

Eccleston Homes

**Desk Study
&
Ground Investigation Report**

for

Mondi Site, Ramsbottom

August 2019

REPORT NO: 19ECH016/DSGI

- *Desk Studies and Site Walkovers*
- *Intrusive Contaminated Land Investigations*
- *Geotechnical Appraisals and Ground Investigations*
- *Landfill Gas Assessments and Remedial Design*
- *Remediation Design and Implementation*
- *Remediation Project Management and Supervision*
- *Site Abnormal Assessments (Foundations and Contaminated Land)*

GEOTECHNICAL - CONTAMINATED LAND- FLOOD RISK

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DOCUMENT ISSUE RECORD

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1 EXECUTIVE SUMMARY

Note – The following summary is not exhaustive and is to be used for guidance purposes only. The full report should be consulted for full details.

1. Site Location

The site is located to the south of Bridge Street and north of Ramsbottom Cricket Club in Ramsbottom. The site has an approximate postcode of BL0 9AL, with coordinates on the British National Grid of 379433,416756. The proposed site is approximately 4.61 hectares in total.

2. Site Description

On Site

The site is currently an unused parcel of land with several derelict structures in the west. The structures comprise two very dilapidated buildings and a large chimney.

The site is predominantly flat and almost entirely covered in hardstanding formed by concrete slabs, with several large and small stockpiles located throughout the site area. Large areas of the centre of the site area heavily vegetated. A full waste container was also noted in the south adjacent to the Cricket Club. A culverted stream / race was noted in the western site area.

A leaking IBC was noted adjacent to the entrance off the lane leading to the sports clubs. The leaking substance was found to be brown and 'rubbery' in nature but was no longer migrating.

There are two 'mounded' areas of soft standing in southern spur with trees on their eastern boundary.

Surrounding Area

The River Irwell is located on the eastern boundary. The remaining area is mixed commercial and residential.

3. Proposed Development

The proposed construction of residential dwellings with associated infrastructure, gardens and public open space.

4. Site History

On Site

The earliest available map of site is the 1850-1851 1:10,560 map with shows the site to be largely undeveloped land with reservoirs in the west and southwest.

The site is first developed in 1891 and a paper mill is shown to occupy the majority of the site, reservoirs are still present in the southern spur area.

By 2014 the majority of the former mill has been destroyed and the reservoirs have now been removed.

Surrounding Area

Initially, much of the land was industrial which was slowly replaced with commercial and residential properties.

5. Published Geology

The BGS map shows the geology beneath the site as the following:

- **Artificial Ground** – Covers entirety of site
- **Superficial** – Alluvium – Clay, Sand and Silt
- **Bedrock** – Millstone Grit Group – Mudstone and Siltstone
 - Hazel Greave Grit – Sandstone

Radon

The Groundsure data states that the site is within a low probability radon area (<1% of properties above the action level), therefore no radon protection measures are required in the construction of new dwellings.

6. Hydrogeology and Hydrology

- The superficial deposits of the Alluvium are designated as Secondary A Aquifer (Moderate Permeability).
- The bedrock deposits of the Sandstone are designated as Secondary A aquifer (Moderate Permeability).
- The site does not lie within Groundwater Source Protection as defined by the Environment Agency.
- There are no potable water abstractions within 500m of site.
- Two groundwater abstractions located onsite, on the western boundary.
- There are two (7 no.) recorded surface water features on site and seven (9 no.) within 250m.
- The site is shown to be at risk from groundwater flooding upon the BGS dataset.
- Flooding – Zones 2 and 3 noted as onsite. Risk is noted as Very Low to High (RoFRaS).

7. Summary of Environmental Data

Possible Contamination Sources and risk levels are shown below;

- **Current Land Use On Site** – Possible – Localised
- **Historical Land Use On Site** – Yes
- **Surroundings Industrial Processes (Historic and Current)** – Possible

In this qualitative risk assessment, a **Low / Moderate - Moderate** risk for ground gas and contamination exists across the site. Some remedial action may be necessary at the site, however, the likes of which cannot be confirmed until the geotechnical and contamination ground investigation has been completed.

8. Scope of Investigation

The fieldwork was carried out between the 25th June – 2nd July 2019 and included the following:

- Eighteen (18 no.) machine excavated trial holes to between 0.60mbgl (TP16) and 3.50mbgl (TP10).
- Eleven (11no.) window sample boreholes to depths between 0.35mbgl (WS18) and 5.00mbgl.
 - A further three (no.) locations were attempted but the concrete slabs were too robust to be cored.
- Four (4no.) rotary boreholes drilled to depths between 30mbgl (RO1) and 38mbgl (RO4).
- Six (6no.) ground gas monitoring visits over a period of at least three months with varying barometric pressures.
- Chemical analysis of forty-seven (47no.) samples.
- Analysis of forty-seven (47no.) samples for asbestos screening, with fifteen (15no.) samples for quantification.
- Analysis of three (3no.) water samples taken from WS1, WS8 and WS16.
- Analysis of four (4no.) surface water samples from the River Irwell and the onsite culverted stream.
- Collection and analysis of three (3no.) soil samples for geotechnical analysis.

9. Ground Conditions Encountered

Ground conditions typically consisted of a CONCRETE slab with reinforcement and a damp-proof course over either a very sandy GRAVEL of LIMESTONE or SANDSTONE, overlying a further CONCRETE slab and subbase. Some locations exhibited areas of possible reworked SAND and / or SILT.

The main site area was almost entirely covered by concrete slabs, and a number of locations showed secondary slabs at depth. Natural strata consisted of both granular and cohesive strata, as well as shale bedrock at depth.

Olfactory and Visual Contamination

Significant visual and olfactory contamination was identified in a number of locations, as well as significant depths of Made Ground.

Obstructions

Concrete slabs were noted at surface and also at depth, some of these slabs were recorded in excess of 600mm thick. A number of the slabs could not be cored and could not be broken out using a 13tonne machine, it is thought that these may be machine bases from the former paper mill.

The large hard slabs were noted around TP11, TP18, WS4, WS5 and WS19. It is likely that more of these slabs will be present at the site.

Groundwater Fieldwork

Groundwater was observed between 0.60 and 3.00mbgl during the site works.

10. Specialist Ground Gas Measures

The site can be classed as Amber 1 / CS2. The site will require low level gas protection measures to be installed. This would usually consist of a 150mm passively vented subfloor void and a taped and sealed gas resistant membrane.

A number of volatile odours and VOCs/SVOCs were noted within the Made Ground during the site investigation however were not substantiated in testing. As a result, a hydrocarbon vapour resistant membrane may be required across the site to mitigate nuisance risk

11. Contamination Assessment and Remedial Actions

A number of exceedances have been observed across the site within Made Ground strata, these are associated with various PAHs, TPH C16-C21, Lead, Arsenic and asbestos. PAHs include the SVOC, Naphthalene. Further to these, a number of VOCs / SVOCs have also been observed above detection limits.

A minimum thickness of 600mm of debris-free soil is required within garden areas and landscaped areas as a capping system to mitigate residual risk to site end users from the asbestos and remaining determinants. It is also anticipated that the secondary slabs will be containing further contamination not observed during the investigation due to plant access limitations within the exclusion zone. The capping is to be made up of imported topsoil and subsoil.

Several areas of hydrocarbon / volatile odours were noted across the site during investigation; however, these were not substantiated in testing. As a result, a hydrocarbon vapour resistant membrane may be required across the site to mitigate nuisance risk – this is to be reviewed following the site strip.

Groundwater and Aquifer Risk

Potential risks to groundwater and aquifers are anticipated given the ground investigation findings and soil analysis results.

12. Off-Site Disposal of Surplus Soil

If there is the need to remove soil / made ground off-site it is recommended that the results of the contamination testing (and possibly further testing) will be assessed by a suitably qualified person. The chemical laboratory data has been screened using the online Hazwaste™ software and the laboratory test results indicate that, generally, the materials onsite would be classified as Non-hazardous.

However, several samples across the site have been shown to be hazardous.

13. Foundations

Due to depths of Made Ground and saturated SILTS being identified at depth, the variable nature of the Made Ground, and the potential for secondary slabs and deep obstructions, a piled solution is advised. Given the generally granular nature of Made Ground and the both cohesive and granular nature of natural soils on site, a driven piled solution should be taken to the appropriate strata. Suitable strata applicable to piling is thought to be at least 20mbegl.

14. Concrete Design

Given the levels of 2:1 water soluble sulphate identified in the vicinity of TP1, TP3 and TP5, a design class of DS-2, an ACEC class of AC-2 and a designated concrete class of DC2 is recommended in this area.

The remainder of the site can be recommended for a design class of DS-1, an ACEC class of AC-1 and a designated concrete class of DC-1.

15. Heave / Shrinkage Potential

Significant shallow cohesive strata were not observed at the site, testing may be undertaken once site levels are confirmed and an assessment of the depth to cohesive strata can be made.

16. Ground Floor Construction

Suspended floor construction e.g. either in situ RC slabs or block and beam flooring is recommended as per NHBC guidance.

17. Control of Groundwater

Limited shallow groundwater was encountered on site however perched groundwater was encountered in several locations. It is likely that provision of pumping / shuttering will be necessary during excavation of foundation trenches during wet weather and to deeper excavations for sewers etc. It is good practice to have such equipment on standby in case of seasonal / abnormal weather conditions.

The proposed flood risk alleviation design has increased site levels to factor in increased river levels in flood events and as such also by the same means lifted the site out of the zone of influence of potential groundwater flooding. The likelihood of solid geology bearing any influence upon groundwater levels to result in flooding is deemed very unlikely given the evidence of the known groundwater levels being in direct correlation / connectivity with the adjacent river and its surrounding superficial geological deposits (circa 20m drift).

Should sewers/excavations deeper than the boreholes/trial pits undertaken be required, further SI will be needed.

18. Highway

According to the criteria of Highways Agency HD 25/95 Volume 7 Section 2 Part 2 HD 25/94, a CBR value of circa 3% on the Made Ground is anticipated, however confirming in-situ CBR's should be undertaken once final formation levels are available. Placement of geotextiles within the areas of roads / parking could also be designed to minimise the subgrade thickness.

2.1 Introduction

The layout is plan can be seen below:



2.2 Site Location

The site is located to the south of Bridge Street and north of Ramsbottom Cricket Club in Ramsbottom. The site has an approximate postcode of BL0 9AL, with coordinates on the British National Grid of 379433,416756. The proposed site is approximately 4.61 hectares in total. See Site Location Plan in Appendix A.

2.3 Site Description

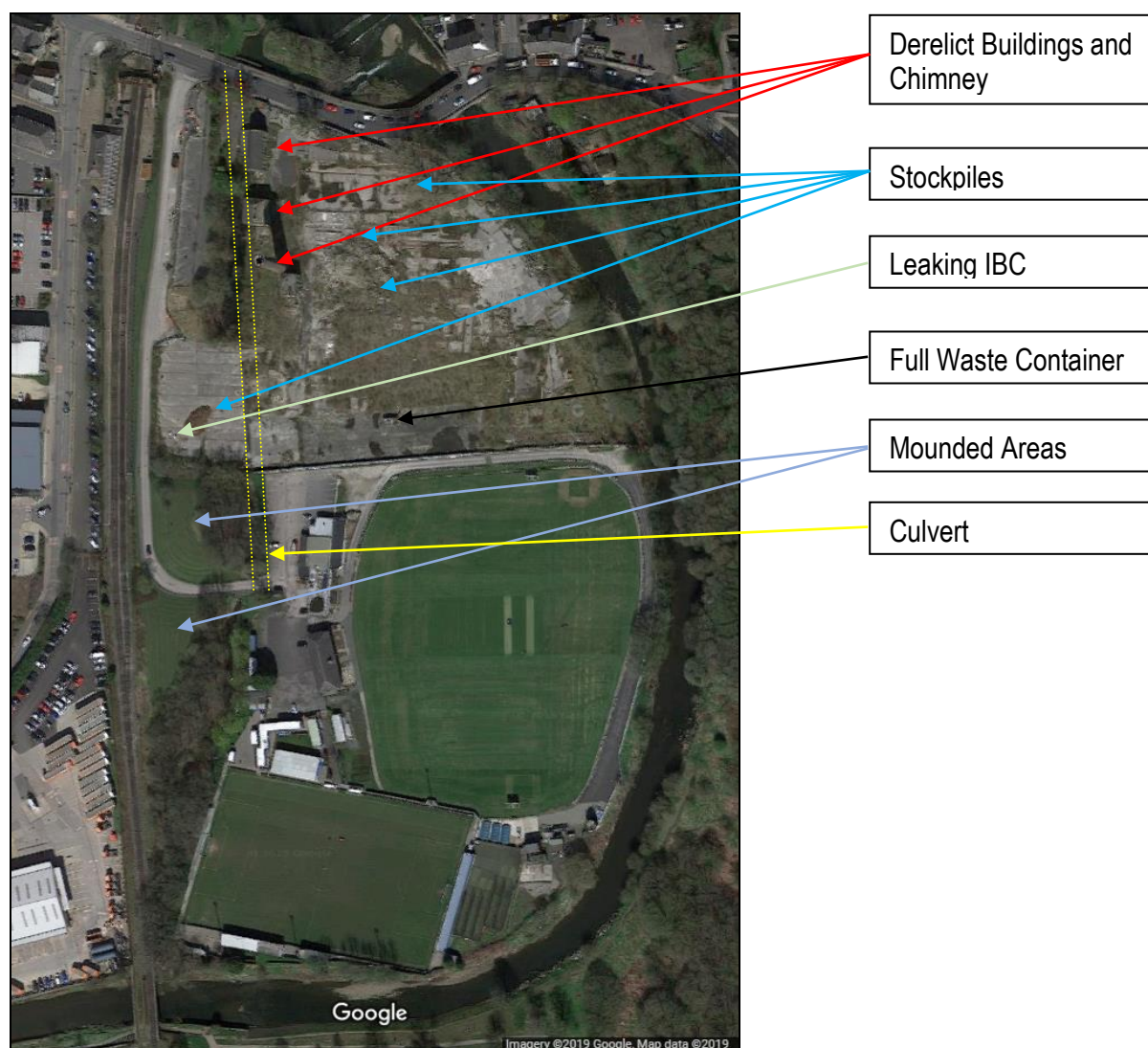
2.3.1 On Site

The site is currently an unused parcel of land with several derelict structures in the west. The structures comprise two very dilapidated buildings and a large chimney.

The site is predominantly flat and almost entirely covered in hardstanding formed by concrete slabs, with several large and small stockpiles located throughout the site area. Large areas of the centre of the site area heavily vegetated. A full waste container was also noted in the south adjacent to the Cricket Club. A culverted stream / race was noted in the western site area.

A leaking IBC was noted adjacent to the entrance off the lane leading to the sports clubs. The leaking substance was found to be brown and 'rubbery' in nature but was no longer migrating.

There are two 'mounded' areas of soft standing in southern spur with trees on their eastern boundary.



2.3.2 Surrounding Area

Surrounding land uses for the site are as follows:

- **North** – Bridge Street, the River Irwell and industrial / commercial buildings beyond.
- **East** – The River Irwell with a wooded area and residential beyond.
- **South** – Sports clubs with the River Irwell beyond.
- **West** – Railway line with Ramsbottom town beyond, mixed residential and commercial properites.

3 SITE HISTORY

3.1 Site History from Ordnance Survey Maps

A search of available historic maps was undertaken to establish the land use history of the site. Extracts of the maps discussed below and can be found in full in Appendix F of this report. All maps are Ordnance Survey unless otherwise stated. All distances quoted on OS maps are taken from the site boundary, which is marked on the map.

3.2 Summary of Site History

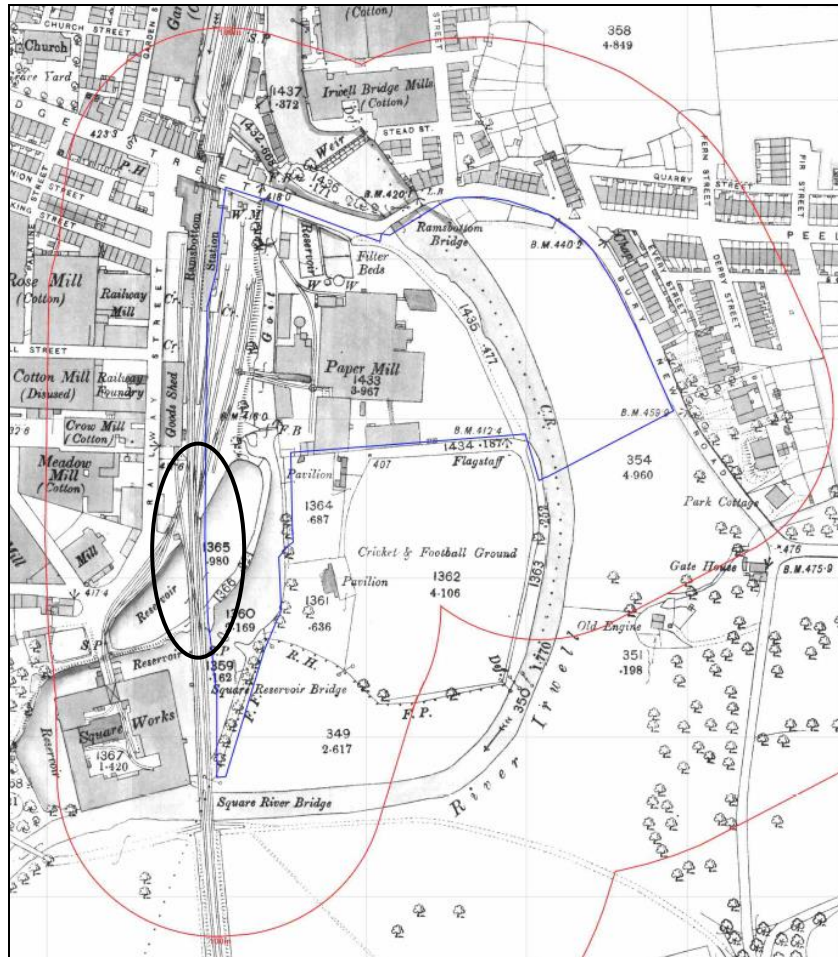
3.2.1 On Site

The earliest map, from 1850-1851, shows the site to be split between undeveloped land and the River Irwell in the east and reservoirs in the west. A small strip of land adjacent to the railway line is shown as a treelined road. An extract of the map is shown below;



