source of ground gases.* *In addition, unrecorded mine entries could be pathway.*	*Mine gases may be present within the historic workings and mine entries which could potentially migrate into proposed buildings underlain by historic mine workings.*	*Ground gas monitoring to determine if gas protection measures will be required in affected dwellings.*
Recorded coal mining surface hazard	○ *Ground subsidence.* ○ *Ground instability.*	***No.***	*Not Applicable*	*Not Applicable*

Coal Mining Risk Assessment for a residential development at Neverstitch Road, Skelmesdale				
Issue	Hazard	Site Affected? Yes/ No	Consequences	Recommended Mitigation Measures
Surface mining (opencast workings)	○ *Potential of a ground gas source and/or migration pathway. Potential settlement problems.* ○ *Combustible material left behind after historic opencast workings may ignite if in the vicinity of excessive heat such as utility cables.*	*No – The property is not in an area affected by past or present coal mining extracted by opencast methods. The property is also not in an area affected by a proposed opencast coal mine.*	*Not Applicable*	*There is a potential risk from the combustibility of shallow coal seams.*

5.0 LAND QUALITY CONCEPTUAL SITE MODEL AND RISK ASSESSMENT

5.1 Introduction

The potential level of risk posed by contaminants in soil and/or groundwater will be influenced by the type and concentration of the contamination at source, the likelihood of exposure occurring, the potential pollution linkages and the likely chronic or acute effects on the receptors.

A contaminant is defined as a substance that has the potential to cause harm, a risk is considered to exist if such a substance is present at sufficient concentrations to cause harm and if a pathway is present a receptor could be exposed to the contaminant.

Section 4.0 compiles the information from the previous sections to assemble a Conceptual Site Model to inform the risk assessment process. The potential sources identified on the site and off the site that are within influencing distance are assessed to determine if pollution linkages exist and an unacceptable risk is posed to human health and controlled waters. The assessment has been carried out on a qualitative basis and aims to produce a complete and comprehensive Preliminary Conceptual Site Model. The potential pollution linkages are displayed on 19255 03 - Illustrative Preliminary CSM.

Three potential types of impacts exist for a site and all three need to be considered in the qualitative preliminary risk assessment:

- Impacts from sources on the subject site.
- Impacts to the surrounding area from the subject site.
- Impacts to the subject site from the surrounding area.

5.2 Potential Contamination Sources

On-Site Sources and Associated Contaminants

From the information obtained during the preliminary risk assessment, several potential on-site sources of contamination have been identified which may affect the redevelopment of the site for residential end use. These include:

- A mound in the north east corner.
- A coal pit in the north east corner.
- A railway line in a cutting passing through the site and other associated railway lines.
- Processes associated with the Sand Wash.
- Allotment gardens.
- Demolished buildings.
- Existing above ground fuel storage tanks.
- Made Ground.
- Coal mine workings.
- Possible arable uses of the agricultural land.

The former mound, demolished buildings and Made Ground could be a potential source of metals, speciated Polycyclic Aromatic Hydrocarbons (PAHs) and asbestos.

Depending on the nature of the material used to infill the coal pit in the north eastern area and the Made Ground beneath the site, these could be sources of permanent ground gases. In addition, the coal mine workings beneath site could be a source of mine gases.

Potential contaminants associated with the allotment gardens could include pesticides and PAHs.

The DoE profile for Railway Lands indicates that potential contaminants may include metals, PAHs, fuel derived hydrocarbons, Polychlorinated Biphenyls (PCBs), solvents, pesticides, asbestos and ground gases.

The above ground fuel storage tanks could be a source of fuel derived hydrocarbons that they stored.

If the fields have been used for arable purposes, pesticides may be present within the topsoil.

Off-Site Sources and Associated Contaminants
Several potential off-site sources of contamination have been identified from the consultations and include the following:

- Former railway lines.
- Old pits and ponds.
- Factory/Cotton Works including a generic tank c.50m to 100m to the south.
- Former Gas Works 200m to the east.
- Allotment gardens 125m south east.
- Depot 150m north east.
- Made Ground c.40m east and Worked Ground c.100m north west.
- Service Station 120m south east.
- Electricity substations 4m north and 51m south.
- Nearby garages.

The Contaminants of Concern associated with railway land and allotment gardens have previously been discussed in the on-site sources.

The old pits/ponds, Made Ground and Worked Ground could be sources of permanent ground gases depending on their depth and the materials used as infill.

The DoE profile for Textile and Dye Manufacturing indicates that potential contaminants associated with Cotton Mills include heavy metals and other inorganic compounds (borates, cyanides, acids and alkalis), Semi-Volatile Organic Compounds (SVOCs including chlorinated organic solvents, sizing agents, flame retardants and bonding agents), pesticides, solid fuel, mineral oil, PCBs and asbestos.

The DoE profile for Gas Works, Coke Works and other Carbonisation Plants indicates potential contaminants include ammoniacal liquors, coal tar, spent oxide foul lime, heavy metals and coal dust. These contaminants can be identified by visual and olfactory means in addition to chemical testing suites to include heavy metals, PAHs, Total Petroleum Hydrocarbons (TPH), Volatile Organic Compounds (VOCs), SVOCs, sulphates and cyanide.