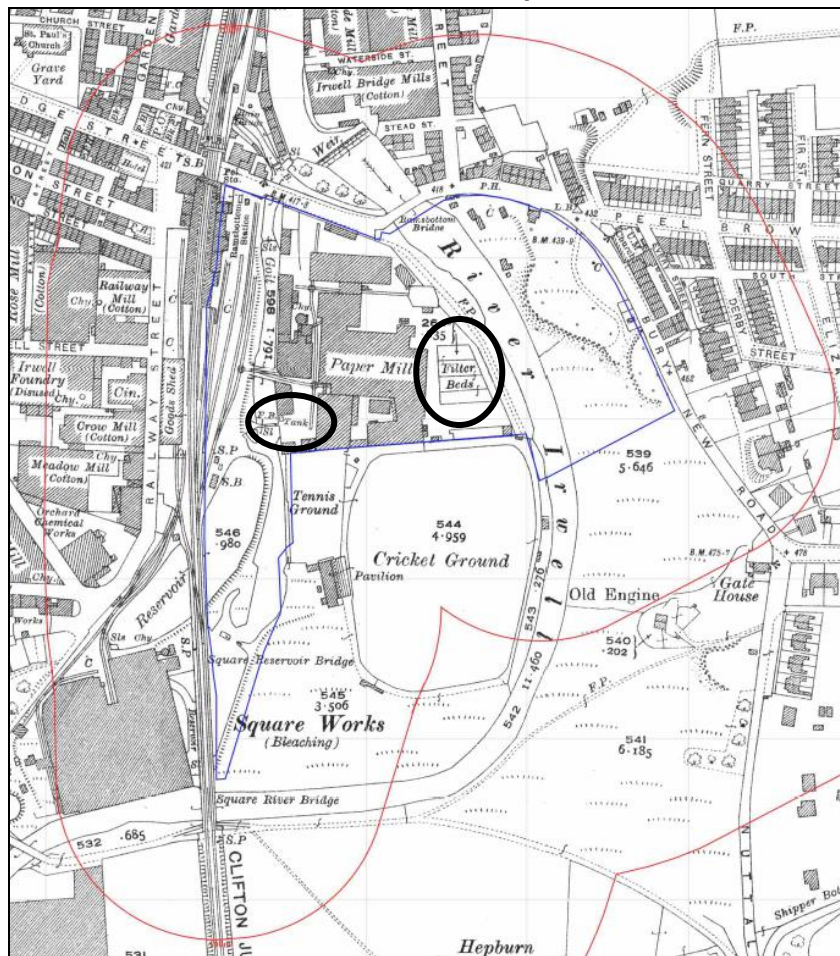
By 1891, the site has been developed and now contains a paper mill, with a number of associated features present. Such as filter beds, reservoirs, chimneys and wells. The railway line to the west of the southern spur appears to cross the reservoir via either a bridge or culvert. An extract of the map is given below;

1891 1:2,500 map



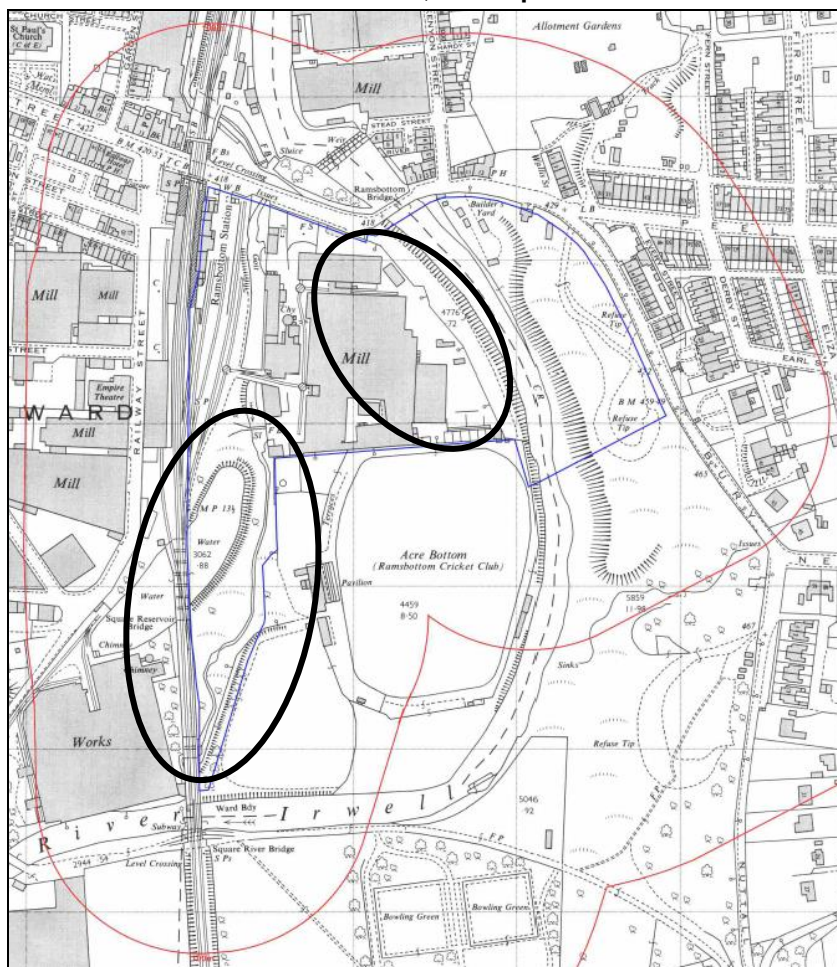
Mapping from 1929 shows a tank in the western area of the site and filter beds in the east of the site. There were also some minor configuration changes to the paper mill. An extract of the map is given below;

1929 1:2,500 map



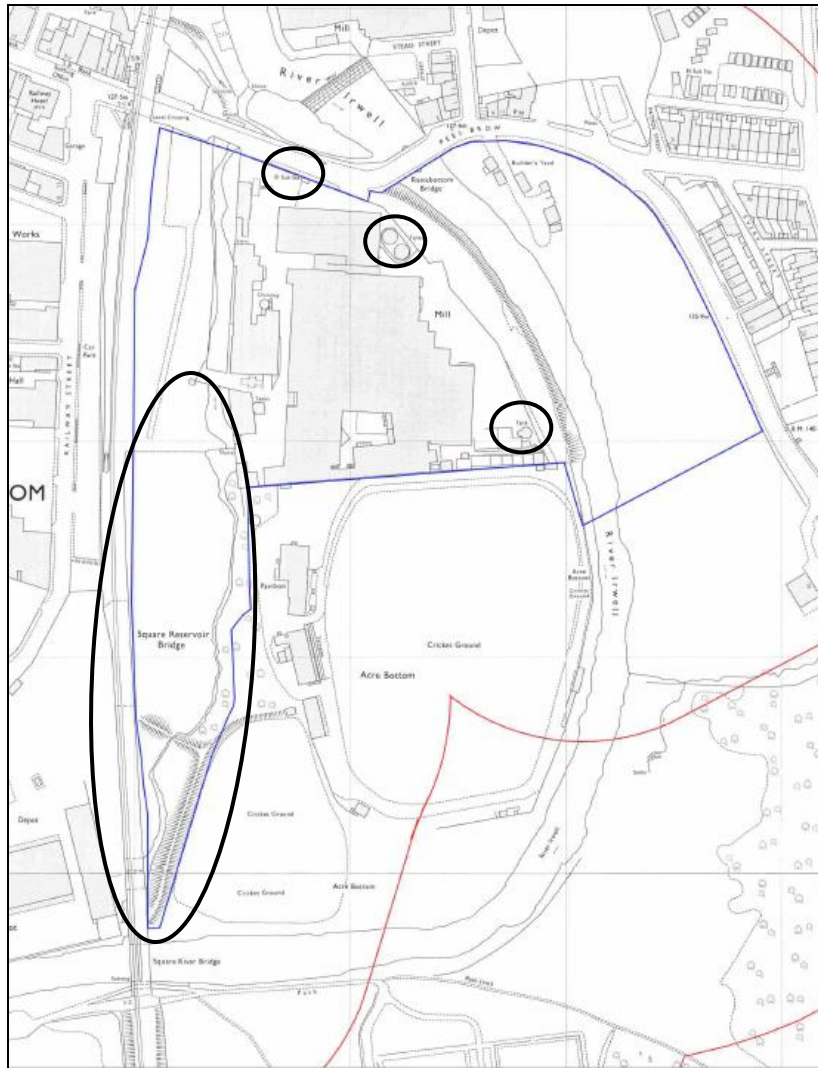
By 1962 the mill has been significantly extended, and a reservoir in the southern spur has been backfilled and a small stream has been created.

1962 1:2,500 map



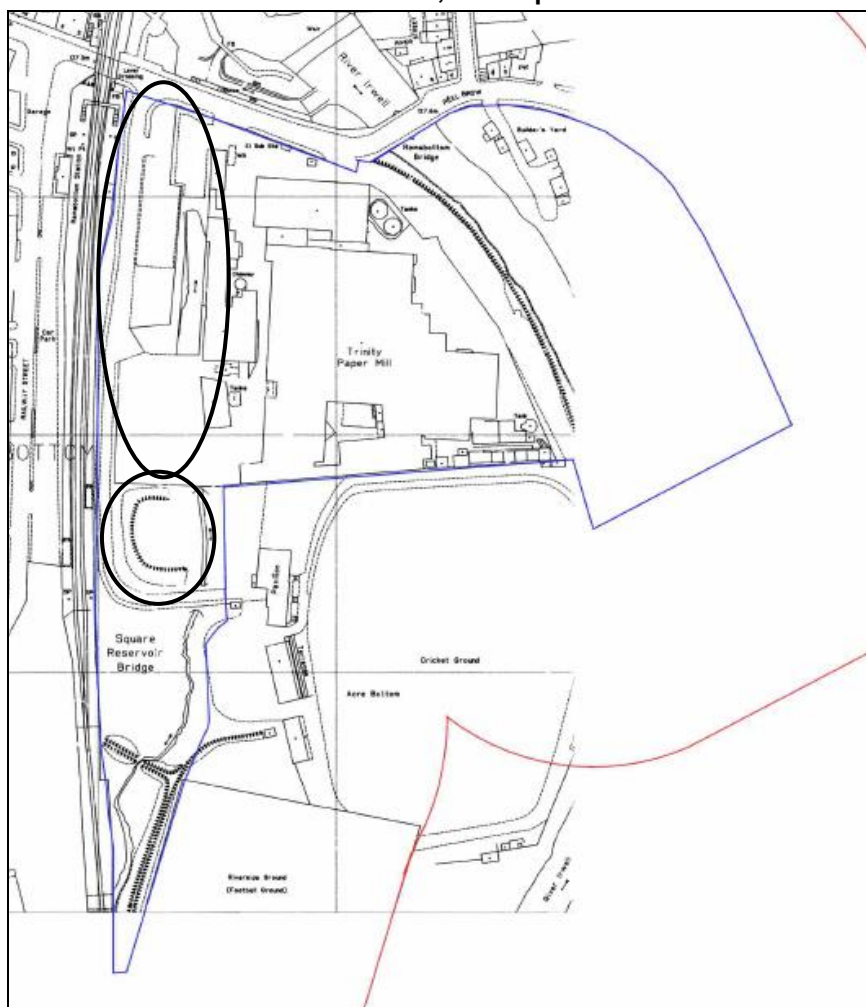
By 1978 the reservoirs in the west of the site have been backfilled. There are two new tank areas shown, the northern area shows two large tank, with one smaller tank in the southeast, and an electricity substation has been constructed on the northern boundary. An extract of the map is given below;

1978 1:1,250 map



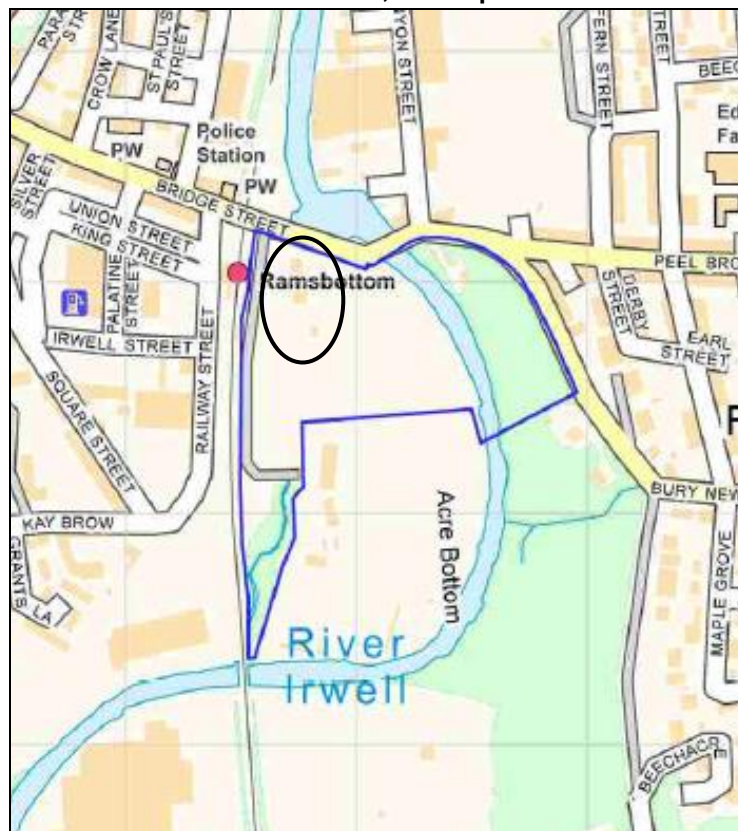
Mapping from 1994 shows a large area of hardstanding in the west has been constructed. The mill has also been extended slightly to the west. The first of the mounds in the southern spur has also been constructed.

1994 1:1,250 map



Historical mapping is inconsistent and often blank between 1994 and 2002. Between 2010 and 2014 the majority of the structures on site are demolished. However, some remain in the northwest of the site, it is assumed these are the structures remaining onsite currently. An extract of the map is shown below;

2014 1:10,000 map



3.2.2 Surrounding Area

The following table summarises the significant changes in historical use within 500m of the site boundary:

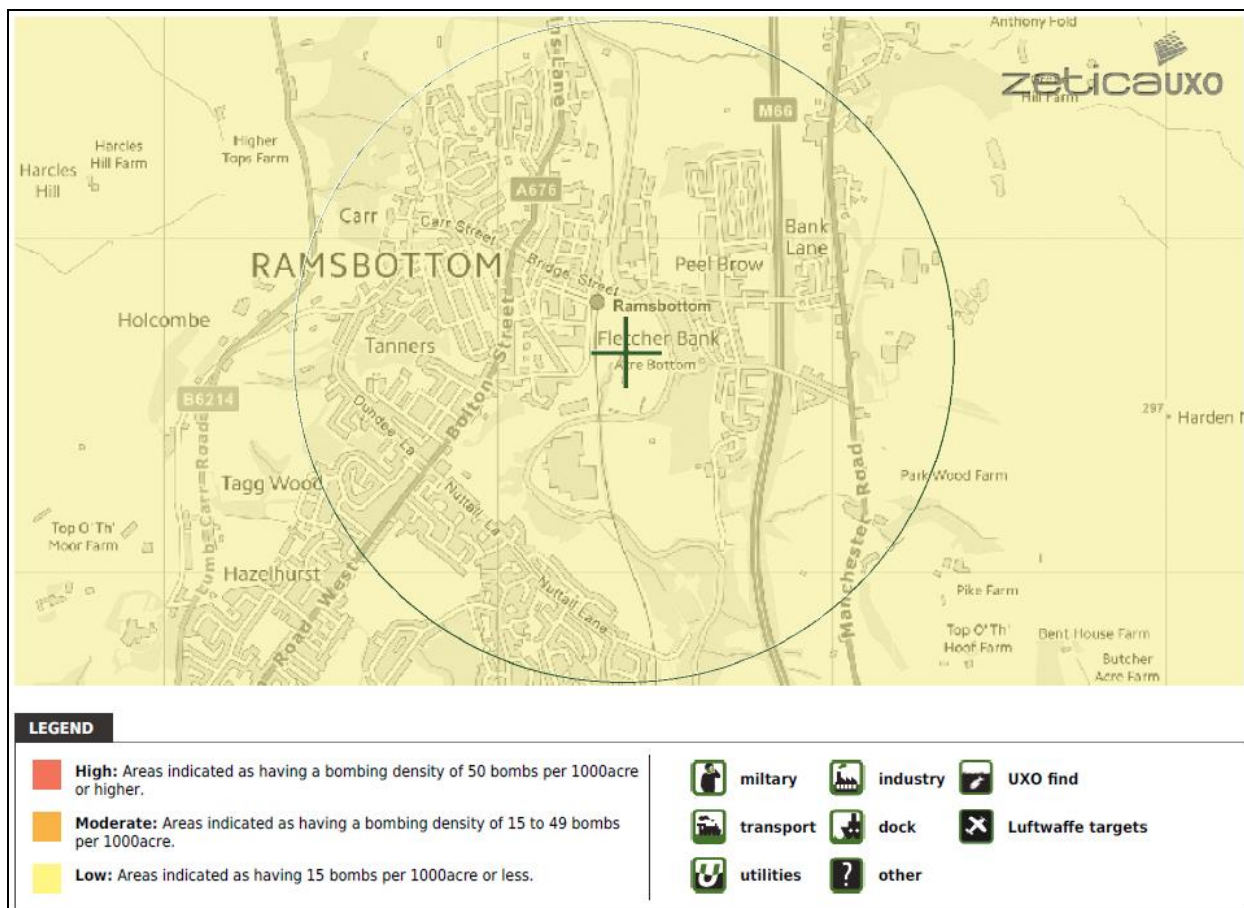
Date First Shown	Land Uses
1850-1851	River Irwell adjacent to the northern and eastern boundaries. Flows north to south. An 'old engine lodge' is shown 200m east. Sandstone quarry located 500m east. Large print works shown on western boundary of southern spur, later labelled as Square Works (bleaching). Series of small and one large reservoirs from 100m to the west. Ramsbottom train station is adjacent to western boundary. Ramsbottom town is shown approximately 200m northwest. Cotton mill with reservoir shown 400m northwest. Large cotton mill with large reservoir labelled as 'Ramsbottom Cotton Mill' detailed 400m north. Large areas are shown to be undeveloped.

1891	50-300m north collection of new mills and other industrial building constructed to the north. Large railway sidings shown 350m north. Large number of mills, works and foundry constructed 50m west of the site. Ramsbottom significantly expanded north, southwest and west. Residential homes constructed along Peel Brow to the east. Large areas to the northeast and southwest remain undeveloped.
1908-1910	Further, small-scale residential development east of the site. Tennis courts and cricket ground shown adjacent to southern boundary. Mill adjacent to southern spur now labelled as 'Square Bleaching Works'.
1927-1929	Soap works constructed 350m north of the site. Holme Mill constructed 75m southwest. Further small-scale residential development 100m southeast. Refuse destructor now constructed 400m north.
1938	Small-scale mapping largely blank. Iron foundry 60m west demolished.
1948	Nuttall Park now detailed south of the site, on the opposite bank of the Irwell.
1955	Large area of possible residential homes built 200m northeast.
1962	Small builders yard detailed 50m northeast. River Irwell banks appear to have been modified slightly. Refuse tip now labelled 200m southeast.
1967-1968	Continued expansion of Ramsbottom town.
1978	Number of mills and works to the west have been demolished, a depot has also been constructed to the west of the southern spur. Electrical substations are also shown. Another cricket ground has been created south of the previous one, with new 'clubhouses' also constructed.
1980	M66 constructed 325m east. Railway sidings to the north have now been reduced to a single line.
1992	Garage constructed 25m east.
1994	Configuration changes to existing mills / works. Southern most cricket club now shown as football club.
2002-2014	A number of works and mills remain to the north and southwest of the site. Two supermarkets were later constructed to the west of the site.

4 UNEXPLODED ORDNANCE (UXO)

A preliminary UXO has been made using online sources of information. The brief search has highlighted that no significant risks are present at the site. Further to this, the site had been developed prior to WWII and remained in use after, increasing the likelihood of any UXO items being recorded and removed.

On the basis of the site history and the online sources, the site is deemed to be at low risk from UXO.



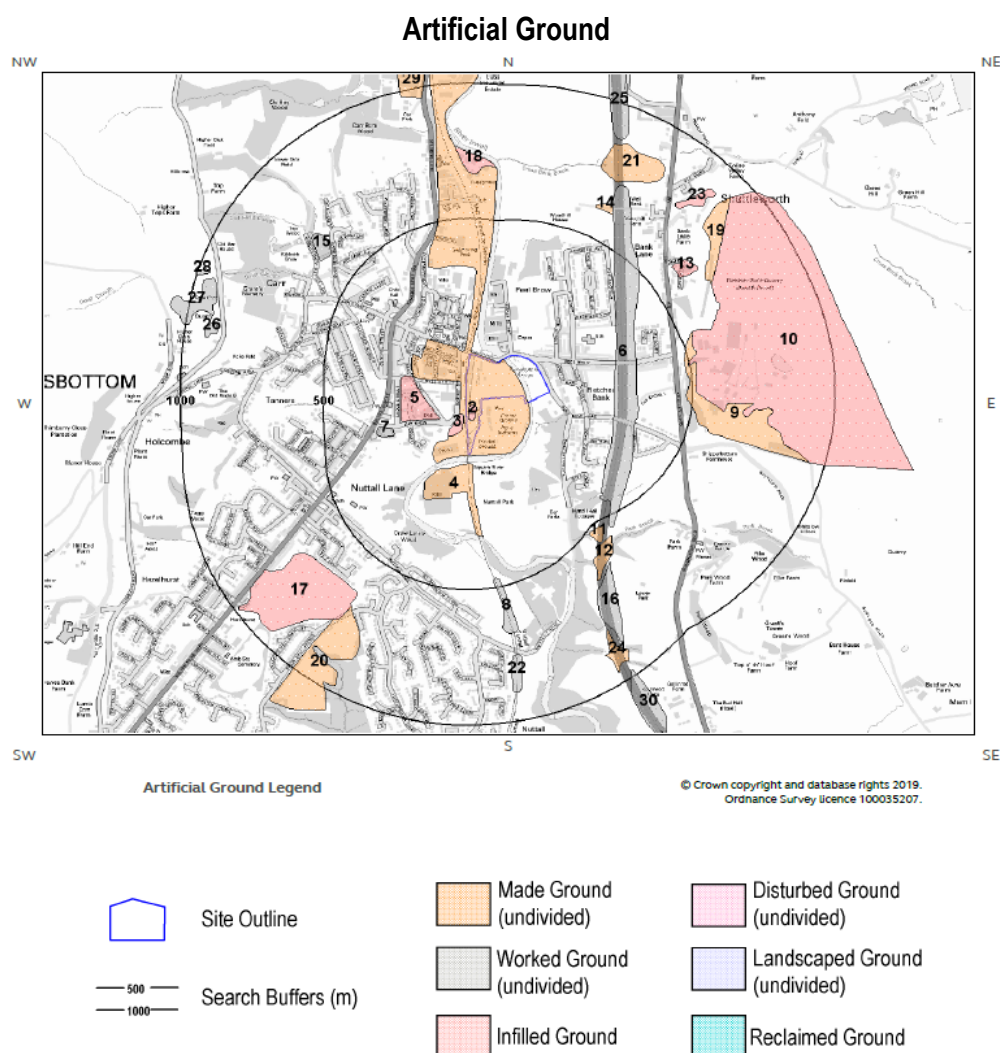
5 GEOLOGY

The following section details the published and available geological data available for the site and the surrounding area. All data is taken from the Groundsure report located in Appendix H unless otherwise stated. This report should be referred to for full details.

5.1 Published Geology

The documented geology of the site is summarised on the British Geological Survey map principally, with further site-specific details detailed below.

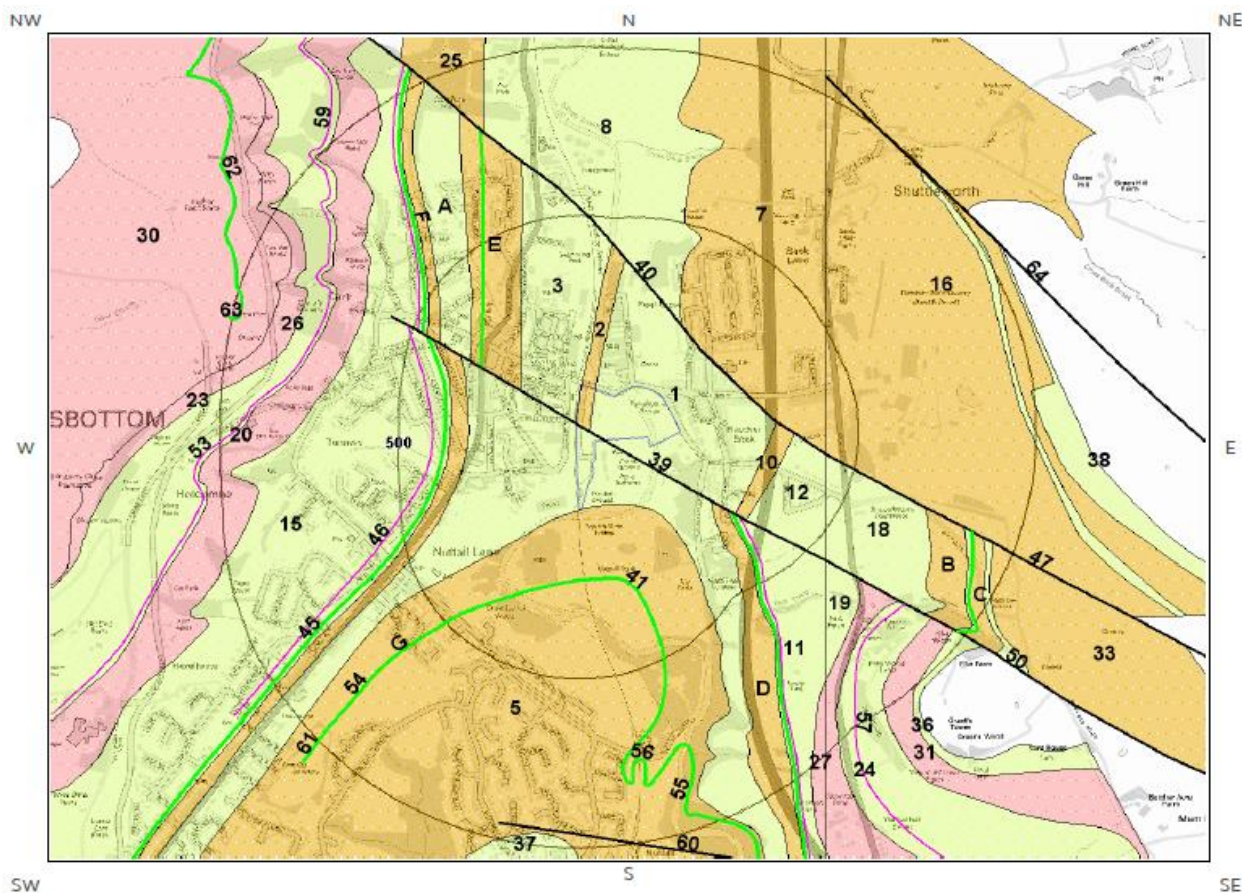
Geology	Artificial Ground and Land Slip	Drift	Solid
1:10,000	Made Ground & Infilled Land	Alluvium – Clay, Sand & Silt	Millstone Grit Group - Mudstone & Siltstone Hazel Greave Grit - Sandstone



Superficial Deposits

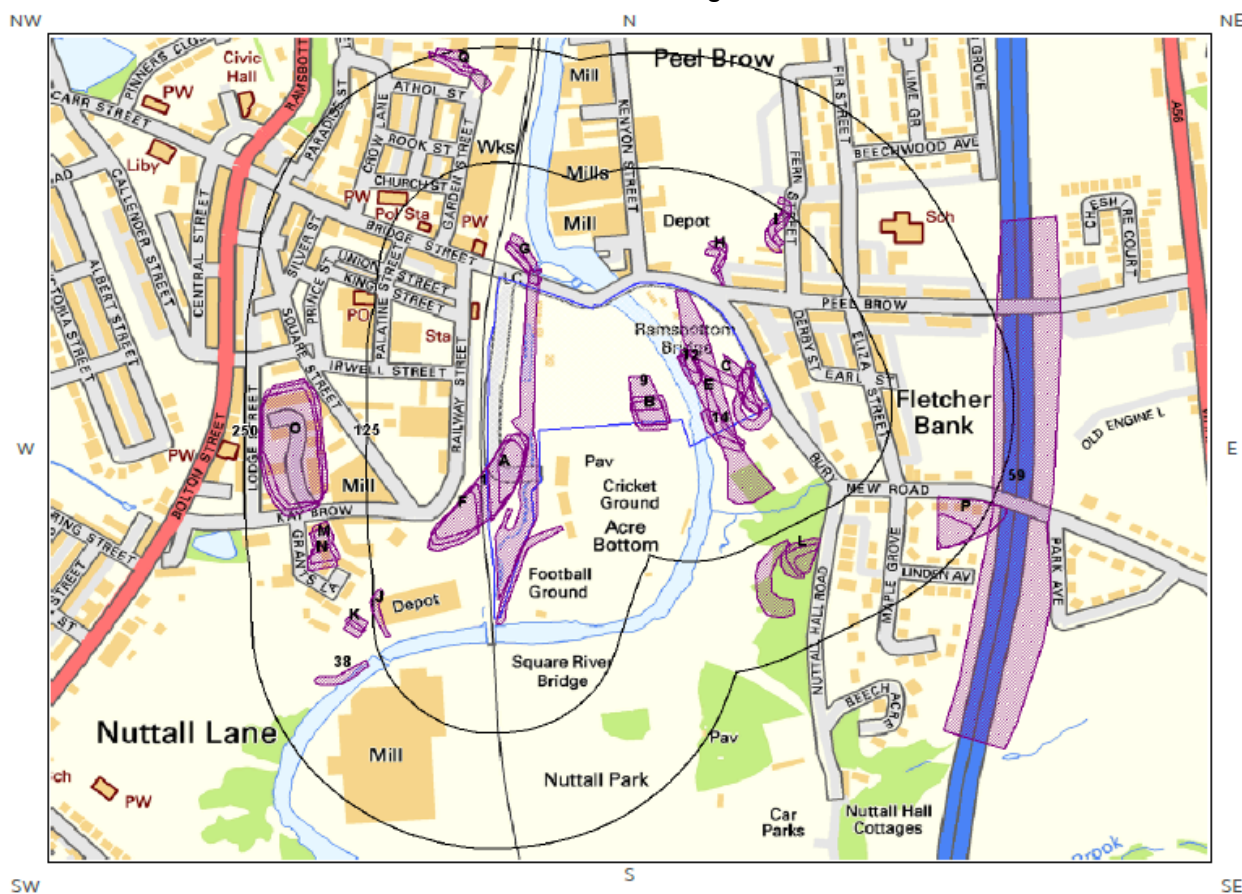


Solid Deposits



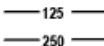
ID	Distance (m)	Direction	LEX Code	Description	Rock Age
1	0.0	On Site	MG-MDSI	Millstone Grit Group [see Also Migr] - Mudstone And Siltstone	Namurian Age
2	0.0	On Site	HZG-SDST	Hazel Greave Grit - Sandstone	Marsdenian Sub-age
3	0.0	On Site	MG-MDSI	Millstone Grit Group [see Also Migr] - Mudstone And Siltstone	Namurian Age
4	0.0	On Site	MG-MDSI	Millstone Grit Group [see Also Migr] - Mudstone And Siltstone	Namurian Age
5	0.0	S	BBS-SDST	Brooksbottoms Grit - Sandstone	Marsdenian Sub-age

Ground Workings



Ground Workings Legend

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-  Site Outline
-  Historic Surface Ground Workings
-  Historic Underground Workings
-  Current Ground Workings
-  Search Buffers (m)
125
250

The features recorded onsite are split between ponds, reservoirs, refuse heaps, filter beds and 'unspecified workings', as listed below;

ID	Distance (m)	Direction	NGR	Use	Date
1	0.0	On Site	379290 416615	Reservoir	1955
2	0.0	On Site	379339 416694	Ponds	1955
3A	0.0	On Site	379318 416624	Reservoir	1948
4A	0.0	On Site	379318 416624	Reservoirs	1891
5A	0.0	On Site	379318 416624	Pond	1908
6A	0.0	On Site	379318 416624	Reservoir	1927
7A	0.0	On Site	379326 416638	Pond	1968
8	0.0	On Site	379327 416522	Unspecified Ground Workings	1908
9	0.0	On Site	379463 416719	Filter Beds	1927
10B	0.0	On Site	379466 416696	Filter Beds	1948
11B	0.0	On Site	379468 416701	Filter Beds	1955
12	0.0	On Site	379507 416745	Refuse Heap	1948
13C	0.0	On Site	379559 416729	Refuse Heap	1927
14	0.0	On Site	379542 416679	Refuse Heap	1948
15D	0.0	On Site	379561 416721	Refuse Heap	1968
16C	0.0	On Site	379568 416722	Refuse Heap	1948
17D	0.0	On Site	379572 416729	Refuse Heap	1955
18E	0.0	On Site	379531 416715	Refuse Heap	1955
19E	0.0	On Site	379544 416715	Unspecified Ground Workings	1968

5.1.1 Linear Features

There is one linear feature located on site and a further 10no. features within 500m. The features within 250m are listed below;

ID	Distance (m)	Direction	Category Description	Feature Description
39	0.0	On Site	FAULT	Normal fault, inferred
40	176.0	NE	FAULT	Normal fault, inferred
41	207.0	S	ROCK	Coal seam, inferred

The feature identified on site is shown as a fault (inferred). Coal mining features are shown to 207m south of the site.

5.1.2 Historical Borehole Records

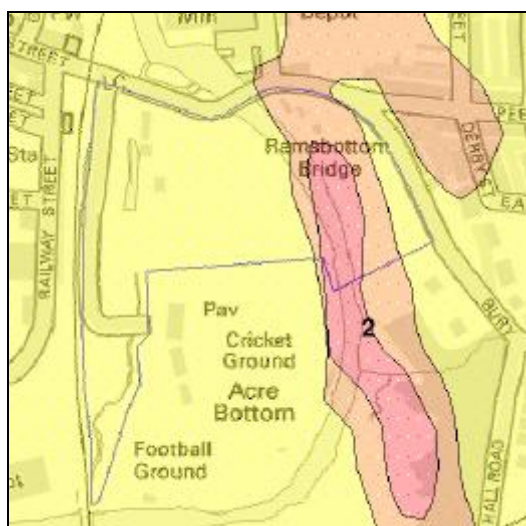
There are 3no. historic boreholes located onsite, that appear for have been used for wells, their succession can be summarised as below;

- Gravel
- Clay
- Conglomerate
- Clay and Gravel
- Rock from circa 19.00mbgl.

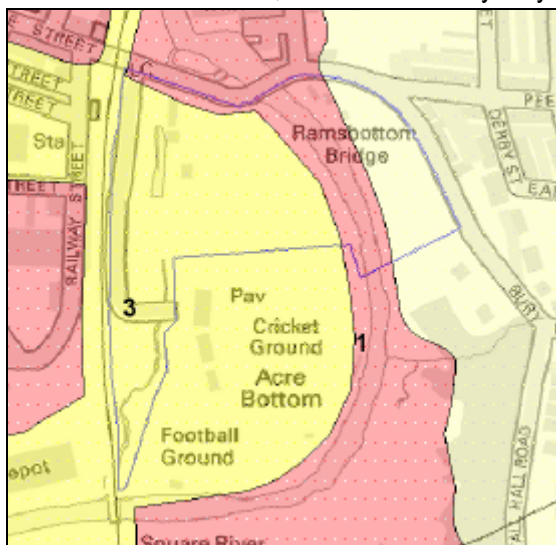
5.2 Ground Stability Issues

Potential risks due to ground stability according to the GroundSure report are listed below, along with maps where moderate risks may be present;

- Shrink-Swell Clay – Low Risk
- Landslide – Low to Moderate Risk, eastern boundary only (shown below)



- Ground Dissolution – Negligible
- Compressible Ground – Low to Moderate Risk, eastern boundary only (shown below)



- Collapsible Deposits – Negligible
- Running Sand – Low Risk

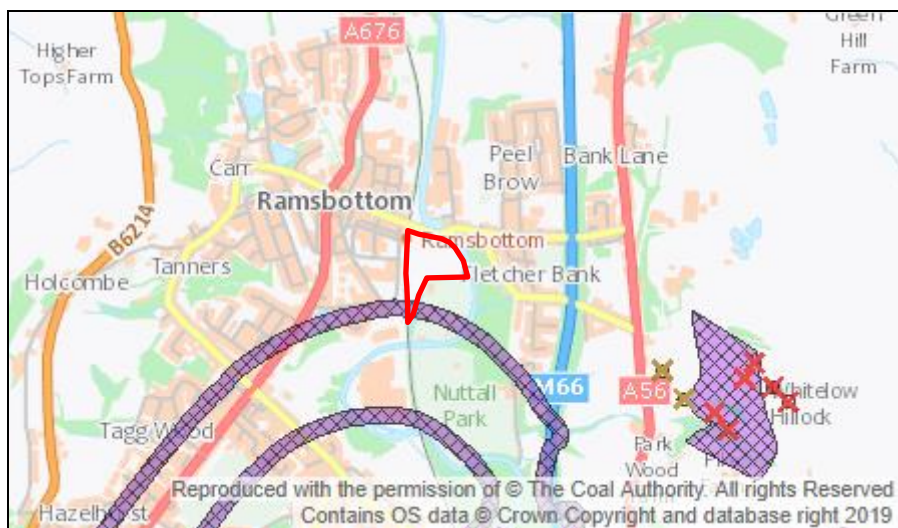
5.3 Geological Features

The table below summarises the presence/absence of recorded mining, extraction and natural cavities records within 500m of site. If entries are present within 250m, further details are provided in the relevant section below.

Data Type	On Site	0 – 250m	250 – 500m
Geological			
Historical Mining	-	-	-
Coal Mining	Yes	Yes	Yes
Non-Coal Mining	Yes	-	Yes
Non-Coal Mining Cavities	-	-	-
Natural Cavities	-	-	-
Brine Extraction	-	-	-

5.3.1 Coal Mining

The site is located within a coal mining area, and coal mining features exist to the south of the site, and as such, a Coal Authority Mining Report has been obtained. Online mapping has shown a possible coal seam to the south, which has further necessitated the Coal Authority report, and a Coal Mining Investigation. A plan showing mine features in the area is shown below;



The salient points of the Coal Authority Report are summarised below;

Section 1 – Mining activity and geology

Past Underground Mining

No past mining recorded.

Probable unrecorded shallow workings

None.

Spine roadways at shallow depth

No spine roadway recorded at shallow depth.

Mine entries

None recorded within 100 metres of the enquiry boundary.

Abandoned mine plan catalogue numbers

None available.

Outcrops

Seam name	Mineral	Seam workable	Distance to outcrop (m)	Direction to outcrop	Bearing of outcrop
LOWER HOLCOMBE BROOK	Coal	Yes	Within	N/A	100

Geological faults, fissures and breaklines

No faults, fissures or breaklines recorded.