The garage, depot and service station could be potential sources of fuel derived hydrocarbons.

Electricity substations often contained PCBs as coolants in the transformers.

5.3 Pollution Linkages

The definition of a pollution linkage is a medium which allows a contaminant to impact a receptor. Potential pollution linkages have been recognised for the residential development from the identified contamination sources that exist.

At this stage, the potential contaminants identified above are considered to pose an unacceptable risk to human health and controlled waters through the following pollution linkages:

- Direct soil and dust ingestion.
- Dermal contact with soil both indoors and outdoors.
- Indoor air inhalation from soil and vapour.
- Outdoor inhalation of soil and vapour.
- Migration and accumulation of ground gas into internal spaces.
- Impaction of groundwater from soil contamination (diffuse and point).
- Impaction of groundwater from groundwater plume.
- Migration of soil and groundwater contamination impacting surface waters.

5.4 Receptors

Receptors generally fall into the categories of human health or controlled waters within the river basin system. The recognised receptors are listed below:

- Future residents of the proposed dwellings.
- The Secondary A Aquifer within the superficial Shirdley Hill Sand deposits and the Lower Pennine Coal Measures.
- The drain on site and the Slate Brook c.55m east.
- Clean potable water supply pipes.

5.5 Preliminary Conceptual Site Model (CSM)

The factual information obtained from the searches and summarised in Section 2.0 and 3.0 has been used to compile a Preliminary CSM. Using Source-Pathway-Receptor assessment criteria that is applicable in the UK, a risk assessment has been completed to determine if a plausible pollution linkage exists between the identified contaminants and receptors. The risk classification has been estimated in accordance with the CIRIA C552 assessment criteria outlined in Appendix 8.

Human Health Pollution Linkage Assessment

- The table below represents the first stage in the land quality risk assessment process - **the Qualitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model						*Qualitative Risk Assessment*
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
PL1	Contaminated Soils	Ingestion of soil and dust. Dermal contact with soil.	Likely	Medium	Moderate	*From the information obtained as part of the preliminary risk assessment, the site has had mixed previous usage. Large areas have remained as fields however, a railway crossed the site together with a tramway to a former sand wash. A coal pit and mound were located in the north east area and allotment gardens were on the central part. In addition, a number of former buildings have been demolished. Currently, the central area contains an area of hardsurfacing, a unit and above ground fuel storage tanks.* *Based on the historic uses of the site, potential Contaminants of Concern include metals, PAHs, fuel derived hydrocarbons, asbestos and pesticides and a plausible pollution linkage exists.* *A number of nearby off-site sources of contamination have been identified by the consultations - most notably a substation 4m north, a garage 50m south west, a former Cotton Mill 50m to the south and a Gas Works c.200m east. Potential Contaminants of Concern include mobile contaminants such as hydrocarbons.*

Conceptual Site Model						Qualitative Risk Assessment
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
						The site and general area are underlain by the Shirdley Hill Sand Formation which could act as a pathway on to site and although unlikely a plausible pollution linkage exists. *If the fields have been used for arable purposes in the past, there is the potential for pesticides to be present within the topsoil which may affect the reuse of it as part of the proposed residential redevelopment.* *The proposed development will incorporate soft landscaping in gardens and public open space, therefore a plausible pollution linkage exists at the site and the risk is considered to be moderate at this stage. Ground Investigation works will be required to quantify the risk.*
PL2	Contaminated Soils	Inhalation of vapour.	Unlikely to Low Likelihood	Medium to Severe	Moderate to Low	*Fuel storage tanks have been identified on site however these are situated on hardsurfacing and significant impaction of the soils is unlikely. These areas will be investigated as part of the Ground Investigation to qualify the preliminary risk.* *In addition, railway lines have crossed parts of the site and a garage was located close to the south west part of the site, these could be sources of hydrocarbons. Therefore, a minor plausible pollution linkage is considered to exist locally on the large area site.*

Conceptual Site Model						*Qualitative Risk Assessment*
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
PL3	Contaminated Soils	Inhalation of soil dust by adjacent site users.	Unlikely	Medium	Low	*Large areas of the site have been undeveloped and significant amounts of mobile contamination is not anticipated beneath the site. Potential contamination is unlikely to have an effect on adjacent site users, therefore no pollution linkage exists.*
PL4	Contaminated Soils	Attacking potable water supply pipe.	Unlikely to Low Likelihood	Medium	Moderate to Low	*Potentially contaminated Made Ground may exist across local areas of the site at depths at which new water supply pipes will be laid. In addition, there is the potential locally for organic contamination to be present in the vicinity of the former railway lines and existing tanks. Depending on the composition of the Made Ground and its associated contaminants the water supply may be at risk locally and a pollution linkage does exist. For large proportions of the site, standard PE pipes are likely to be suitable.* *A local water company risk assessment is required prior to construction to advise on the level of protection required for the potable water supply.*
PL5	Ground Gas	Migration and accumulation of ground gas in internal spaces.	Likely	Medium to Severe	Moderate to High	*The historic maps indicate that Made Ground will be present beneath the site and a former coal pit was on the north east corner which it is assumed has been infilled.*