Opencast mines

None recorded within 500 metres of the enquiry boundary.

Coal Authority managed tips

None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

Site investigations

None recorded within 50 metres of the enquiry boundary.

Remediated sites

None recorded within 50 metres 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

None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes

None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining

None recorded.

Coal mining licensing

None recorded within 200 metres of the enquiry boundary.

Court orders

None recorded.

Section 46 notices

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence. The property is in an area where a notice to withdraw support was given in 1955. 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.

Withdrawal of support notices

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

5.3.2 Non-Coal Mining

One entry is recorded within 250m, and is noted as onsite as detailed below;

ID	Distance (m)	Direction	Name	Commodity	Assessment of likelihood
1	0.0	On Site	Not available	Vein Mineral	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and <u>localised and are at a level where they need not be considered</u>

Vein minerals unlikely to have impact onsite.

5.3.3 Radon

The Groundsure data states that the site is within a low probability radon area (<1% of properties above the action level), therefore no radon protection measures are required in the construction of new dwellings.

5.4 Hydrogeological and Hydrological Features

The table below summarises the presence/absence of any hydrological licences and incidents within 500m of the proposed site. If entries are present within 250m, further details are provided in the relevant subsection below;

Data Type	On Site	0 – 250m	250 – 500m
Hydrogeology & Hydrology			
Licensed Discharge Consents	-	5	1
Red List Discharge Consents	-	-	-
Ground Water Abstraction Licences	2	-	-
Surface Water Abstraction Licences	-	6	8
Potable Water Abstraction Licences	-	-	-
Source Protection Zones	-	-	-
Ground Water Vulnerability & Soil Leaching Potential	1	1	1
Surface Water Features	2	7	Not Searched

5.4.1 Licensed Discharge Consents

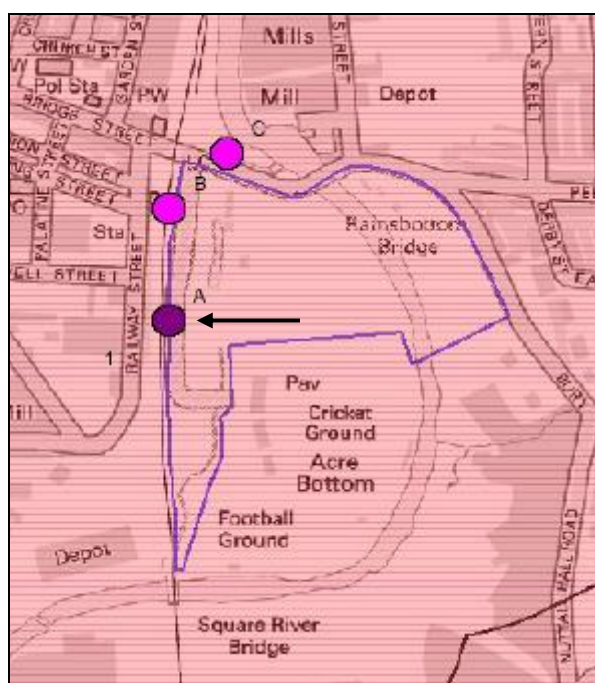
There are five (5no.) entries located within 250m of the site, as detailed below;

ID	Distance (m)	Direction	NGR	Details
9	13	N	379348 416847	Address: CARR STREET CSO 099BP, 82 CARR STREET, RAMSBOTTOM, BURY, LANCASHIRE, BL0 9EG Effluent Type: SEWAGE DISCHARGES - SEWER STORM OVERFLOW - WATER COMPANY Permit Number: 01BRY0001 Permit Version: 4 Receiving Water: RIVER IRWELL Status: VARIED UNDER EPR 2010 Issue date: 11/04/2018 Effective Date: 11-Apr-2018 Revocation Date: -
10B	38	E	379350 416470	Address: CARR STREET CSO 099BP, 82 CARR STREET, RAMSBOTTOM, BURY, LANCASHIRE, BL0 9EG Effluent Type: SEWAGE DISCHARGES - SEWER STORM OVERFLOW - WATER COMPANY Permit Number: 01BRY0001 Permit Version: 2 Receiving Water: RIVER IRWELL Status: VARIED UNDER EPR 2010 Issue date: 03/09/2010 Effective Date: 03-Sep-2010 Revocation Date: 04/02/2016
11B	38	E	379350 416470	Address: CARR STREET CSO 099BP, 82 CARR STREET, RAMSBOTTOM, BURY, LANCASHIRE, BL0 9EG Effluent Type: SEWAGE DISCHARGES - SEWER STORM OVERFLOW - WATER COMPANY Permit Number: 01BRY0001 Permit Version: 1 Receiving Water: RIVER IRWELL Status: VARIED UNDER EPR 2010 Issue date: - Effective Date: 01-Jan-1995 Revocation Date: 02/09/2010
12C	232	N	379419 417068	Address: BRITANNIA WORKS, KENYON ST, RAMSBOTTOM, BURY, LANCASHIRE Effluent Type: TRADE DISCHARGES - COOLING WATER Permit Number: 0165/76 Permit Version: 2 Receiving Water: RIVER IRWELL Status: SURRENDERED UNDER EPR 2010 Issue date: - Effective Date: 01-Jan-1995 Revocation Date: 15/08/2017
13C	232	N	379419 417068	Address: BRITANNIA WORKS, KENYON ST, RAMSBOTTOM, BURY, LANCASHIRE Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: 0165/76 Permit Version: 1 Receiving Water: RIVER IRWELL Status: REVOKED - UNSPECIFIED Issue date: - Effective Date: 01-Apr-1991 Revocation Date: 31/12/1994

5.4.2 Groundwater Abstraction Licenses

There are two (2no.) entries for groundwater abstraction licences, both are listed onsite, the extract is given below with approximate locations;

ID	Distance (m)	Direction	NGR	Details
3A	0	On Site	379300 416700	Status: Historical Licence No: 2569001030 Details: Process water Direct Source: Ground Water - North West Region Point: "BOREHOLE AT PEEL BRIDGE MILLS, RAMSBOTTOM" Data Type: Point Name: DANISCO PAPER LTD Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 14/02/1966 Expiry Date: - Issue No: 101 Version Start Date: 21/08/1999 Version End Date:
4A	0	On Site	379300 416700	Status: Historical Licence No: 2569001030 Details: Process Water Direct Source: Ground Water - North West Region Point: BOREHOLE AT PEEL BRIDGE MILLS, RAMSBOTTOM Data Type: Point Name: MONDI HOLCOMBE LIMITED Annual Volume (m³): 359149 Max Daily Volume (m³): 1637 Original Application No: - Original Start Date: 14/02/1966 Expiry Date: 31/03/2015 Issue No: 105 Version Start Date: 11/08/2008 Version End Date:



5.4.3 Surface Water Abstraction Licences

There are six (6no.) entries for surface water abstraction licences, the extract is given below;

ID	Distance (m)	Direction	NGR	Details	
25B	7	W	379300 416800	Status: Historical Licence No: 2569001029 Details: Process water Direct Source: Surface, Non-Tidal - North West Region Point: R.IRWELL AT RAMSBOTTOM Data Type: Point Name: MONDI PAPER LIMITED	Annual Volume (m³): - Max Daily Volume (m³): - Application No: - Original Start Date: 14/02/1966 Expiry Date: - Issue No: 102 Version Start Date: 11/09/2001 Version End Date:
26B	7	W	379300 416800	Status: Historical Licence No: 2569001224 Details: Process Water Direct Source: Surface, Non-Tidal - North West Region Point: R.IRWELL AT RAMSBOTTOM Data Type: Point Name: MONDI HOLCOMBE LIMITED	Annual Volume (m³): 90920 Max Daily Volume (m³): 1091.04 Application No: - Original Start Date: 12/04/1988 Expiry Date: - Issue No: 103 Version Start Date: 11/08/2008 Version End Date:
27B	7	W	379300 416800	Status: Historical Licence No: 2569001029 Details: Process Water Direct Source: Surface, Non-Tidal - North West Region Point: GOIT FED BY SURFACE DRAINAGE AND RIVER IRWELL AT RAMSBOTTOM Data Type: Point Name: MONDI HOLCOMBE LIMITED	Annual Volume (m³): 322766 Max Daily Volume (m³): 1637 Application No: - Original Start Date: 14/02/1966 Expiry Date: 31/03/2015 Issue No: 105 Version Start Date: 11/08/2008 Version End Date:
28C	16	N	379350 416850	Status: Historical Licence No: 2569001246 Details: Supply to a Leat for Throughflow Direct Source: Surface, Non-Tidal - North West Region Point: RIVER IRWELL AT BRIDGE STREET, RAMSBOTTOM Data Type: Point Name: BURY METROPOLITAN BOROUGH COUNCIL	Annual Volume (m³): - Max Daily Volume (m³): - Application No: - Original Start Date: 19/01/1994 Expiry Date: - Issue No: 100 Version Start Date: 11/08/2000 Version End Date:
29C	16	N	379350 416850	Status: Historical Licence No: 2569001246 Details: Supply to a Leat for Throughflow Direct Source: "Surface, Non-Tidal - North West Region" Point: "RIVER IRWELL AT BRIDGE STREET, RAMSBOTTOM" Data Type: Point Name: BURY METROPOLITAN BOROUGH COUNCIL	Annual Volume (m³): - Max Daily Volume (m³): - Application No: - Original Start Date: 19/01/1994 Expiry Date: - Issue No: 100 Version Start Date: 11/08/2000 Version End Date:
30C	16	N	379350 416850	Status: Active Licence No: 2569001246 Details: Supply To A Leat For Throughflow Direct Source: Surface, Non-Tidal - North West Region Point: RIVER IRWELL AT BRIDGE STREET RAMSBOTTOM Data Type: Point Name: BURY METROPOLITAN BOROUGH COUNCIL	Annual Volume (m³): 6.31152e+007 Max Daily Volume (m³): 172920 Application No: - Original Start Date: 19/01/1994 Expiry Date: - Issue No: 100 Version Start Date: 11/08/2000 Version End Date:

5.4.4 Groundwater Vulnerability & Soil Leaching Potential

There are three (3no.) entries located within 250m of the site, one of which is located onsite, as detailed below;

Distance (m)	Direction	Classification	Soil Vulnerability Category	Description
0	On Site	Minor Aquifer/High Leaching Potential	HU	Soil information for urban areas and restored mineral workings. These soils are therefore assumed to be highly permeable in the absence of site-specific information.
15	E	Minor Aquifer/Low Leaching Potential	L	Soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants.
409	E	Minor Aquifer/High Leaching Potential	HU	Soil information for urban areas and restored mineral workings. These soils are therefore assumed to be highly permeable in the absence of site-specific information.

5.4.5 Surface Water Features

There are nine (9 no.) entries for surface water features within 250m, two of which are located onsite. Extract below;

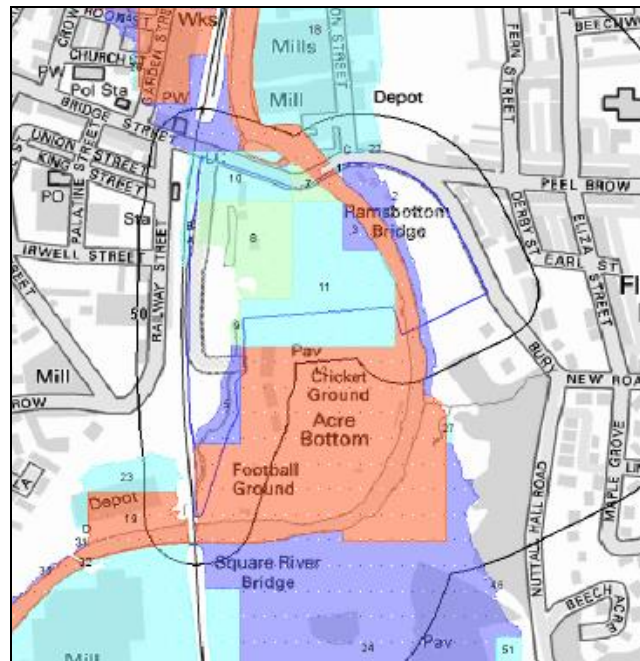
Distance (m)	Direction
0	On Site
0	On Site
10	SW
10	W
11	NW
72	S
86	SE
86	SE
119	SW

5.4.6 Hydrogeology and Hydrology

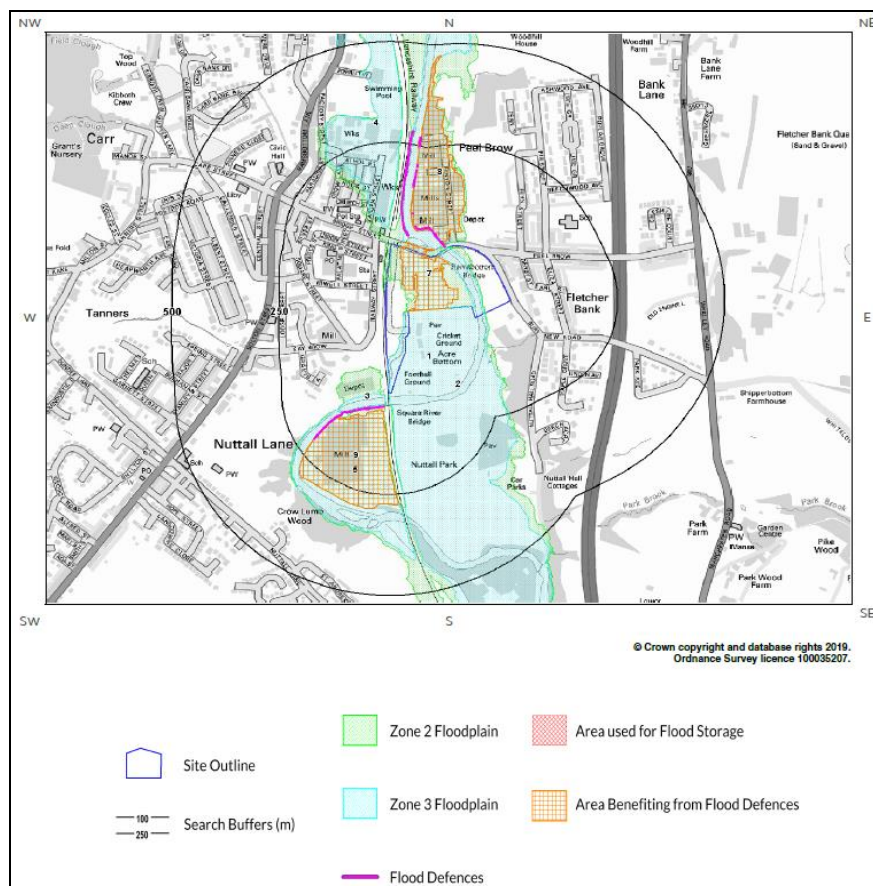
- The superficial deposits of the Alluvium are designated as Secondary A Aquifer (Moderate Permeability).
- The bedrock deposits of the Sandstone are designated as Secondary A aquifer (Moderate Permeability).
- The site does not lie within Groundwater Source Protection as defined by the Environment Agency.
- There are no potable water abstractions within 500m of site.
- Two groundwater abstractions located onsite, on the western boundary.
- There are two (7 no.) recorded surface water features on site and seven (9 no.) within 250m.
- BGS data shows the site to be at significant to moderate risk of groundwater flooding.
- Flooding – Zones 2 and 3 noted as onsite. Risk is noted as Very Low to High (RoFRaS). Map of risks given below;

5.4.7 Flood Risk Mapping

RoFRas



Environment Agency



6 ENVIRONMENTAL DATA

The following section details environmental data available for the site and the surrounding area. Full details can be found in the EnviroCheck Report by Landmark located in Appendix H.

The table below summarises the presence/absence of any waste, hazardous substance sites of industrial land uses within 500m of the proposed site. If entries are present within 250m, further details are provided in the relevant section below.

Data Type	On Site	0 – 250m	250 – 500m
Environmental Permits, Incidents & Registers			
Historic Integrated Pollution Control Authorisations	-	2	-
Integrated Pollution Prevention and Control Authorised Activities	2	1	-
Part A (2) & Part B Activities and Enforcements	-	3	-
Category 3 or 4 Radioactive Substances Authorisations	-	-	-
Water Industry Referrals	-	-	-
Hazardous Substance Consents & Enforcements	-	-	-
EA / NRW Recorded Pollution Incidents	-	4	-
Landfill & Other Waste Sites			
EA / NRW Registered Landfill Sites	-	-	-
EA / NRW Historic Landfill Sites	-	1	2
BGS / DoE Landfill Site Survey	-	-	-
Landfills in Local Authority & Historical Mapping Records	2	2	2
Operational & Non-operational Waste Treatment, Transfer & Disposal Sites	-	5	7
EA / NRW Licenced Waste Sites	-	6	-
Hazardous Sites			
COMAH and NIHHS Sites	-	-	-
Historical Industrial Sites			
Potentially Contaminative Uses	32	89	75
Historical Tank Database	15	23	2
Historical Energy Features Database	3	15	20
Historical Petrol & Fuel Site Database	-	-	-
Historical Garage & Motor Vehicle Repair Database	-	7	-
Historical Military Sites	-	-	-
Potentially Infilled Land	19	40	55
Current Land Use			
Current Industrial Sites Data	1	39	Not Searched
Petrol & Fuel Sites	-	1	1
National Grid Underground Electricity Cables	-	-	-
National Grid Gas Transmission Pipelines	-	-	-
Designated Environmentally Sensitive Sites			
Sites of Special Scientific Interest (SSSI)	-	-	-
National Nature Reserves (NNR)	-	-	-
Special Areas of Conservation (SAC)	-	-	-
Special Protection Areas (SPA)	-	-	-
Areas of Outstanding Natural Beauty (AONB)	-	-	-
National Parks	-	-	-
Green Belt Land	-	-	-

6.1 Environmental Permits, Incidents & Registers

6.1.1 Historic Integrated Pollution Control Authorisations

There are two records for Historic IPC Authorisations within 250m of the site, an extract is given below;

ID	Distance (m)	Direction	NGR	Details	
32D	7	W	379300 416800	Operator: Mondi Packaging Holcombe Ltd Address: Holcombe Mill, Bridge Street, Ramsbottom, Bury, Lancashire, BL0 0BS Process: Paper And Pulp Manufacturing Processes	Permit Number: AU7451 Original Permit Number: IPCAPP Date Approved: 27-1-1997 Effective Date: 29-1-1997 Status: Superseded By Variation
33D	7	W	379300 416800	Operator: Mondi Packaging Holcombe Ltd Address: Holcombe Mill, Bridge Street, Ramsbottom, Bury, Lancashire, BL0 0BS Process: Paper And Pulp Manufacturing Processes	Permit Number: BD4546 Original Permit Number: IPCMINVAR Date Approved: 24-11-1998 Effective Date: 30-11-1998 Status: Revoked - Now Ippc

6.1.2 Integrated Pollution Prevention and Control Authorised Activities

There are three records for IPPC Authorised Activities within 250m of the site, two of which are onsite. an extract is given below;

ID	Distance (m)	Direction	NGR	Details	
26E	0	On Site	379400 416760	Operator: MONDI HOLCOMBE LTD Installation Name: DANISCO PAPER MILL EAEPRBJ6542IQS002 Process: PAPER, PULP AND BOARD; PRODUCING PAPER/BOARD >20T/D	Permit Number: BJ6542IQ Original Permit Number: BJ6542IQ EPR Reference: - Issue Date: 09/01/2002 Effective Date: 09/01/2002 Last date noted as effective: 2019-01-31 Status: SUPERCEDED
27E	0	On Site	379400 416760	Operator: MONDI HOLCOMBE LTD Installation Name: DANISCO PAPER LIMITED Process: PAPER, PULP AND BOARD; PRODUCING PAPER/BOARD >20T/D	Permit Number: KP3530KN Original Permit Number: BJ6542IQ EPR Reference: - Issue Date: - Effective Date: 25/06/2010 Last date noted as effective: 2019-01-31 Status: SURRENDER EFFECTIVE
28D	7	W	379300 416800	Operator: MONDI PAPER LTD Installation Name: - Process: PAPER, PULP & BOARD; PRODUCING PAPER/BOARD >20T/D	Permit Number: BJ6542 Original Permit Number: BJ6542 EPR Reference: - Issue Date: 09/01/2002 Effective Date: 09/01/2002 Last date noted as effective: 2004-10-01 Status: SUPERSEDED BY PAS

A closure report should be requested / obtained from the Environment Agency.

6.1.3 Part A (2) & Part B Activities and Enforcements

There are three (3 No.) entry for Part A (2) & Part B Activities and Enforcements within 250m. The extract is shown extract below;

ID	Distance (m)	Direction	NGR	Details
23	49	W	379261 416836	Address: Station Garage, Railway Street, BLO 9AL Process: Petrol Vapour Recovery Status: Historical Permit Permit Type: Part B Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified
24	157	W	379163 416894	Address: First Impression, 44 Bridge Street, Ramsbottom, Bury, BLO 9AQ Process: Dry Cleaning Status: Current Permit Permit Type: Part B Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified
25	476	N	379221 417313	Address: Ramsbottom Service Station, Stubbins Road, Ramsbottom, BLO OPU Process: Unloading of Petrol into Storage at Service Stations Status: Current Permit Permit Type: Part B Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified

6.1.4 EA / NRW Recorded Pollution Incidents

There are four (4no.) records for EA / NRW Recorded Pollution Incidents within 250m of the site, an extract of the records is given below;

ID	Distance (m)	Direction	NGR	Details
1	69	S	379512.0 416592.0	Incident Date: 17-Apr-2002 Incident Identification: 72361.0 Pollutant: Oils and Fuel Pollutant Description: Unidentified Oil Water Impact: Category 3 (Minor) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)
2	94	NW	379405.0 416919.0	Incident Date: 22-Jun-2014 Incident Identification: 1247989.0 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Smoke Water Impact: Category 3 (Minor) Land Impact: Category 3 (Minor) Air Impact: Category 2 (Significant)
3	132	E	379446.0 416462.0	Incident Date: 15-Apr-2002 Incident Identification: 71682.0 Pollutant: Oils and Fuel Pollutant Description: Unidentified Oil Water Impact: Category 3 (Minor) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)
4	197	SW	379133.0 416382.0	Incident Date: 13-Jun-2001 Incident Identification: 9000.0 Pollutant: Oils and Fuel Pollutant Description: Gas and Fuel Oils Water Impact: Category 3 (Minor) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)

6.2 Landfill & Other Waste Sites

6.2.1 EA / NRW Historic Landfill Sites

There is one (1no.) entry for an historic landfill site within 250m, an extract is given below;

ID	Distance (m)	Direction	NGR	Details
15	0	On Site		Site Address: Mill Lodge, Railway Street/Kenyon Street, Ramsbottom, Bury, Greater Manchester Waste Licence: Yes Site Reference: C013, RD/LIC/009/76 Waste Type: Inert, Industrial Environmental Permitting Regulations (Waste) Reference: - Licence Issue: 13-Dec-1977 Licence Surrendered: 08-May-1990 Licence Holder Address: Irwell Street, Ramsbottom Operator: - Licence Holder: Irwell Street Metal Company Limited First Recorded: 31-Dec-1977 Last Recorded: 31-Jul-1979

6.2.2 Landfills in Local Authority & Historical Mapping Records

There are four (4no.) entries for Landfills in Local Authority & Historical Mapping Records within 250m of site, two of which are located onsite, an extract of the record is below;

ID	Distance (m)	Direction	NGR	Site Address	Source	Data Type
47	0	On Site	379550 416786	Refuse Tip	1962 mapping	Polygon
48	0	On Site	379557 416719	Refuse Tip	1962 mapping	Polygon
49	136	SE	379581 416524	Refuse Tip	1962 mapping	Polygon
50	221	N	379565 417057	Refuse Tip	1962 mapping	Polygon

6.2.3 Operational & Non-operational Waste Treatment, Transfer & Disposal Sites

There are five (5no.) entries for Operational & Non-operational Waste Treatment, Transfer & Disposal Site records within 250m of site. The records within 100m are given below;

ID	Distance (m)	Direction	NGR	Details
3A	79	N	379463 416958	Type of Site: Scrap Yard Site Address: N/A Planning Application Reference: N/A Date: 1992 Further Details: N/A Data Source: Historic Mapping Data Type: Polygon
4A	79	N	379463 416958	Type of Site: Scrap Yard Site Address: N/A Planning Application Reference: N/A Date: 1994 Further Details: N/A Data Source: Historic Mapping Data Type: Polygon

6.2.4 Records of Environment Agency / Natural Resources Wales Licensed Waste Sites

There are six (6no.) Records of Environment Agency/Natural Resources Wales licensed waste sites within 250m of the site boundary, an extract of the records within 100m is given below;

ID	Distance (m)	Direction	NGR	Details
27F	91	N	379441 416928	Site Address: Waterside Mill & Peel Bridge Mill, Kenyon Street, Ramsbottom, Lancs, BLO 0AB Type: 75kte HCI Waste TS + treatment Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: AWR003 EPR reference: CP3897ES/A001 Operator: A W R Rent A Skip Ltd Waste Management licence No: 100969 Annual Tonnage: 0.0 Issue Date: 04/08/2009 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: A W R Rent A Skip Correspondence Address: -
28F	91	N	379441 416928	Site Address: Waterside Mill, Kenyon Street, Ramsbottom, Lancashire, BLO 0AB Type: 75kte HCI Waste TS + treatment Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: WHE032 EPR reference: EA/EPR/QP3092EN/T001 Operator: Wheeldon Brothers Waste Ltd Waste Management licence No: 100969 Annual Tonnage: 74999.0 Issue Date: 04/08/2009 Effective Date: 22/11/2010 Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Transferred Site Name: Waterside Mill & Peel Bridge Mill Correspondence Address: -
29F	98	N	379455 416937	Site Address: Land/premises At, Kenyon Street, Ramsbottom, Bury, Lancashire, BLO 0AB Type: Special Waste Transfer Station Size: >= 25000 tonnes < 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: ISM001 EPR reference: EA/EPR/MP3496CP/V002 Operator: Irwell Street Metal Co Ltd Waste Management licence No: 53695 Annual Tonnage: 6250.0 Issue Date: 05/01/1994 Effective Date: - Modified: 21/11/2002 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Irwell Street Metal Co Ltd Correspondence Address: -

6.3 Historical Industrial Sites

6.3.1 Potentially Contaminative Uses

There are One-hundred and twenty-one (121no.) records of Potentially Contaminative Uses within 250m of the site, 32 of which are located onsite, an extract of the records onsite is given below;

ID	Distance [m]	Direction	Use	Date
1D	0	On Site	Refuse Heap	1927
2BK	0	On Site	Refuse Heap	1948
3A	0	On Site	Refuse Heap	1968
4A	0	On Site	Refuse Heap	1948
5A	0	On Site	Refuse Heap	1955
6B	0	On Site	Paper Mill	1908
7B	0	On Site	Paper Mill	1948
8	0	On Site	Railway Sidings	1955
9BL	0	On Site	Unspecified Ground Workings	1908
10B	0	On Site	Paper Mill	1927
11B	0	On Site	Unspecified Mill	1891
12B	0	On Site	Paper Mill	1955
13B	0	On Site	Unspecified Mill	1968
14B	0	On Site	Unspecified Mill	1980
15C	0	On Site	Filter Beds	1927
16C	0	On Site	Filter Beds	1948
17C	0	On Site	Filter Beds	1955
18BJ	0	On Site	Unspecified Ground Workings	1968
19BI	0	On Site	Refuse Heap	1948
20D	0	On Site	Refuse Heap	1955
21AB	0	On Site	Railway Sidings	1968
22E	0	On Site	Railway Sidings	1948
23E	0	On Site	Railway Sidings	1927
24E	0	On Site	Railway Sidings	1891
25E	0	On Site	Railway Sidings	1908
26F	0	On Site	Railway Station	1927
27F	0	On Site	Railway Station	1908
28F	0	On Site	Railway Station	1891
29F	0	On Site	Railway Station	1948
30F	0	On Site	Railway Station	1955
31F	0	On Site	Railway Station	1968
32G	0	On Site	Bleaching Works	1955

6.3.2 Historical Tank Database

There are twenty-three (23no.) records of tank records within 250m of the site, fifteen of which are located onsite, an extract of the records onsite is given below;

ID	Distance (m)	Direction	Use	Date
197C	0	On Site	Unspecified Tank	1978
198C	0	On Site	Unspecified Tank	1992
199E	0	On Site	Unspecified Tank	1891
200E	0	On Site	Tanks	1992
201AS	0	On Site	Unspecified Tank	1938
202AS	0	On Site	Unspecified Tank	1910
203AS	0	On Site	Unspecified Tank	1929
204E	0	On Site	Tanks	1992
205E	0	On Site	Tanks	1978
206AT	0	On Site	Tanks	1992
207AT	0	On Site	Tanks	1978
208E	0	On Site	Tanks	1994
209E	0	On Site	Tanks	1994
210AT	0	On Site	Tanks	1994
211C	0	On Site	Unspecified Tank	1994

6.3.3 Historical Energy Features

There are fifteen (15no.) records in the historical energy database within 250m of the site, three of which are located onsite, an extract of the records onsite is given below;

ID	Distance (m)	Direction	Use	Date
222AW	0	On Site	Electricity Substation	1992
223AW	0	On Site	Electricity Substation	1978
224AW	0	On Site	Electricity Substation	1994

6.3.4 Historical Garage & Motor Vehicle Repair Database

There are seven (7no.) records in the historical garage & vehicle repair database within 250m of the site, an extract of the records onsite is given below;

ID	Distance (m)	Direction	Use	Date
260BG	41	W	Garage	1962
261BG	42	W	Garage	1992
262BG	42	W	Garage	1994
263BG	43	W	Garage	1978
264M	92	N	Depot and Destructor Works	1978
265BH	218	W	Garage	1992
266BH	218	W	Garage	1978

6.3.5 Potentially Infilled Lane

There are fifty-nine (59no.) records for potentially infilled land within 250m of the site, nineteen of which are located onsite, an extract of the records onsite is given below;

ID	Distance(m)	Direction	Use	Date
267BI	0	On Site	Refuse Heap	1948
268A	0	On Site	Refuse Heap	1927
269BJ	0	On Site	Refuse Heap	1955
270A	0	On Site	Unspecified Ground Workings	1968
271A	0	On Site	Refuse Heap	1955
272A	0	On Site	Refuse Heap	1948
273A	0	On Site	Refuse Heap	1968
274BK	0	On Site	Refuse Heap	1948
275BL	0	On Site	Unspecified Ground Workings	1908
276BM	0	On Site	Reservoir	1955
277BN	0	On Site	Reservoirs	1891
278BN	0	On Site	Reservoir	1948
279BN	0	On Site	Pond	1908
280BN	0	On Site	Reservoir	1927
281BN	0	On Site	Pond	1968
282C	0	On Site	Filter Beds	1955
283C	0	On Site	Filter Beds	1927
284AS	0	On Site	Ponds	1955
285C	0	On Site	Filter Beds	1948

6.4 Current Land Use

6.4.1 Current Industrial Sites

There forty (40no.) records for current industrial sites within 250m of the site, one of which is located onsite, an extract of the records within 100m are given below;

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
1	0	On Site	Chimney	379361 416764	Greater Manchester, BLO	Chimneys	Industrial Features
2	21	W	East Lancashire Railway (Ramsbottom Station)	379286 416809	Greater Manchester, BLO	Railways (Heritage, Steam and Miniature)	Tourism
3	46	W	TNT Express	379253 416647	Railway Street, Ramsbottom, Bury, Greater Manchester, BLO 9AL	Distribution and Haulage	Transport, Storage and Delivery
4A	47	W	Ramsbottom Metalwork	379253 416735	Empire Works, Railway Street, Ramsbottom, Bury, Greater Manchester, BLO 9AL	Metalworkers Including Blacksmiths	Construction Services
5C	48	W	Station Garage	379262 416837	Railway Street, Ramsbottom, Bury, Greater Manchester, BLO 9AL	Vehicle Repair, Testing and Servicing	Repair and Servicing
6A	50	W	Works	379250 416726	Greater Manchester, BLO	Unspecified Works Or Factories	Industrial Features
7A	56	W	Electricity Sub Station	379244 416737	Greater Manchester, BLO	Electrical Features	Infrastructure and Facilities
8B	56	NW	Booth King Partnership Ltd	379274 416887	Tollgate House 9c, Bridge Street, Ramsbottom, Bury, Greater Manchester, BLO 9AB	Civil Engineers	Engineering Services
9	57	NE	Electricity Sub Station	379560 416865	Greater Manchester, BLO	Electrical Features	Infrastructure and Facilities
10B	64	NW	Tank	379283 416902	Greater Manchester, BLO	Tanks (Generic)	Industrial Features
11	66	N	Depot	379465 416905	Greater Manchester, BLO	Container and Storage	Transport, Storage and Delivery
12C	67	W	Works	379241 416823	Greater Manchester, BLO	Unspecified Works Or Factories	Industrial Features
13	79	NW	Formulated Polymer Products Ltd	379267 416911	8, Garden Street, Ramsbottom, Bury, Greater Manchester, BLO 9BQ	Adhesives and Sealants	Industrial Products
14	81	W	Depot	379225 416492	Greater Manchester, BLO	Container and Storage	Transport, Storage and Delivery
15	89	N	ISM Waste & Recycling	379468 416928	Kenyon Street, Ramsbottom, Bury, Greater Manchester, BLO 0AB	Waste Storage, Processing and Disposal	Infrastructure and Facilities
16	95	W	Ramsbottom Paint & Bodyshop	379205 416584	Kay Brow Yard, Kay Brow, Ramsbottom, Bury, Greater Manchester, BLO 9AY	Vehicle Repair, Testing and Servicing	Repair and Servicing

6.4.2 Petrol & Fuel Sites

There two (2no.) records for petrol & fuel sites within 250m of the site, an extract of the record is given below;

ID	Distance (m)	Direction	NGR	Company	Address	LPG	Status
41B	49	W	379260 416837	UNBRANDED	Railway Street, Ramsbottom, Bury, Greater Manchester, BL0 9AL	No	Closed
42	498	N	379193 417329	ESSO	Stubbins Lane, Ramsbottom, Bury, Greater Manchester, BL0 0PU	No	Open

7 SUMMARY OF ENVIRONMENTAL SENSITIVITY

The following section is a review of the environmental sensitivity of the site as discussed in Sections 2 - 6. Significant potential risks are discussed in the following subsections and will then be evaluated as part of the Site Conceptual Model in Section 8.

Sources are defined as where pollution comes from, pathways are a route in which the pollution travels and receptors are anything affected by a pollutant. Further details on Source-Pathway-Receptor methodology can be found in Appendix D.

The table below focuses on significant site-specific sources, pathways and receptors. More 'generic' pathways and receptors (such as site end uses) will be covered as part of the initial Site Conceptual Model in Section 8.

7.1 Sources

Source	Distance/ Direction	Details	Significant Risk
Current Site Use – derelict	On Site	No significant sitewide contamination anticipated onsite from current land use, due it being derelict, although leaking IBCs were noted during brief walkover. No contaminative processes anticipated ongoing onsite.	Possible - Localised
Historic Site Use – Paper Mill & associated infrastructure	On Site	The site has been occupied by a paper mill for much of its known history and has gone through several phases of extension prior to it being demolished. Potential contamination includes VOCs/SVOCs, heavy metals, PAH, TPH and asbestos. Potential biogenic ground gas source associated with demolition products and made ground on site. Possible redundant services in situ. Ground investigation and ground gas monitoring.	Yes
Surrounding Industrial Processes (Historical and Current)	Adjacent to Site	The site was set in a largely industrial setting with various works located to the north and west, these later became shops etc. Groundwater assumed to flow west to east across the site towards the Irwell. Possible contaminants from these historic uses include heavy metals, PAH, VOCs/SVOCs, TPHs and asbestos. Anticipated cohesive and granular strata across the site. Ground investigation and ground gas monitoring to confirm.	Possible

7.2 Pathways and Receptors

Pathways and Receptors	Distance/ Direction	Details	Significant Risk
Aquifers	Below Site	Potential for both cohesive and granular strata under the site. The site does not lie within a groundwater source protection zone and no potable water abstractions within 500m of site. Site history suggests contamination may be present.	Possible

8 INITIAL CONCEPTUAL SITE MODEL

For details on how the conceptual model is evaluated please refer to Appendix D.

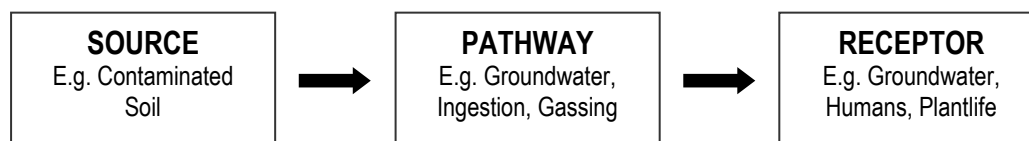
This section of the report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

Potential contamination sources and environmentally sensitive receptors have been discussed in Section 7. Potentially significant risks are evaluated as part of the subsequent sub-sections.

8.1 Source-Pathway-Receptor Linkages

The risk assessment uses a 'Source-Pathway-Receptor' methodology for assessing whether a source of contamination could potentially lead to harmful consequences. This means that there needs to be a pollutant linkage from source to receptor for harm to be caused, this linkage consisting of a source of pollution; a pathway for the pollutant to move along; a receptor that is affected by the pollutant.

The current potential risks to site arising from various Source-Pathway-Receptor linkages are assessed below. A risk may be considered significant if all three of the stages are present and therefore providing a pollution linkage. The various sources, pathways and receptors are considered separately. The assessment is based on the future use, which is understood to be residential with home-grown produce.