Conceptual Site Model						Qualitative Risk Assessment
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
						Off-site sources of ground gases include recorded Made Ground c.40m east and Worked Ground c.100m to the north west. Old pits and ponds have also been located within 250m which could have been infilled. *It is likely that mine workings are present beneath the site which could also be a source of mine gas generation. Prior to construction, if present the workings will be grouted and the ground gas regime will be altered, this should be taken into consideration in the final ground gas assessment.* *It is proposed to construct residential dwellings across the site. Ground gases could migrate through the underlying soils and into the proposed buildings, therefore a plausible pollution linkage does exist.* *Comprehensive ground gas monitoring is likely to allow zonation of risk areas and required gas protection measures due to the large area of the site and a localised source will not blight the entire site.*

Controlled Waters Pollution Linkage Assessment

- The table below represents the first stage in the land quality risk assessment process – **Qualitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model						*Qualitative Risk Assessment*
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	*Rationale*
PL6	Contaminated Soils	Impaction of groundwater from soil contamination (diffuse and point). Impaction of groundwater from groundwater plume.	Unlikely	Mild	Very Low	*Made Ground is expected to be beneath the site - particularly in vicinity of the former railway lines, sand wash area, existing shed and former clay pit. Significant mobile Contaminants of Concern are not anticipated.* *Geological maps indicate that the site is underlain by the Shirdley Hill Sand (Secondary A Aquifer), Glacial Till comprising clay (Secondary Aquifer undifferentiated) and the solid bedrock is indicated to be sandstone and Pennine Lower Coal Measure Formation (Secondary A Aquifer). However, the thickness of the Shirdley Hill Sand is insignificant based on information gained from the neighbouring Ground Investigation and the Glacial Till clay will have acted as an aquitard.* *A well was located on the south eastern area of the site and this could potentially be a pathway for contamination to migrate to the underlying groundwater. However, significant contamination is not anticipated in this area of the site.* *The site is not within 500m of a SPZ and is not considered to be a sensitive resource. The site is also not within 2km of any groundwater or potable water abstraction licenses.*

Conceptual Site Model						*Qualitative Risk Assessment*
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	*Rationale*
						Furthermore, the proposed development will increase the proportion of hardstanding in the form of new dwellings, driveways and estate roads and a new drainage system will also be installed. This will considerably reduce infiltration and potential leaching of contaminants through the Made Ground. *No realistic pollution linkage is considered to exist.*
PL7	Contaminated Soils	Migration of soil and groundwater contamination impacting surface waters.	Unlikely	Mild	Very Low	*Pollution Linkage 7 refers to the impaction of the drain on site and the nearby Slate Brook c.55m east.* *No significant sources of contamination have been identified and the clay beneath the site will have prevented the lateral migration of any potential contaminants.* *The residential development will be betterment of the site, in particular around the existing shed/tanks, and will have the effect of removing the potential source of mobile contaminants.* *The risk is considered to be very low as no plausible linkage exists.*

6.0 GROUND ENGINEERING RECOMENDATIONS AND POTENTIAL LIMITATIONS

6.1 Preliminary Foundation Assessment

The site is underlain by the Shirdley Hill Sand Formation and Glacial Till deposits. The solid geology consists of Lower Pennine Coal Measures strata which includes shallow coal seams that are likely to have been worked in the past.

Foundation designs will be influenced by the potential for coal mine workings beneath the site that will require stabilising and grouting up. The extent of the grouting area will be dependent on numerous factors including the depth and thickness of workings and will be determined by the Ground Investigation and development layout.

It is anticipated that shallow strip foundations will be applicable to much of the site however the mine workings may result in foundations being reinforced. Foundations will require designing in accordance with CIRIA C758D 'Abandoned mine workings manual'.

Foundations will also require deepening in the vicinity of trees and will need to be designed in accordance with NHBC Chapter 4.2 'Building Near Trees'.

An area of soft ground was identified during the site reconnaissance in the northern area (Ramsbottom Land) where reeds were present. Foundations may require deepening if soft soils extend beneath this area of the site.

Detailed foundation designs can be undertaken after Ground Investigation works have taken place to confirm the shallow and deep geology beneath the site.

The above preliminary foundation recommendations are based on desk-based information and should be confirmed by a Ground Investigation in accordance with current guidance.

6.2 Additional Limitations

The site is affected by a legacy of historic coal mining activities and investigation will be required to determine the extent and depth of workings. The Coal Mining Risk Assessment should be referred to.

A number of slight changes in level occur across the site, including the former railway line that was in a cutting. Enabling works may be required locally to create level construction platforms.

SuDS drainage may be a feasible option across the site due to the underlying Shirdley Hill Sand Formation. Soil percolation tests should be carried out in accordance with BRE 365:2015 'Soakaway Design'.

A number of overhead powerlines were noted during the site reconnaissance which require re-routing.