Type of Contamination	Potential Sources	Potential Pathway	Potential Receptors	Pollution Linkage	Comment	Estimated Level of Risk
Ground Gas	Historical Land Use- On Site	Inhalation of Vapours	Construction/ Maintenance Workers	Potentially Active	Possible ground gas from deep made ground and areas of former industry. Ground investigation and ground gas monitoring to confirm. PPE to protect.	Low - Moderate
	Neighbouring Land Use Within 250m Of Site	Vapours Penetrating Unprotected Buildings	Future Site Users	Potentially Active	Possible ground gas from deep made ground and areas of former industry. Ground investigation and ground gas monitoring to confirm.	Moderate
Surface and Near Surface Contaminants Within Soils	Historical Land- Use On Site Neighbouring Land Use Within 250m Of Site	Ingestion, Inhalation, Dermal Contact	Current Site Users	Potentially Active	Potential for deep basements, foundations, pits and deep Made Ground. Potential determinants from historic site use and neighbouring land use comprise heavy metals, VOCs/SVOCs, PAH's, TPH's and asbestos. Site is currently derelict. Ground investigation to confirm and target.	Low - Moderate
			Construction Workers	Potentially Active	Potential for deep basements, foundations, pits and deep Made Ground. Potential determinants from historic site use and neighbouring land use comprise heavy metals, VOCs/SVOCs, PAH's, TPH's and asbestos. Ground investigation to confirm and target.	Moderate
			Future Site Users	Potentially Active	Potential for deep basements, foundations, pits and deep Made Ground. Potential determinants from historic site use and neighbouring land use comprise heavy metals, VOCs/SVOCs, PAH's, TPH's and asbestos. Ground investigation to confirm and target.	Moderate
			Adjacent Land Users	Potentially Active	Surrounding area is residential and commercial. Historically industrial.	Low - Moderate
		Direct Contact	Structures	Potentially Active	Potential sulphates onsite could be a risk to structural foundations. Ground investigation to confirm.	Low – Moderate
		Absorption in Root Zone	Plants	Potentially Active	Possible TPH, PAH, heavy metals and sulphates within the made ground demolition material and former industry on site/in immediate area.	Low – Moderate
Mobile Contaminants, Leachables e.g. from Pollution Sources Adjacent to Site/On Site	Historical Land- Use On Site	Leaching into Groundwater	Groundwater	Potentially Active	Potential for some migration due to anticipated cohesive and granular deposits.	Low
	Neighbouring Land Use Within 250m Of Site	Off-site Migration in Groundwater	Abstractions	Potentially Active	No current potable groundwater abstractions. Not in a Groundwater Source Protection Zone. Historic boreholes noted onsite.	Moderate
			Controlled Waters	Potentially Active	Surface water located on site, and adjacent to the eastern boundary. No water quality data for Irwell within GroundSure report.	Moderate
Organic and Inorganic Contaminants Within Soils / Groundwater	Historical Land- Use On Site Neighbouring Land Use Within 250m Of Site	Potable Water Supply Pipes	Utilities Workers	Potentially Active	Potential for lighter end hydrocarbon contamination including PAHs and TPHs. Ground investigation to confirm, then liaise with local water authority supplier.	Low – Moderate

8.2 Contamination Summary

In this qualitative risk assessment, a **Low / Moderate - Moderate** risk for ground gas and contamination exists across the site. Some remedial action may be necessary at the site, however, the likes of which cannot be confirmed until the geotechnical and contamination ground investigation has been completed.

8.3 Geotechnical Constraints

- Existing and redundant services across site.
- Potential tree heave as cohesive stratum anticipated (anticipated).
- Shallow groundwater.
- Depth of Made Ground / former foundations within the vicinity of former buildings and possible basements.
- Large buried structures.
- Culvert crosses site.
- Erosion of the riverbanks.
- Potential for deep saturated SILT deposits.
- Potential for coal workings in the south of the site.
- Former extraction wells onsite.

9 FIELDWORK

9.1 Fieldwork Objectives

The objectives of the intrusive ground investigation will be to:

- Clarify the 'Initial Contamination Conceptual Model'.
- Clarify the Initial Risk Assessment.
- Benchmark the contamination status of the site.
- Provide data for the design of any remedial works that may be required.
- Provide a geotechnical appraisal for the site.

9.2 Fieldwork Scope

The fieldwork was carried out between the 25th June – 2nd July 2019 and included the following:

- Eighteen (18 no.) machine excavated trial holes to between 0.60mbgl (TP16) and 3.50mbgl (TP10).
- Eleven (11no.) window sample boreholes to depths between 0.35mbgl (WS18) and 5.00mbgl.
 - A further three (3no.) locations were attempted but the concrete slabs were too robust to be cored.
- Four (4no.) rotary boreholes drilled to depths between 30mbgl (RO1) and 38mbgl (RO4).
- Six (6no.) ground gas monitoring visits over a period of at least three months with varying barometric pressures.
- Chemical analysis of forty-seven (47no.) samples.
- Analysis of forty-seven (47no.) samples for asbestos screening, with fifteen (15no.) samples for quantification.
- Analysis of three (3no.) water samples taken from WS1, WS8 and WS16.
- Analysis of four (4no.) surface water samples from the River Irwell and the onsite culverted stream.
- Collection and analysis of three (3no.) soil samples for geotechnical analysis.

The exploratory hole positions were selected and set out by Betts Geo Environmental Ltd (BGE) as shown on the Exploratory Hole Location Plan in Appendix B.

Surface water sampling locations were specified by Ecclestone Homes.

Services are present onsite, and are known to cross areas of planned investigation, however, the majority of services are located within the roads and footpaths. Prior to any intrusive works, each location was checked for services using a cable avoidance tool (CAT) and review of statutory service plans.

Rotary boreholes were targeted to the south of the site where coal mining was thought to be present.

Access was made via a gate on the small lane leading to the sports clubs. No access was allowed within the 60m exclusion zone for heavy plant (JCB & 13T excavator).

A further site investigation was carried out on 12th and 13th May 2022 and consisted of the following:

- 9 No. trial pits (TP101 – TP109) to 4.0 m bgl
- 1 No. trial trench (TT101) to 1.4 m bgl
- Chemical analysis of 2 No. samples (TP102 @ 1 m bgl and TP105 @ 1.5 m bgl)
- Asbestos analysis of 2 No. samples (TP102 @ 1 m bgl and TP105 @ 1.5 m bgl)
- Collection and analysis of two soil samples for Atterberg testing (TT101 @ 0.8 m bgl and TP102 @ 2.0 m bgl)
- Collection of 3 No. bulk samples for Particle Size Distribution (PSD) testing

The purpose of this investigation was to determine the materials that were below the concrete slabs and how thick the concrete slabs are.

10 GROUND CONDITIONS

10.1 General

The exploratory holes were logged by an Engineer in general accordance with the recommendations of BS5930:1999+A2:2010. Detailed descriptions, together with relevant comments, are given in the Exploratory Hole Logs included in Appendix C.

Ground conditions typically consisted of a CONCRETE slab with reinforcement and a damp-proof course over either a very sandy GRAVEL or LIMESTONE or SANDSTONE, overlying a further CONCRETE slab and subbase. Some locations exhibited areas of possible reworked SAND and / or SILT.

The main site area was almost entirely covered by concrete slabs, and a number of locations showed secondary slabs at depth.

Natural strata consisted of both granular and cohesive strata, as well as shale bedrock at depth.

Excavation in TP16 showed significant amounts of water and potential contamination. Materials excavated were similar to those expected from the buildings strip and demolition (SAND to BOULDER graded materials).

The full logs should be consulted in conjunction with this summary.

10.2 Ground Conditions Summary

Strata	Description	Thickness (m)	
		Top	Base
TOPSOIL	Maintained grass over brown clayey gravelly occasionally cobbly fine to coarse SAND. Gravel and cobbles are fine to coarse angular to subangular of rootlets, brick, concrete, metal, timber, paper and textiles.	0.00	0.20
CONCRETE	Reinforced concrete slab with DPC. Often noted as 200mm thick at varying depths across the site. In-situ slabs occasionally noted as +600mm thick.	0.00	1.65
MADE GROUND - Granular	Made ground granular materials consisted largely of either a subbase such as limestone or sandstone gravel or a demolition type waste. Demolition wastes comprised mixed brick, concrete and sandstone, as well as metals, textile, plastic, papers, ash and glass. Granular made ground was prevalent across the site from shallow depth.	0.00	2.85
MADE GROUND - Cohesive	Cohesive made ground as identified as either reworked CLAY or SILT and was occasionally noted as having hydrocarbon or organic odours.	0.90	4.50
NATURAL - Cohesive	Cohesive strata were recorded as either CLAY and SILT and were often sandy. CLAY was noted as often having a significant granular content which became coarse with depth.	0.60	23.00
NATURAL -	Natural granular deposits were noted to be SAND, GRAVEL	1.35	9.50

Granular	and SANDS & GRAVELS. Coarse grained granular materials were usually recorded at a greater depth when compared to SAND.		
Bedrock	Dark grey shale with occasional sandstone bands	23.00	38.00

10.3 Visual and Olfactory Contamination

Significant visual and olfactory contamination was identified in a number of locations, as well as significant depths of Made Ground mentioned above. Notes on observed contamination are as detailed in the table below;

Exploratory Hole	Depth (mbgl)	Strata	Remark
TP1	1.00	MADE GROUND	Hydrocarbon odour
TP2	1.00		
TP5	2.25	Possible MADE GROUND	Slight organic odour
TP8	1.20	MADE GROUND	Black water with sheen and strong hydrocarbon odour.
TP16	0.60		Strong hydrocarbon and 'waste' type odour
WS1	2.75		Slight hydrocarbon odour
WS16	1.95		Hydrocarbon odour
	2.20		Slight organic odour
TP101	0.30	MADE GROUND	Hydrocarbon odour
TP102	0.25	MADE GROUND	
TP105	1.20	MADE GROUND	Hydrocarbon staining and odour on base of concrete

The area in the south west corner identified very different composition of Made Ground in the form of organics / textile / paper waste / plastics within a predominantly granular matrix with boulders of concrete. Processing of this material under a mobile plant licence is anticipated with control of groundwater and groundwater treatment potentially required. This area is shown below:



10.4 Obstructions

Concrete slabs were noted at surface and also at depth, some of these slabs were recorded in excess of 600mm thick.

A number of the slabs could not be cored and could not be broken out using a 13tonne machine, it is thought that these may be machine bases from the former paper mill.

The large hard slabs were noted around TP11, TP18, WS4, WS5 and WS19. It is likely that more of these slabs will be present at the site.

The slabs were broken through during the investigation in May 2022.

10.5 Groundwater – Fieldwork

Exploratory Hole	Depth (mbgl)	Strata	Remark
TP2	1.70	MADE GROUND:	Seepage
TP4	2.65	GRAVEL	Water Strike
TP5	2.25	MADE GROUND	
TP8	2.10		
TP10	1.75	MG / SILT	
	3.50		Water Strike
TP11	1.35 – 3.00	SAND	Slightly Damp
TP13	1.80	SILT	Damp
TP16	0.60	MADE GROUND	Standing Water – with sheen and hydrocarbon odour
TP18	1.30	SILT	Slightly Damp
WS1	2.75	MADE GROUND	Wet from 2.75mbgl
WS7	3.70 – 3.85	SAND	Water Strike
WS8	4.00	SAND	Water Strike
WS9	2.60	MADE GROUND	Water Strike
WS15	0.90	MADE GROUND	Standing Water
WS16	3.00	SILT	Water Strike
TP103	1.15	MADE GROUND	Water entering pit from broken pipe, movement across top of silt.
TP104	0.9	MADE GROUND	700mm culvert noted, standing water, no flow noted
TP106	2.2	SILT	Clay pipe at 2.20mbgl - medium inflow reducing.
TP107	2.05	SILT	Clay pipe noted at 2.05mbgl, medium inflow reducing.
TP108	1.85 and 2.05	MADE GROUND & SILT	Water seepage at 1.85mbgl, likely linked to broken pipe.
TP109	2.3	SILT	Clay pipe noted at 2.30mbgl with low-medium inflow, reducing.
TT101	1.20	MADE GROUND	Unrecorded water supply pipe struck at around 1.20mbgl. Fast inflow, not slowing. Dark brown to light brown to clear flow.

10.6 Groundwater – Post-Fieldwork Monitoring

The table below indicates groundwater encountered during the monitoring post fieldwork (6/6 visits have been undertaken);

Exploratory Hole	Depth to Water (mbgl)	Depth to Base of Well (mbgl)
WS1	2.73 - 3.13	4.05 - 4.15
WS7	2.9 - 3.38	4.10 - 4.15
WS8	1.75 - 1.93	3.30 - 3.50
WS16	0.8 - 1.15	2.80 - 2.85

11 COAL MINING INVESTIGATION

The site lies at the base of the Rossendale Coalfield, part of the Carboniferous Pennine Lower Coal Measures of Namurian age. The Geological Survey shows a possible outcrop of the thin Holcombe Brook Coal across the southern part of the site dipping north and overlain by the thick drift deposits of an infilled glacial meltwater channel.

There are no relevant collieries and shaft sections in Ramsbottom and evidence of the presence of the Holcombe Brook Mine is derived from hillside exposures on the valley sides east and west of the site. Evidence for shales possibly lying above the seam was encountered in water wells bored for the former paper works which occupied the site.

The Holcombe Brook Coal is a variable and impersistent coal seam of poor quality and interbedded with black shales. The seam was occasionally mined on the hills above Rossendale where it was occasionally worked at outcrop, and has a thickness thought to be up to 300mm. There are no shaft sections showing the seam and no deeper coal seams of workable thickness in this part of Lancashire. The Coal Authority have no records of any mineshafts on or within 20m of the site. Coal mining in Rossendale is first recorded in 1612 at Gambleside on the eastern slope of the valley 3km north of the site where the Upper and Lower Mountain Mines outcrop. Four (4no.) rotary holes were sunk to depths between 30mbgl (RO1) and 38mbgl (RO4) and was undertaken with a Coal Authority Permit.

Rockhead is weathered and comprised of dark grey shales and sandstones at depths greater than 20m. Drilling did not show any workings or seams of coal. It is therefore deemed that the site is at Low Risk from Coal Mining.

12 LABORATORY TESTING

12.1 General

An assessment of potential determinants associated with the current/former site uses has been undertaken. Determinants originating from the current/former site uses may include metals, polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs) and asbestos. A general suite of testing should detect most potential contaminants.

Test	No. of Tests	Description
pH Values	52	Determination of pH (using Cyberscan pH meter).
Sulphate - Soluble 2:1 Extract	52	Dionex.
Arsenic, Cadmium, Chromium VI, Chromium III, Total Chromium, Lead, Mercury, Selenium, Copper, Nickel, Complex and Free Cyanide and Zinc.	52	Soil samples were analysed in accordance with UKAS/MCERTS standards Inductively coupled plasma atomic emission spectroscopy (ICP-OES)
Speciated Polycyclic Aromatic Hydrocarbons (PAH),	49	Determination of Polycyclic Aromatic Hydrocarbons by GC-MS. End/end extraction using DCM on as received sample. In house method modified USEPA 8270. Include coronene if required.
TPH CWG	49	TPH CWG (Aliphatics C5-6,>6-8,>8-10,>10-12,>12-16,>16-21,>2-35) (aromatics >C5-7,>7-8,>8-10,>10-12,>12-16,>16-21,>21-35) C5-8 fractions by Headspace GC-MS (003S). C8-35 fractions on as received sample extracted with hexane/acetone, aliphatic/aromatic splits run by GC-FID (005S), banded as listed above.
GRO/BTEX/MTBE by GC-FID (C5-10; C10-C12)	49	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12).
Organic Matter	49	Determination of Organic Matter by combustion.
Asbestos Screen	49	Visual Screening for Fibres.
Atterberg	5	BS1377 Part 2. 1990, 4.3,5.3,5.4
Moisture Content	5	BS1377 Part 2. 1990, 3.2
Particle Size Distribution (PSD)	2	Wet Sieving Method

13 CONTAMINATION ASSESSMENT

13.1 General

Contaminants of concern recorded at concentrations above relevant screening values are summarised below. For ease of description, the identification of contaminant sources and possible re-use of material, Topsoil, Made Ground, Natural Strata and Groundwater will be dealt with in separate sub-headings in this section of the report where required.

Our assessment is based on the following assumptions:

- The proposed site end use is of a high-risk rating (residential housing with gardens). For analysis purposes, 'residential with home grown produce' is deemed most appropriate end use.
- The superficial Alluvial deposits are classed as a Secondary A Aquifer (Moderate Permeability).
- The bedrock deposits of the Mudstone & Sandstone are classed as a Secondary A Aquifer (Moderate Permeability).
- It is deemed that some statistical analysis is appropriate. Where sample data numbers are low and/or targeted, each determinant result is reviewed further as an individual result as opposed to an average across the site.
- Site history has indicated a **Low - Moderate** risk of contamination and ground gas.
- Statistical analysis of the chemical test results has been undertaken in general accordance with Environment Agency 2009 SGV Guidance and AtRisk 2017 using the combined assessment criterion given by CLEA (Note: all SSVs for EA derivation are for a SOM of 6%, in line with Environment Agency Report SC050021/SR4 – this figure is deemed representative as an average value for a sandy loam soil). AtRisk 2017 are used to the nearest SOM percentage deemed appropriate.
- Potential free product was identified in TP16.
- Following the withdrawal of CLR 7-10 Guidance documents by the Environment Agency, statistical analysis has been undertaken in accordance with the CIEH/CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration' (May 2008). As such, the use of the mean value test alone is not considered.

A full risk assessment is detailed within Section 13 of this report.

13.2 Soils Contamination Summary

13.2.1 Made Ground

Made Ground was encountered across site and comprised various heterogenous materials such as brick, concrete, metal and plastic etc and a sandy topsoil. Details of the exceedances are provided in the table below:

Location	Depth (mbgl)	Determinant	Soil Organic Matter Content (SOM) (%)	Observed Concentration (mg/kg)	Threshold Concentration (mg/kg)
TP1	0.10	Lead Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(ah)anthracene	7	290 16 15 17 2.4	200 8.54 2.05 9.86 1
	1.00	Lead Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(ah)anthracene Naphthalene Chrysotile & Amosite	5.3	280 12 10 13 1.4 1.3 <0.001 %	200 4.52 1.5 7.72 0.838 0.829 <0.001 %
TP2	0.50	Lead Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(ah)anthracene Naphthalene Chrysotile & Amosite	5.2	260 9.6 9.3 13 1.5 1 <0.001 %	200 4.52 1.5 7.72 0.838 0.829 <0.001 %
TP3	0.15	Lead Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(ah)anthracene Naphthalene Chrysotile & Amosite	5.9	250 25 23 28 3 9.7 <0.001 %	200 4.52 1.51 7.72 0.838 0.829 <0.001 %
	1.50	Lead TPH C16-C21 Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(ah)anthracene Indeno(123-cd pyrene) Naphthalene Chrysotile & Amosite	4.4	220 400 25 23 28 3 9.7 3.5 <0.001 %	200 319 4.52 1.5 7.72 0.838 7.31 0.829 <0.001 %
TP4	0.50	Chrysotile	0.8	<0.001 %	<0.001 %
TP5	1.70	Arsenic Chrysotile	6.2	46 <0.001 %	37 <0.001 %
TP6	0.50	Lead	7.8	970	200

TP9	0.20	Lead Chrysotile	4.4	430 0.001 %	200 <0.001 %
TP10	0.50	Chrysotile	2.7	<0.001 %	<0.001 %
TP11	0.50	Chrysotile	1.1	<0.001 %	<0.001 %
TP12	0.45	Chrysotile	2.6	0.095	<0.001 %
TP14	0.50	Chrysotile & Amosite	2.9	<0.001 %	<0.001 %
TP15	1.00	Chrysotile	3.7	<0.001 %	<0.001 %
TP16	0.60	Chrysotile	4.5	0.002 %	<0.001 %
TP17	0.60	Amosite	4.9	<0.001 %	<0.001 %
TP18	1.00	Lead	4.1	240	200
WS1	0.55	Arsenic Lead Chrysotile	6.3	67 670 0.002	37 200 <0.001 %
WS7	0.95	Arsenic Lead Benzo(a)pyrene Naphthalene	2.4	43 1100 2.8 0.94	37 200 1.51 0.829
WS8	0.50	Benzo(a)anthracene Benzo(a)pyrene Naphthalene	4.6	6.5 4.9 0.89	4.52 1.51 0.826
WS11	0.50	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene	8.2	8.1 7.2 8.3	8.54 2.05 9.86
WS12	0.35	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(ah)anthracene Naphthalene	2.9	8.5 7.2 7.8 0.88 13	4.52 1.5 7.72 0.838 0.829
WS16	0.75	Arsenic Lead	2.2	140 470	37 200
	2.00	Arsenic Lead	5	160 1100	37 200

13.2.2 Possible Made Ground / Natural

Possible MADE GROUND / natural strata was recorded in a number of locations and was commonly observed as a soft greyish brown / grey and black SILT.