7.0 CONCLUSIONS AND GROUND INVESTIGATION SCOPE RATIONALE

7.1 Land Quality

Large areas of the site have remained as fields however, a railway crossed the site together with a tramway to a former sand wash. A coal pit and mound were in the north east area and allotment gardens were on the central part. In addition, several former buildings have been demolished. Currently, the central portion contains an area of hardsurfacing, a shed and a above ground fuel storage tanks. Potential off-site sources of contamination include a substation, garage, gas works and cotton mill.

Large areas of the site have not been developed and the risk will be low risk however, in the previously developed areas *the risk to human health is considered to be moderate*.

Significant mobile contamination is not anticipated beneath the site and *the risk to controlled waters is low.*

Made Ground is likely to be below the site and a former coal pit was in the north east area. In addition, recorded Made Ground/Worked Ground is within 100m which could also be a source of ground gas. Historic mine workings are likely to be present beneath the site which could be a source of mine gas. *The ground gas risk is considered to be moderate to high*.

7.2 Ground Engineering

The site is underlain by the Shirdley Hill Sand Formation and Glacial Till deposits. The solid geology consists of Lower Pennine Coal Measures strata which includes shallow coal seams that are likely to have been worked in the past.

The foundation solution is likely to be shallow strip foundations which will need reinforcing where plots are affected by mine workings. Foundation designs will be influenced by the potential for coal mine workings beneath the site that will require stabilising and grouting up.

7.3 Additional Considerations

The site is affected by a legacy of historic coal mining activities and investigation will be required to quantify the risk and design appropriate solutions.

A number of slight changes in level occur across the site, including the former railway line that was in a cutting. Enabling Works may be required locally to create level construction platforms.

SuDS drainage may be a feasible option across the site due to the underlying Shirdley Hill Sand Formation.

Overhead powerlines currently cross the site.

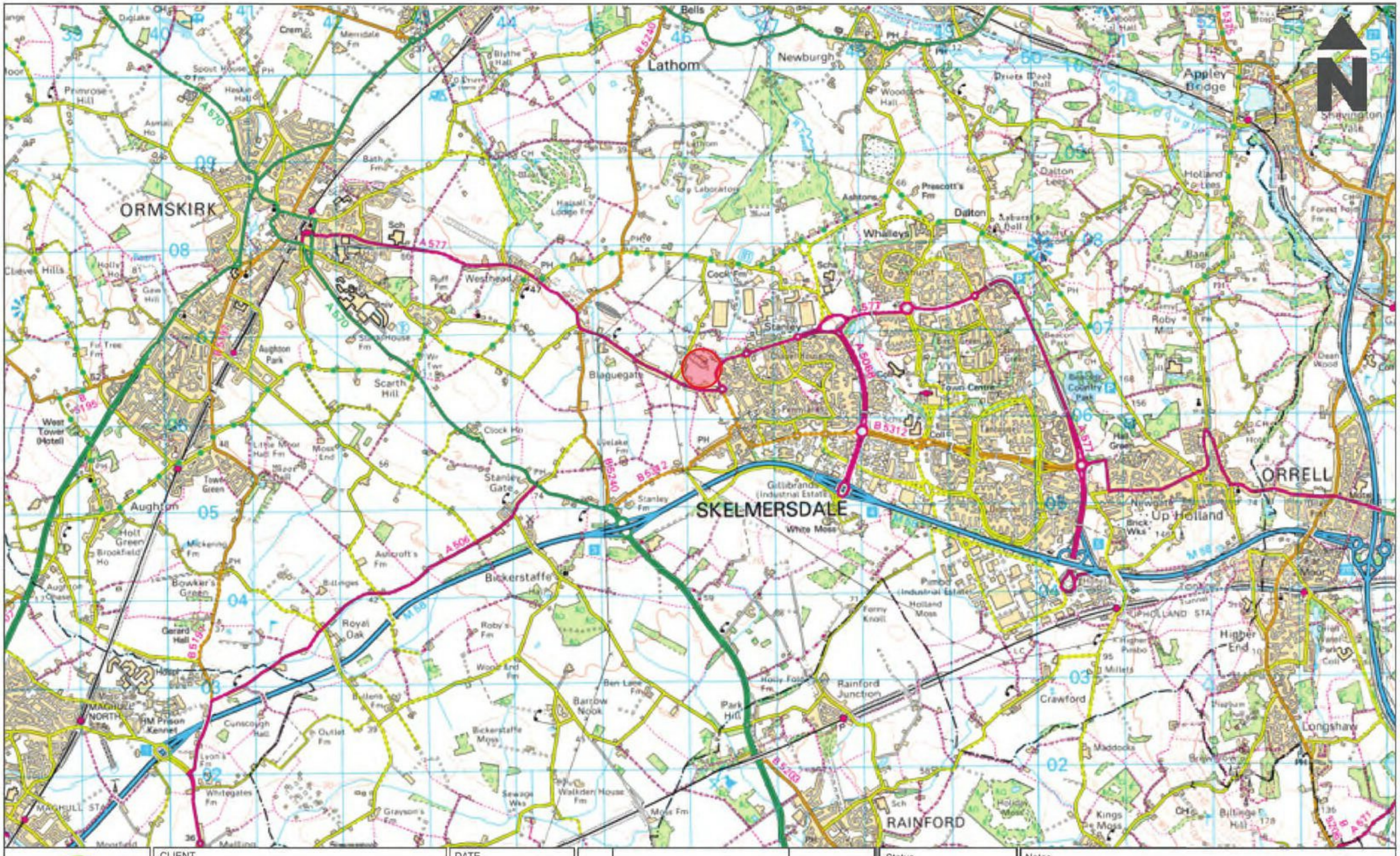
7.4 Recommended Ground Investigation Scope of Investigation