Location	Depth (mbgl)	Determinant	Soil Organic Matter Content (%)	Observed Concentration (mg/kg)	Threshold Concentration (mg/kg)
TP5	2.25	Arsenic Benzo(a)pyrene	5.1	53 1.8	37 1.51
WS1	2.75	Lead	7.1	200	200

13.2.3 Naphthalene and VOCs / SVOCs

Naphthalene was recorded above the most stringent 1% SOM thresholds in a number of locations and may pose a risk to end users through volatilisation and ingress into the new structures. The list below highlights areas potentially at risk;

Location	Depth (mbgl)	Observed Concentration (mg/kg)	1% SOM Threshold Concentration (mg/kg)
TP1	0.10	1.1	0.829
	1.00	1.3	
TP2	0.50	1	
TP3	0.15	3.5	
	1.50	8.6	
TP5	1.00	0.84	
WS1	2.75	5.3	
WS7	0.95	0.94	
WS8	0.50	0.89	
WS11	0.50	7.7	
WS12	0.35	13	

Further to the above, positive detections of VOCs / SVOCs have also been observed in the locations detailed below;

Location	Depth (mbgl)	Determinant	Observed Concentration (mg/kg)	1% SOM AtRisk Threshold Concentration (mg/kg)
VOCs				
WS1	2.75	Ethylbenzene	0.001	-
		p & m-Xylene	0.015	-
		o-Xylene	0.011	-
		1,3,5-Trimethylbenzene	0.001	-
		1,2,4-Trimethylbenzene	0.037	-
SVOCs				
TP1	1.00	2-Methylnaphthalene	1.20	-
		Dibenzofuran	1.60	-
		Carbazole	1.50	-
		Anthraquinone	0.80	-
TP3	1.50	2-Methylnaphthalene	6.30	-
		Dibenzofuran	6.50	-
		Carbazole	6.00	-
		Anthraquinone	1.50	-
TP5	1.70	2-Methylnaphthalene	0.80	-
		Dibenzofuran	1.10	-
		Carbazole	0.80	-
		Anthraquinone	0.80	-
WS1	2.75	2-Methylnaphthalene	3.30	-
		Dibenzofuran	1.60	-
		Carbazole	1.00	-
		Anthraquinone	0.50	-
WS7	0.95	4-Chloroaniline	0.40	-
		2-Methylnaphthalene	0.70	-
		Dibenzofuran	0.80	-
		Carbazole	0.80	-
		Anthraquinone	0.60	-

- No current guidance using AtRisk Thresholds

13.2.4 Natural Strata

Location	Depth (mbgl)	Determinant	Soil Organic Matter Content (%)	Observed Concentration (mg/kg)	Threshold Concentration (mg/kg)
WS10	1.00	Benzo(a)anthracene	4.2	20	4.52
		Benzo(a)pyrene		14	1.5
		Benzo(b)fluoranthene		12	7.72
		Dibenzo(ah)anthracene		1.5	0.838

13.2.5 Asbestos

Asbestos, of varying types, was detected in a number of locations as detailed in section 13.2.1, with quantification only showing four locations with concentrations above detection limits (0.001%), as shown below;

Location	Depth (mbgl)	Asbestos Type	Observed Concentration (%)
TP9	0.20	Chrysotile	0.001
TP12	0.45		0.095
TP16	0.60		0.002
WS1	0.55		0.002

13.3 Controlled Waters Contamination

Water samples were collected from boreholes onsite, the culvert and the River Irwell, as stated below;

- Samples of groundwater were collected from WS1, WS8 and WS16.
- Samples from the River Irwell were labelled as US1 (Upstream) and DS1 (Downstream).
- Samples from the Culvert were labelled as MS1, MS2 and MS3 (Midstream).

Analysis of the water results has shown that the majority of determinants were below detection. However, there were several exceedances, as detailed in the table below;

Location	Determinant	Observed Concentration (µg/l)	Threshold Freshwater Surface (FS) & General Quality of Groundwater (GQGW) (µg/l)
WS1	Cyanide Arsenic	14	5 (FS: short-term value)
		9.35	7.5 (GQGW)
MS1b	Zinc	14	5 (FS: short-term value)
DS1	Zinc	12 (visit 1) 11 (visit 2)	10.9 (FS: long-term value)
US1 MS1 MS1b MS2 MS3	Copper	6.2 – 12 5.6 – 6.8 10 3.4 – 6.1 1	1* (FS: long-term value)

Location	Determinant	Observed Concentration (µg/l)	Threshold Freshwater Surface (FS) & General Quality of Groundwater (GQGW) (µg/l)
DS1	Copper	6 - 11	1* (FS: long-term value)

* Dependant on bioavailability

14 ENVIRONMENTAL RISK ASSESSMENT

14.1 General

This section assesses likely risks to the identified receptors, arising from potential contamination sources. It provides a final qualitative assessment of the risks involved, indicating whether (where appropriate) any immediate action is required to mitigate certain risks.

In assessing the risk qualitatively, it is appropriate to use the methods outlined in the CIRIA document C552, "Contaminated Land Risk Assessment a Guide to Good Practice". It uses a classification of risk based on the magnitude of the potential consequence or severity of risk occurring, compared with the magnitude of the probability or likelihood of the risk occurring. These are indicated on the attached tables in Appendix J.

The superficial deposits are classed as Secondary Undifferentiated Aquifer (Low Permeability) and the Bedrock deposits are classed as a Secondary A Aquifer (Moderate Permeability). With respect to human health, the proposed end use (residential with home grown produce) is of high sensitivity. Therefore, the site's environmental setting is considered to be of a **Moderate to High** environmental sensitivity. Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures (see Section 15.2), therefore, the primary residual risks that require assessment are Site End Users. The following sections are split into soils and groundwater for clarity.

14.2 Assessment of Contamination Analytical Results

Soils

A number of exceedances have been observed across the site within Made Ground strata, these are associated with various PAHs, TPH C16-C21, Lead, Arsenic and asbestos. PAHs include the SVOC, Naphthalene. Further to these, a number of VOCs / SVOCs have also been observed above detection limits.

The Made Ground exceedances have been recorded at varying depths between 0.10mbgl and 2.00mbgl. With deeper exceedances at 2.25mbgl (TP5) and 2.75mbgl (WS1), within potential Made Ground strata.

Based on the locations of TP5 and WS1, in relation to the formerly existing reservoirs, it is now considered likely that these are Made Ground samples from backfill / basal reservoir materials. As shown in the sketch below;



Occurrences of Dibenzo(ah)anthracene and Naphthalene are hotspots and statistically significant, and will therefore require further works, such as delineation, to mitigate the risk they pose to human health.

Double Ratio Plot analysis identified the source of the elevated benzo(a)pyrene in TP7 and TP8 to be coal derived. As the source is coal derived, the values may be compared against the DEFRA C4SL 2017 value of 4.95mg/kg due to a reduced bioavailability. Given that the results are below this threshold, minimal risk is anticipated from this source and it is deemed below residential thresholds in TP7 and TP8. The remaining benzo(a)pyrene exceedances are shown to likely sourced from Coal Tar / Creosote and cannot be discounted on this basis.

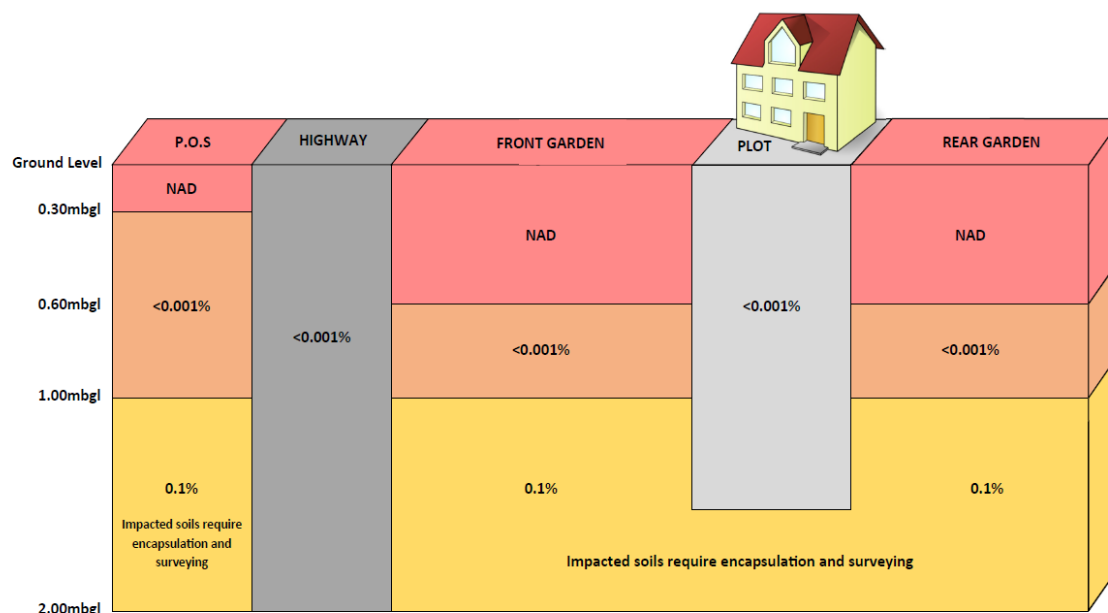
Statistical analysis of the Arsenic exceedances has shown that they are statistically significant and should be treated as hotspots, where they exceed the threshold value of 37mg/kg. Similarly, the occurrences of Lead are also considered significant and will require further works or mitigation in locations where they exceed 200mg/kg.

Asbestos (Amosite and Chrysotile) was identified in a number of locations with quantification testing recording concentrations within soils ranging from 0.001% (TP9) to 0.095% (TP12).

The presence of asbestos within the Made Ground is likely due to poorly managed historical demolition which the fill is largely comprised of and the practice of incineration of waste materials without prior screening. ICRCL Guidance Note 64/85 "Asbestos on Contaminated Sites" (1990) is still the most current guidance for asbestos in soil and suggests asbestos fibres should be <0.001% w/w within soil. Dutch and Australian Guidance also suggest the use of a threshold of 0.001% as a threshold for asbestos in soil. The Dutch Guidelines consider the risk from Chrysotile to be ten times less than Amphibole asbestos but the HSE, WHO, the Australian DoH and the USEPA have chosen not to distinguish between different asbestos fibre types.

The concentration (0.095%) of Chrysotile asbestos within the ash fill in TP12 at 0.45m potentially poses a significant risk to end users and construction workers, if the material is exposed and soil and asbestos fibres allowed to become airborne. Groundworks should follow CAR-SOIL™ Guidance. Given that the material used to back fill comprises a high percentage of demolition waste, the presence of further asbestos is likely. Detections of asbestos are also likely to occur the demolition waste stockpiles that exist onsite.

Below is a sketch showing levels of asbestos concentrations and locations where they are commonly accepted / unacceptable. This should be confirmed with the Local Authority prior to implementation, and should therefore only be used as a guide;



Notes:

P.O.S - Public Open Space

NAD - No Asbestos Detected

0.001% - Soils may contain $\leq 0.001\%$ using composite testing to ensure there is no potential risk to human health. Value is present where there may be short-term low level exposure of soils containing trace asbestos fibres by construction workers where an appropriate level of asbestos management is employed (e.g. dust suppression).

0.1% - Soils at depth of $> 1.00\text{mbgl}$ may contain $< 0.1\%$ asbestos using composite testing where they will be not likely not be disturbed in the future and will therefore be in an area of Low Sensitivity. Risk assessment completed in accordance with the Asbestos JIWG Risk Assessment Tools.

Undefined - Dependant upon soils encountered during earthworks, which may be placed at depths to ensure no potential risk to human health.

Burial and encapsulation of asbestos should be agreed with regulators and consultant prior to the works being undertaken. Consideration should also be made to CAR-SOIL™.

In general, widespread contamination was observed across the site, in conjunction with several hotspots.

Further investigation into the stockpiles is advised. Movement of these materials should also be carried out using correct dampening down methods.

A minimum thickness of 600mm of debris-free soil and no dig layer is required within garden areas and landscaped areas as a capping system to mitigate residual risk to site end users from the asbestos and remaining determinants. It is also anticipated that the secondary slabs will be containing further contamination not observed during the investigation due to plant access limitations within the exclusion zone. The capping is to be made up of imported subsoil and topsoil.

Several areas of hydrocarbon odours were noted across the site during investigation; however, these were not substantiated in testing. As a result, a hydrocarbon vapour resistant membrane may be required across the site to mitigate nuisance risk – this is to be reviewed following the site strip.

Groundwater and Aquifer Risk

Various exceedances have been noted within surface and groundwater samples. As summarised below;

Location	Determinant	Observed Concentration (µg/l)	Threshold Freshwater Surface (FS) & General Quality of Groundwater (GQGW) (µg/l)
WS1	Cyanide Arsenic	14 9.35	5 (FS: short-term value) 7.5 (GQGW)
MS1b	Zinc	14	5 (FS: short-term value)
DS1	Zinc	12 (visit 1) 11 (visit 2)	10.9 (FS: long-term value)
US1 MS1 MS1b MS2 MS3	Copper	6.2 – 12 5.6 – 6.8 10 3.4 – 6.1 1	1* (FS: long-term value)
DS1	Copper	6 - 11	1* (FS: long-term value)

* Dependant on bioavailability

Exceedances for Copper have been noted in all holes. There is little to no variation between upstream and downstream samples, so the source is likely located upstream of the site. No elevated levels of copper were identified on site within the soils suggesting the source is not on site.

The water sampled in WS1 are thought to be perched waters within the made ground strata it is therefore not considered representative of true groundwater at the site. Based on site history, the types of contamination and levels observed are considered typical of a site such as this. Downstream and midstream sampling has not showed correlating results, so the onsite perched waters are not considered to be in significant continuity with the River Irwell.

The downstream and midstream samples show a minor Zinc exceedance against the long-term mean threshold. On the basis, that this is a short sampling period with a minor exceedance, continued monitoring is likely to show mean concentrations below the threshold. No elevated levels of zinc were identified on site within the soils suggesting the source is not on site.

No significant risks to sensitive water abstractions/controlled waters are anticipated due to the following: no groundwater abstractions within 500m of site, no significant link between onsite and River Irwell chemical concentrations.

The risk to groundwaters / aquifers is therefore deemed as Low.

15 GROUND GAS ASSESSMENT

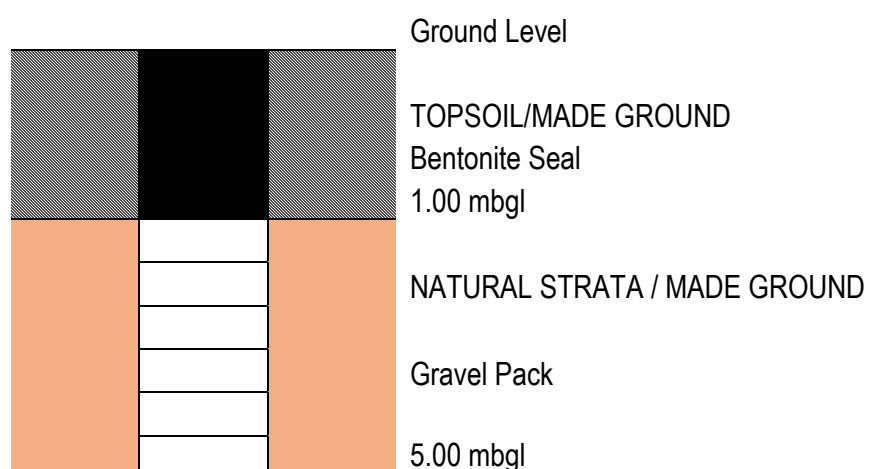
15.1 Ground Gas Requirements – Radon

The EnviroCheck data states that the site is within a low probability radon area (1-3% of properties above the action level).

15.2 Ground Gas Assessment

15.2.1 Ground Gas Boreholes Installations

The four (4 No.) boreholes were all installed up to 5.00 mbgl with 1.00 m of plain pipe and between 4.0 m of slotted pipe. A typical installation is shown below;



15.2.2 Summary of Results

Six out of six (6/6) ground gas visits have been undertaken, and gas monitoring is now completed, and the results are summarised below (see Appendix E for full details).

Location	Peak Gas Flow (l/h)	Atmospheric Pressure Range (mb)		Peak CH ₄ (%)	Peak CO ₂ (%)	Minimum O ₂ (%)	Gas Screening Value (GSV) (l/h)	
		Min	Max				CH ₄	CO ₂
WS1	<0.1	985	1006	0.10	4.30	16.70	0.0001	0.0043
WS7	0.1	985	1006	0.10	3.60	14.10	0.0001	0.0036
WS8	0.1	985	1006	0.10	9.70	14.10	0.0001	0.0097
WS16	0.1	985	1006	0.10	0.60	18.80	0.0001	0.0006

15.2.3 Guidance

Three recent publications are used for ground gas risk assessment:

- 'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present', Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties.
- CIRIA C665 'Assessing risks posed by hazardous ground gases for buildings' 2007 - for high rise residential / flats.
- BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

Further details / accompanying notes for the following gas risk assessment are enclosed in Appendix G. The proposed development at the site is private residential two-storey houses, therefore assessments using the NHBC Guidance are deemed most appropriate.

15.2.4 Gas Recommendations

Elevated CO₂ has been observed in one location, WS8, which showed a maximum concentration of 9.70%. Whilst this is close to the suggested Amber 1 / Amber 2 threshold, it does not exceed it. Further to this, when taking gas flow into account, the calculated gas screening value (GSV) is significantly lower than the Amber 1 / 2 - threshold, showing there is little driving force to mobilise the ground gas.

From a review of the strata identified, the majority of made ground was granular in nature with no significant organic matter noted to suggest significant ground gas production or migration. Small pockets of organic material may be present within the alluvial material or other made ground on site. When alluvium or peat was deposited it contained organic material. Initially this would have degraded to produce methane gas. However, only the labile (easily degradable material) would have been used up. Old recalcitrant peat such as deep peat layers in alluvium generates very little new methane. As was generated it would have been emitted from the surface of the alluvium before being encased beneath made ground. Therefore, the ongoing risk from ground gas from this source is low.

On the basis of the above, the site can be classed as Amber 1 / CS2. The site will require low level gas protection measures to be installed.

A number of volatile odours and VOCs/SVOCs were noted within the Made Ground during the site investigation however were not substantiated in testing. A hydrocarbon vapour resistant membrane may be required across the site to mitigate nuisance risk – this is to be reviewed following the site strip and localised remediation.

16 REVISED CONCEPTUAL SITE MODEL

16.1 General

The Initial Conceptual Site Model has been amended in light of data obtained during the ground investigation, most notably the arsenic and lead contaminated soil in relation to the screening criteria for the proposed end use.

16.2 Final Conceptual Site Model

This section reassesses likely risks to the identified receptors, arising from potential contamination sources. It provides a final qualitative assessment of the risks involved, indicating whether (where appropriate) any immediate action is required to mitigate certain risks. It also discusses (where appropriate) what longer term measures or remedial works may be required in the future if the site were to be developed. It is considered that the site has not been assessed by the Local Authority as a contaminated site under the terms of the Environmental Protection Act 1990 Part IIa.

Target (Receptor)	Potential Source-Pathway Linkage	Remedial Action Required (where appropriate)	Est. Degree of Risk to Target Following Remedial Action Where Necessary
Site End Users	Inhalation of soil gases, odours or dust.	Site classed as Amber 1 / CS2. Low level gas protection measures required.	Low
Site End Users	Ingestion of, and skin contact with, contaminated soil.	Full 600mm clean and inert capping required across the site. No dig layer may be required due to presence of asbestos.	Low
Site End Users	Ingestion of contaminants in vegetables etc. or in soils adhering to vegetables, etc	Full 600mm clean and inert capping required across the site. No dig layer may be required due to presence of asbestos.	Low
Construction/Maintenance Workers	Inhalation of soil gases, odours or dust.	PPE	Low (assumed basic PPE is used)
Construction/Maintenance Workers	Ingestion of, and skin contact with, contaminated soil.	PPE	Low (assumed basic PPE is used)
Plants	Adverse effects on growth caused by presence of phytotoxic contaminants in soil.	Full 600mm capping required across the site. No dig layer may be required due to presence of asbestos.	Low
Buildings and Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion and fire hazards.	Site classed as Amber 1 / CS2. Low level gas protection measures required.	Low
Foundations	Sulphate attack of foundations	Foundations to be designed as per section 18.4.	Low
Water Supplies	Hydrocarbons penetrating plastic water supply pipes.	United Utilities pipeline risk assessment required. Protect-A-line to be allowed for in costings.	Low
Groundwater	Migration of soluble contaminants into groundwater on or off site.	No sensitive receptors within influencing distance.	Low
Surface Water	Migration of soluble contaminants and/or direct run-off of contaminants.	Limited impact on surface water from site, possible sources of contamination located upstream.	Low

17 OUTLINE STRATEGY FOR RISK REDUCTION / REMEDIATION STRATEGY

17.1 General

The following section details any recommendations to reduce risk on site and recommends remedial actions (as per the previous sections of this report). For clarity, the section is split into sub-sections as per the conceptual site model (Section 14).

17.2 Construction / Maintenance Workers

A number of exceedances have been observed across the site within Made Ground strata, these are associated with various PAHs, TPH C16-C21, Lead, Arsenic and asbestos. PAHs include the SVOC, Naphthalene. Further to these, a number of VOCs / SVOCs have also been observed above detection limits.

There are currently no assessment criteria for risks to construction workers, the following recommendations should be adhered to during site works:

- Site workers should wear gloves, boots and overalls and wash their hands before eating, drinking and smoking. Excessive dust generation should be avoided.
- It is recommended that during all excavations adequate ventilation should be maintained. If man entry into excavations is required, gas monitoring should be carried out as a precaution.
- If areas of suspected contamination are found then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.
- Asbestos was encountered on site, vigilance should be adhered, and any suspected asbestos should be notified, and a suitably qualified person appointed to inspect.

17.3 Site-End Users

A minimum thickness of 600mm of debris-free soil is required within garden areas and landscaped areas as a capping system to mitigate residual risk to site end users from the asbestos and remaining determinants. It is also anticipated that the secondary slabs will be containing further contamination not observed during the investigation due to plant access limitations within the exclusion zone. The capping is to be made up of imported topsoil and subsoil.

Several areas of hydrocarbon / volatile odours were noted across the site during investigation; however, these were not substantiated in testing. As a result, a hydrocarbon vapour resistant membrane may be required across the site to mitigate nuisance risk – this is to be reviewed following the site strip.

17.4 Ground Gas Protection Measures

As per Section 15.2.4, the site can be classed as Amber 1 / CS2. The site will require low level gas protection measures to be installed. This would usually consist of a 150mm passively vented subfloor void and a taped and sealed gas resistant membrane.

A number of volatile odours and VOCs/SVOCs and possible TPH hotspot in TP16 were noted within the Made Ground during the site investigation however were not substantiated in testing. As a result, a hydrocarbon vapour resistant membrane may be required across the site to mitigate nuisance risk – this is to be reviewed following the site strip / Remediation.

17.5 Off-Site Disposal of Soils

Other than removal of hardstanding, no significant changes in site levels are understood to be proposed. However, any waste is likely to require excavation and offsite disposal and result in significant development costs.

The handling, re-use or disposal of waste is regulated by the Environment Agency. Any material excavated on-site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. One of the ways this can be achieved is set out in the Development Industry Code of Practice (CoP; Ref. 13). This builds on the Environment Agency guidance document Definition of waste: developing greenfield and brownfield sites (2006). The Agency will take into account the use of the CoP in deciding whether to regulate materials as waste. If materials are dealt with in accordance with the CoP, the Agency considers that those materials are unlikely to be waste at the point when they are to be used for the purpose of land development.

All material proposed for off-site disposal (e.g. during future construction works) should be given a proper description and waste classification assessment as required by the Environmental Protection Duty of Care Regulations (Ref. 14), and in accordance with WM3 and the Environment Agency Technical Guidance on the assessment and classification of Hazardous Waste.

The chemical laboratory data has been screened using the online Hazwaste™ software and the laboratory test results indicate that, generally, the materials onsite would be classified as Non-hazardous.

However, several samples across the site have been shown to be hazardous, these are listed in the table below, these results should be read in conjunction with the Hazwaste™ report in in Appendix K.

Location	Depth (mbgl)	Comments
TP3	1.50	HP7 - Carcinogenic - TPH (C6 to C40) HP11 – Mutagenic - TPH (C6 to C40)
TP9	0.20	HP14 – Ecotoxic - Zinc sulphate
WS7	0.95	HP7 - Carcinogenic - Lead
WS6	0.55	HP8 - Corrosive - pH
WS16	2.00	HP7 - Carcinogenic - Lead

No allowance can be made for classification of materials between exploratory hole locations.

The recorded asbestos concentrations fall below the Hazardous Waste threshold (>0.1%) and no visible asbestos materials were observed.

It is recommended that the results of the contamination testing (including the history of the site) be

presented to the proposed landfills to obtain their acceptance of the information to date. However, further testing maybe required to fully assess the waste classification of the soils requiring offsite disposal. A copy of the Hazwaste™ summary report is presented in Appendix K. The results of these tests should be confirmed by the proposed waste receiver.

Segregation of the Topsoil, Made Ground and Natural Strata should be possible given the chemical analysis and very different visual identification.

It's recommended that a full waste management plan be compiled for the site.

17.6 Piped Drinking Water Supplies

The use of Protect-A-line is anticipated; however, a pipeline assessment should be undertaken to confirm.

18 GEOTECHNICAL ASSESSMENT

18.1 Introduction

It is understood that the proposed development will consist of construction of residential properties with associated rear gardens, associated infrastructure, public open space and new highway. Associated foundation loadings are anticipated to be low.

18.2 Site Preparation and Excavation

Excavations undertaken during site works were unstable within the made ground, all excavations should be planned, and due consideration should be given to providing temporary support or suitable battering. Excavations should be regularly inspected by a competent person to ensure continued safety. Further advice on the safety of excavations is given in *Health and Safety in Construction*. Shallow (<1.20mbgl) excavations for service trenches should be straight forward however, could be complicated by variable Made Ground on site.

18.3 Control of Groundwater

Limited shallow groundwater was encountered on site however perched groundwater was encountered in several locations. It is likely that provision of pumping / shuttering will be necessary during excavation of foundation trenches during wet weather and to deeper excavations for sewers etc. It is good practice to have such equipment on standby in case of seasonal / abnormal weather conditions.

Should sewers/excavations deeper than the boreholes/trial pits undertaken be required, further SI will be needed.

It is noted that the site may be at risk from groundwater flooding based upon the BGS datasets. The BGS datasets are deemed somewhat generic and based upon a variety of geological settings including valleys in areas underlain by chalk, and in river valleys with thick deposits of alluvium and river gravel.

Groundwater flooding is generally caused by excessive rainfall and high water tables.

The Weetwood FRA confirms that the site has a moderate to significant risk of groundwater flooding (based on BGS dataset). The report asserts that this modelled estimate is overstated due to the extent of the existing hard cover currently on the site and a measurement of existing groundwater levels.

On this site the current site hardstanding coverage is generally impermeable and the BGS data base is based upon geological strata present (river terrace/valley deposits). River levels correlate with existing physical ground water monitoring data – i.e. shown to be in continuity as would be expected in the given geological and geomorphological setting.

River levels will indeed influence groundwater levels and during periods of heavy rain or flooding, rivers can overflow and saturate the surrounding land, leading to a rise in the water table and increased groundwater levels. Understanding the dynamics between river levels and groundwater is crucial for developing

comprehensive flood management strategies.

The proposed flood risk alleviation design has increased site levels to factor in increased river levels in flood events and as such also by the same means lifted the site out of the zone of influence of potential groundwater flooding. The likelihood of solid geology bearing any influence upon groundwater levels to result in flooding is deemed very unlikely given the evidence of the known groundwater levels being in direct correlation / connectivity with the adjacent river and its surrounding superficial geological deposits (circa 20m drift).

18.4 Foundations

Due to depths of Made Ground and saturated SILTS being identified at depth, the variable nature of the Made Ground, and the potential for secondary slabs and deep obstructions, a piled solution is advised.

Given the generally granular nature of Made Ground and both cohesive and granular nature of natural soils on site, a driven piled solution should be taken to the appropriate strata.

Suitable strata applicable to piling is thought to be at least 20mbgl.

As an alternative by placing suitable granular fill during the remedial work (excavation and crushing of obstructions / concrete) a vibro ground improvement may be applicable with double reinforced strip foundation upon the improved ground.

A specialist piling / ground improvement foundation contractor should be consulted with regards to the design of the foundations, suitability of piled solution and provision for proof digging plots to remove obstructions.

The southern spur area, which is underlain by a landfill, has been shown to be heavily contaminated. Possible natural strata are located at 5.00-5.50mbgl, with bedrock noted at 21.00-23.00mbgl. Due to the levels of contamination and possible free product observed in these areas a piled solution may pose a significant risk to groundwater, and another solution may be required. Remedial work is required in this locality to both remove / stabilise contamination and make the fill geotechnically suitable (removal of large granular and biodegradable / plastics) Upon remediation a piled solution may be viable subject to further risk assessment.

Due to proximity of railway and possibly interconnected bodies of fill / water care must be taken when considering remedial work / foundations in this locality.

The anticipated impacted area is shown below;



18.5 Ground Floor Construction

Suspended floor construction e.g. either in-situ RC slabs or block and beam flooring is recommended as per NHBC guidance.

18.6 Soakaway

Soakaway tests were not undertaken due to anticipated contamination and depth of Made Ground.

18.7 Heave / Shrinkage Potential

Significant shallow cohesive strata were not observed at the site, testing may be undertaken once site levels are confirmed and an assessment of the depth to cohesive strata can be made.

18.8 Highway

According to the criteria of Highways Agency HD 25/95 Volume 7 Section 2 Part 2 HD 25/94, a CBR value of circa 3-5% on the Made Ground is anticipated, however confirming in-situ CBR's should be undertaken once layouts and levels are known.

Placement of geotextiles within the areas of roads / parking could also be designed to minimise the subgrade thickness.

18.9 Protection of Buried Concrete

It is considered for concrete design purposes that a brownfield site and mobile groundwater conditions are applicable.

Given the levels of 2:1 water soluble sulphate identified in the vicinity of TP1, TP3 and TP5, a design class of DS-2, an ACEC class of AC-2 and a designated concrete class of DC2 is recommended in this area.

The remainder of the site can be recommended for a design class of DS-1, an ACEC class of AC-1 and a designated concrete class of DC-1.

19 Further Works

19.1 Further Works Summary

The following works are required to adequately characterise the site and provide a basis to mitigate risk to human health and the environment;

- Sampling of stockpiles left onsite from demolition works.

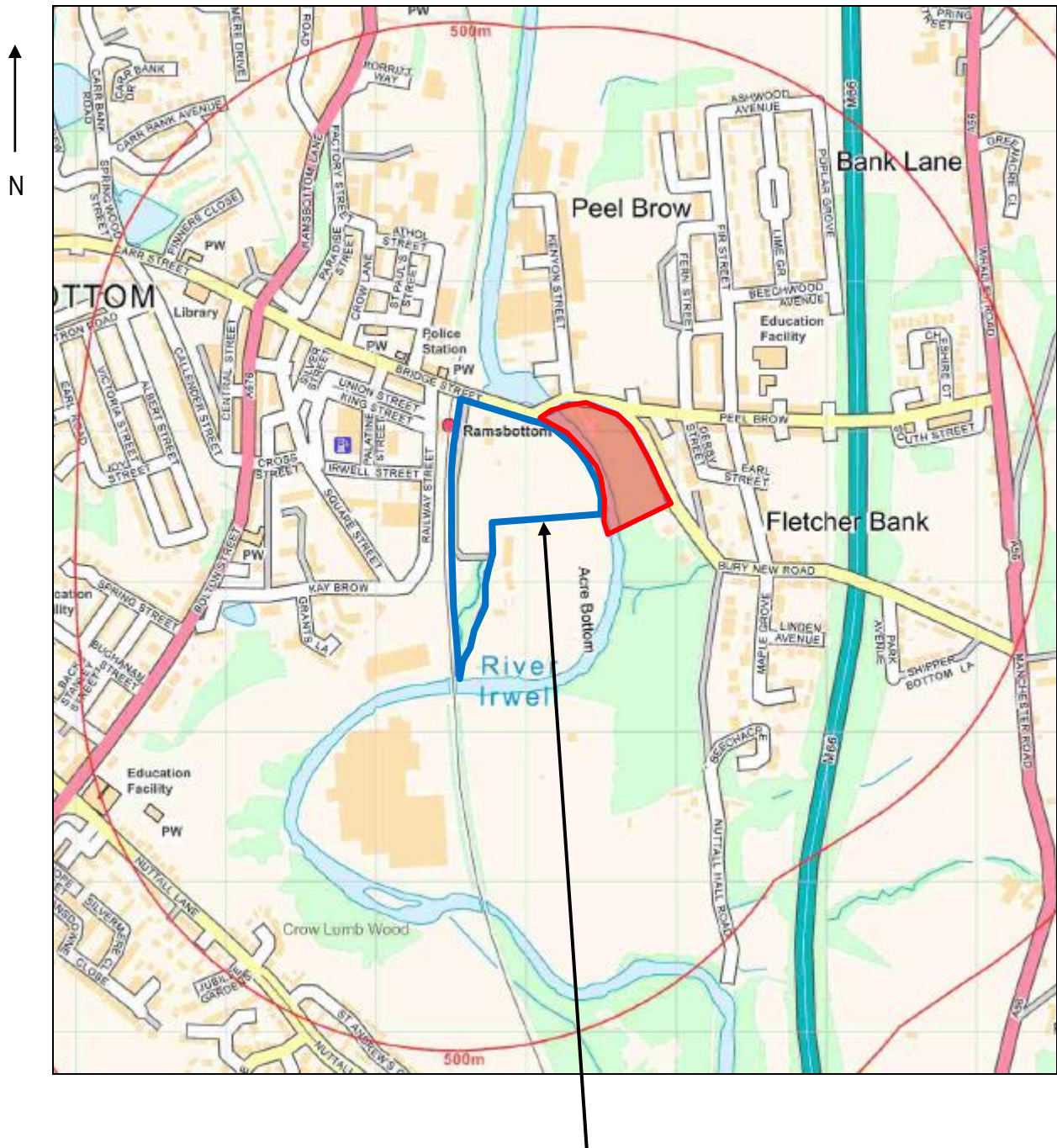
20 REFERENCES

- 20.1** *BS 5930:2015 Code of Practice for Site Investigation.*
- 20.2** *BS1377: 2016 Methods of Test for Soils for Civil Engineering Purposes.*
- 20.3** Assessment of risks to human health from land contamination: an overview of the development of guideline values and related research. EA, 2002.
- 20.4** *Contaminated Land Risk Assessment; A Guide to Good Practice; CIRIA C552: 2001.*
- 20.5** *Health and Safety in Construction, HSG150, HSE, 1996.*
- 20.6** *Hazardous Waste: Interpretation of the Definition and Classification of Hazardous Waste, Environment Agency, WM2 Version 1.0, June 2003.*
- 20.7** *DoE (1991), The Building Regulations Approved Document C, Site Preparation and Resistance to Moisture, HMSO.*
- 20.8** *Baker W (1987), Investigation Strategy - lecture at City of Birmingham Development Department Symposium on Methane Generating Sites, 9 December 1987, Industrial Research Laboratories, Birmingham.*
- 20.9** *NHBC Standards, Chapter 4.2, 2017 Building Near Trees.*
- 20.10** *Highways Agency HD 25/95 volume 7 section 2 Part 2 HD 25/94.*
- 20.11** *Water Regulations Advisory Scheme (2002) The selection of materials for water supply pipes to be laid in contaminated land.*
- 20.12** *Anon (1997) Dutch in Policy Retreat on Contaminated Land ENDS (Environmental Data Services), 269, 46.*
- 20.13** *Piling In Layered Ground: Risks to Groundwater and Archaeology Science Report SC020074/SR Environment Agency October 2006.*
- 20.14** *Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention National Groundwater & Contaminated Land Centre report NC/99/73 F J Westcott, C M B Lean & M L Cunningham May 2001.*
- 20.15** *'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present', Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties.*
- 20.16** *CIRIA C665 'Assessing risks posed by hazardous ground gases for buildings' 2007 - for high rise residential / flats.*
- 20.17** *BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.*
- 20.18** *BRE 414 'Protective measures for housing on gas-contaminated land' Roger Johnson, Parkman Environment 2001.*
- 20.19** *BS 8500- 1:2006 'Concrete – Complementary British Standard to BS EN 206-1 – Part 1: Method of specifying and guidance for the specifier' November 2006.*

- 20.20** *'Planning Policy 23: Planning and Pollution Control' Office of the Deputy Prime Minister 2004.*
- 20.21** *CLR11 'Model Procedures for the Management of Land Contamination' DEFRA 2004.*
- 20.22** *BRE 465 'Cover Systems for Land Regeneration' 2004.*
- 20.23** *'The UK Approach for Evaluating the Human Health Risks from Petroleum Hydrocarbons in Soils, Environment Agency Science Report P5-080/TR3', Environment Agency (May 2005).*
- 20.24** *TOX12- Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Dioxins, Furans and Dioxin-like PCBs' Environment Agency 2003.*
- 20.25** *Atkins AtRisksoil.