Based on the information in this report we consider a main investigation is required in accordance with BS 10175:2013, BS 8576 and BS 22475. The following scope of works is recommended based on the Preliminary CSM compiled, additional works may be required as the result of planning conditions for the proposed development:

Method of Investigation	G / E
Windowless sample boreholes to 4m to 5m bgl	E
Trial pits to 3.0m to 4.0m bgl	G/E
Trial trenching to identify shallow coal seams	G
Possible geophysical survey to determine the position of shallow mine features	G
Rotary open hole drilling	G
Deep monitoring installations	E
Shallow gas monitoring installations	E
Chemical testing	E
Geotechnical testing	G
Ground gas monitoring	E

Note **Environmental (E) / Geotechnical (G)**

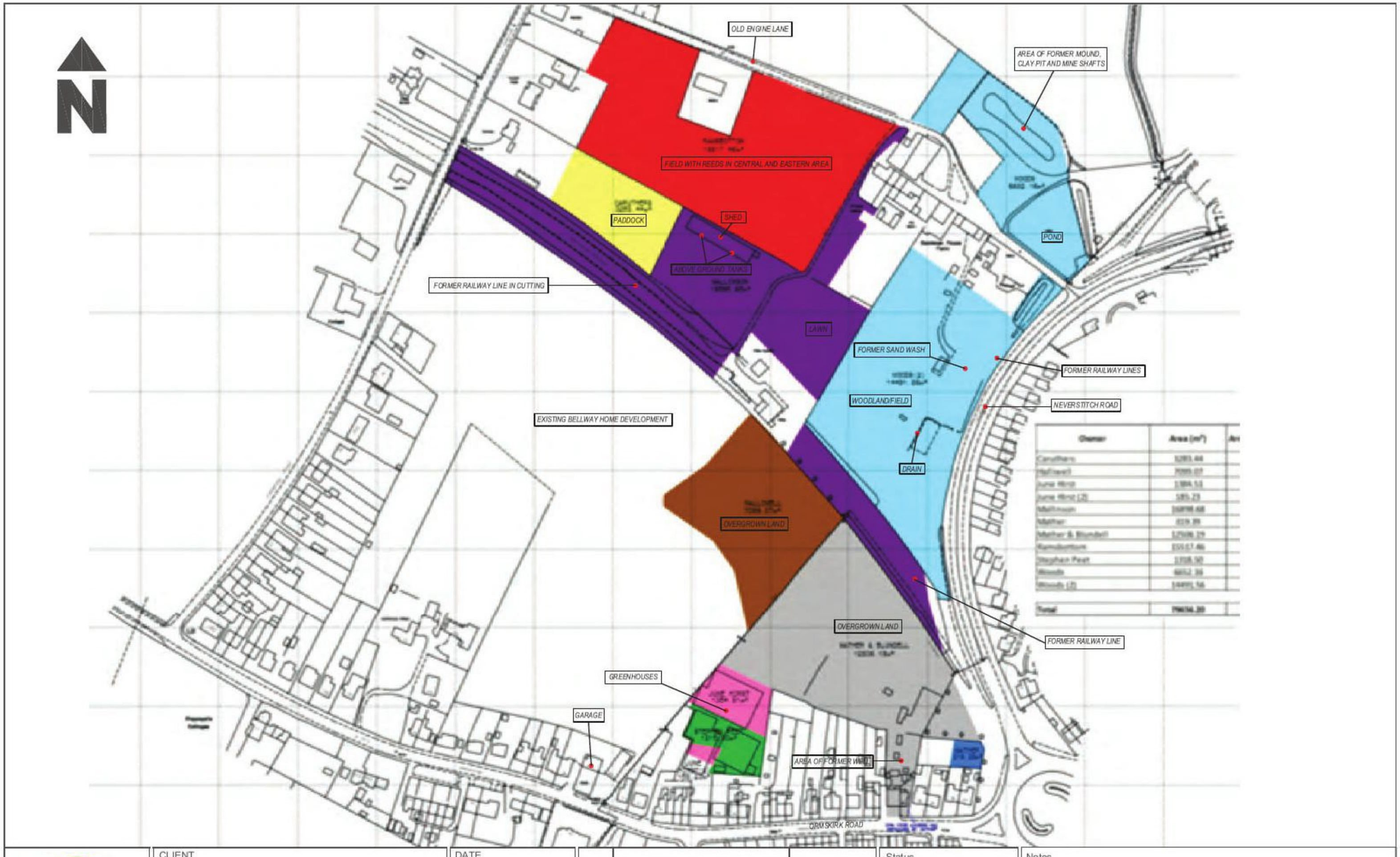
APPENDIX 1 - Plans



GROUNDTECH CONSULTING	CLIENT	DATE				Status	
	BELLWAY HOMES (NW)	DECEMBER 2019				Preliminary	
	PROJECT TITLE	SCALE				Draft	
	NEVERSTITCH ROAD, SKELMERSDALE	NTS				Issued	●
	PLAN TITLE	PLAN NUMBER				For Comment	
	PROJECT LOCATION PLAN	19255 01	Rev.	Details	Date	Approved	

Notes

Location of the site



Owner	Area (m²)	Area (ac)
Carruthers	5283.44	
Highland	7095.07	
June Hirst	1884.53	
June Hirst (2)	585.73	
Mathieson	158798.48	
Mather	819.89	
Mather & Blundell	125098.29	
Ramsbottom	5515.46	
Vaughan Peet	1708.50	
Wilcocks	6812.39	
Wilcocks (2)	19491.56	
Total	336764.89	

GROUNDTECH CONSULTING

CLIENT	BELLWAY HOMES (NW)
DATE	DECEMBER 2019
PROJECT TITLE	NEVERSTITCH ROAD, SKELMERSDALE
SCALE	NTS
PLAN TITLE	PRELIMINARY DEVELOPMENT CONSTRAINTS PLAN
PLAN NUMBER	19255 02

Rev.	Details	Date

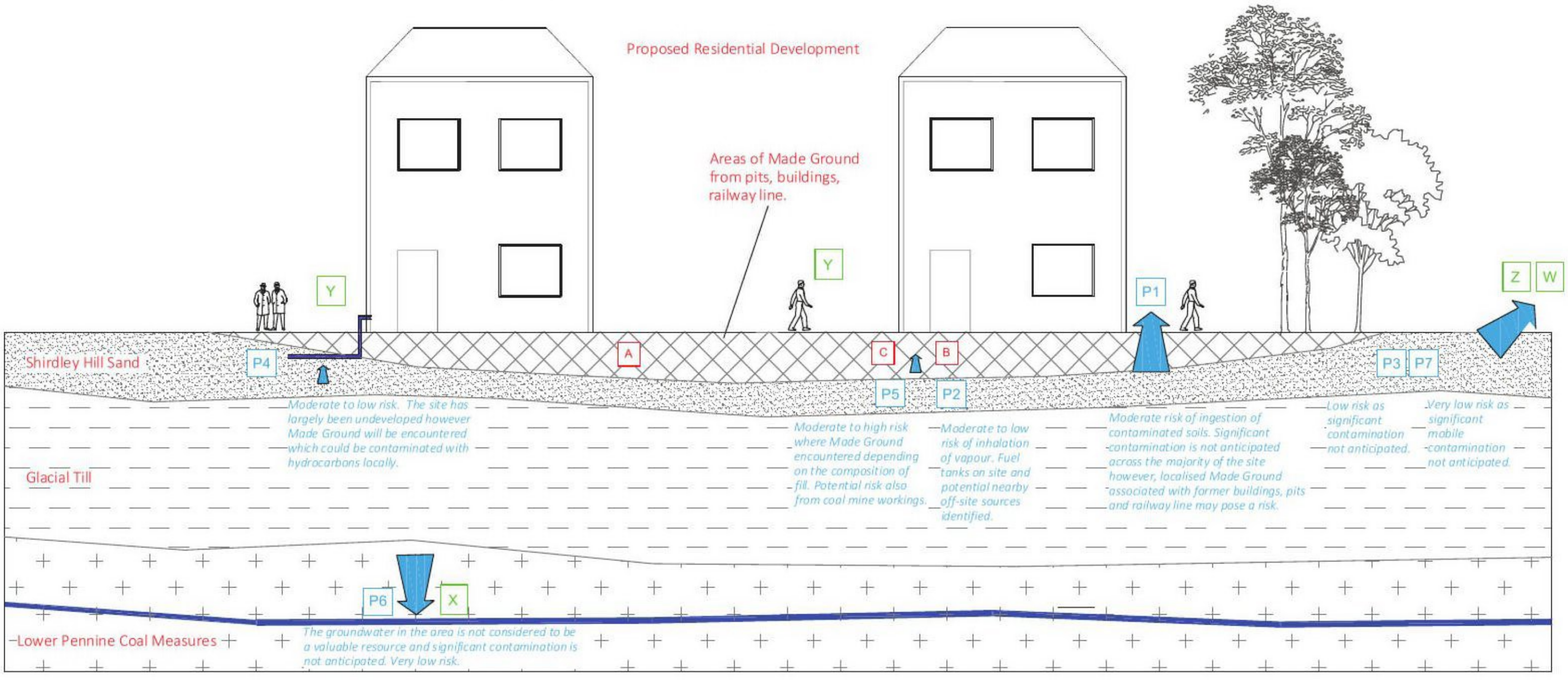
Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

SOURCES
A. Contaminated soils / Made Ground. B. Ground gas. C. Mine Gas

POLLUTION LINKAGES
P1. Ingestion of soil and dust. P2. Inhalation of vapour. P3. Inhalation of soil dust by adjacent site users. P4. Attacking of potable water supply pipe. P5. Migration and accumulation of ground gas in internal places. P6. Impaction of groundwater from soil contamination. P7. Migration of soil and groundwater contamination impacting surface waters.

RECEPTORS
W. Drain on site. Slate Brook c.55m east. X. Groundwater within the Secondary A Aquifers. Y. Site end users. Z. Adjacent site users.



GROUNDTECH CONSULTING

CLIENT	BELLWAY HOMES (NW)
DATE	DECEMBER 2019
PROJECT TITLE	NEVERSTITCH ROAD, SKELMERSDALE
SCALE	NTS
PLAN TITLE	ILLUSTRATIVE PRELIMINARY CSM
PLAN NUMBER	19255 03

Rev.	Details	Date

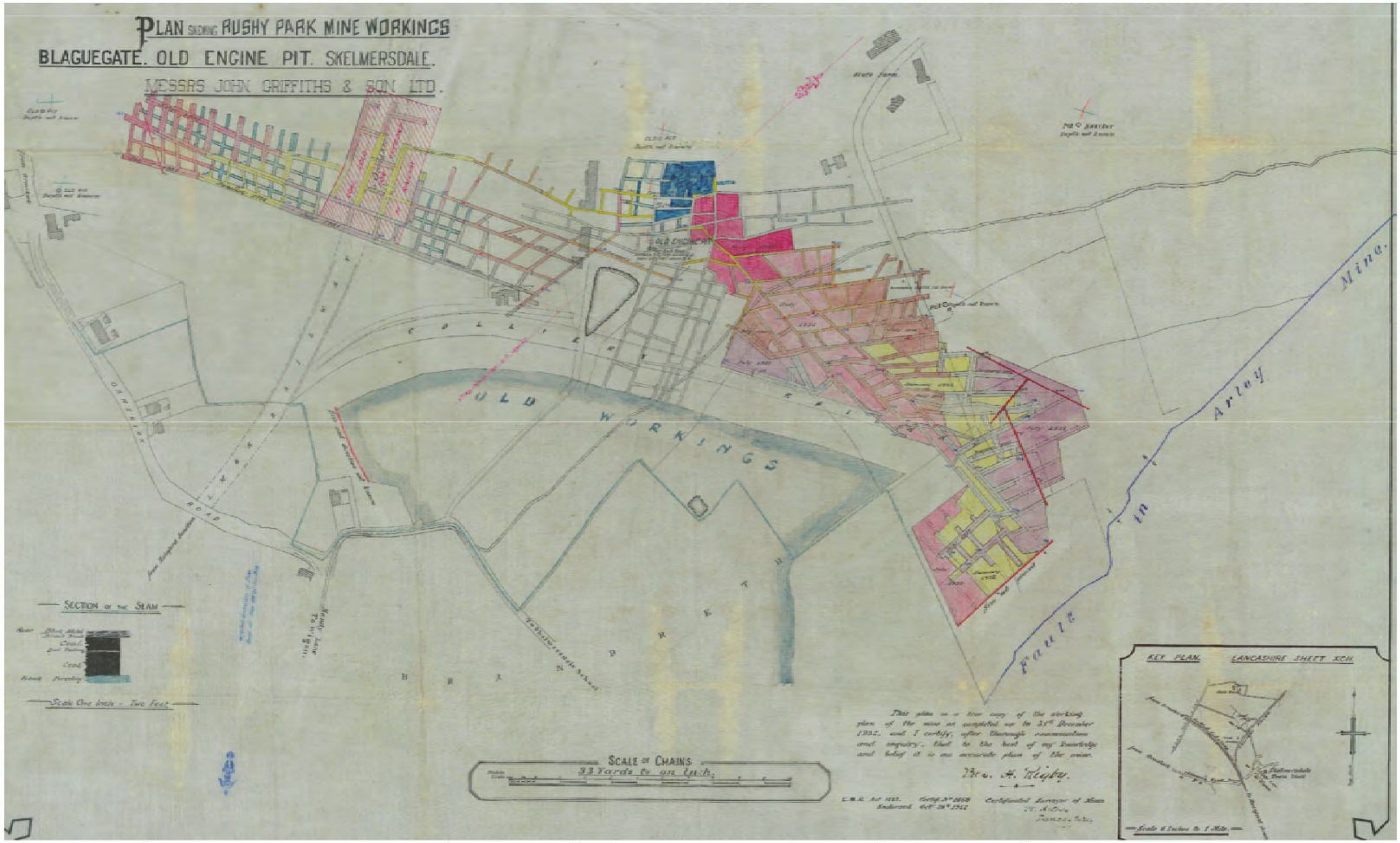
Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

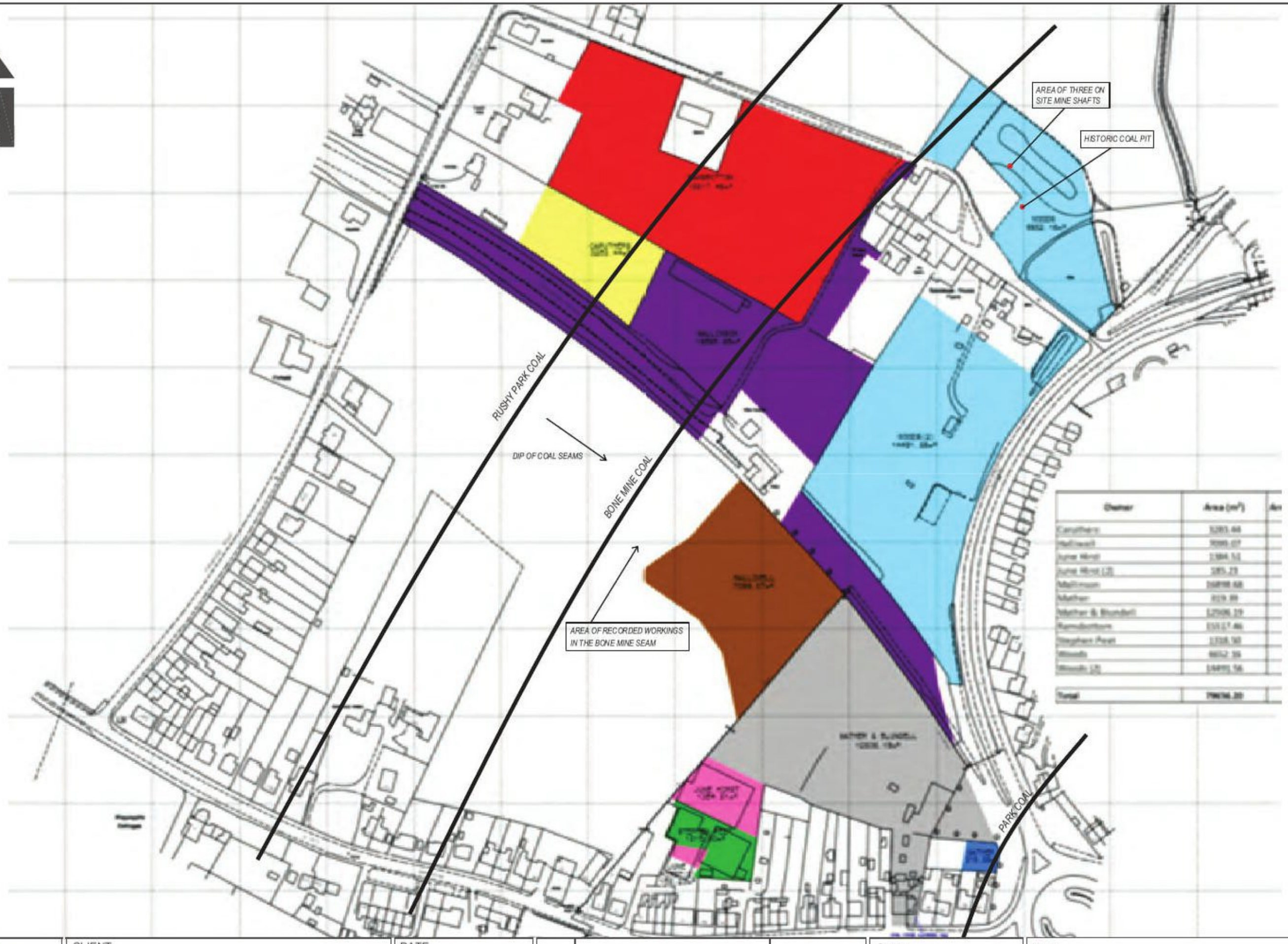
PLAN SHOWING RUSHY PARK MINE WORKINGS

BLAGUEGATE. OLD ENGINE PIT. SKELMERSDALE.

MESSRS JOHN GRIFFITHS & SON LTD.



GROUNDTECH CONSULTING	CLIENT	DATE				Status		Notes
	BELLWAY HOMES (NW)	DECEMBER 2019				Preliminary		
	PROJECT TITLE	SCALE				Draft		
	NEVERSTITCH ROAD, SKELMERSDALE	NTS				Issued	●	
	PLAN TITLE	PLAN NUMBER				For Comment		
	MINING ABANDONMENT PLAN	19255 04	Rev.	Details	Date	Approved		



Owner	Area (m²)	
Carruthers	5283.44	
Hallowell	7095.07	
Lyme Wood	1364.52	
Lyme Wood (2)	385.73	
Mathinson	168198.68	
Mather	819.99	
Mather & Blundell	12506.29	
Ramsbottom	5557.46	
Slaughan Pearl	1338.50	
Wilcock	9652.56	
Wilcock (2)	15495.56	
Total	796766.89	

GROUNDTECH CONSULTING

CLIENT	BELLWAY HOMES (NW)
PROJECT TITLE	NEVERSTITCH ROAD, SKELMERSDALE
PLAN TITLE	COAL FEATURES PLAN
DATE	DECEMBER 2019
SCALE	NTS
PLAN NUMBER	19255 05

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes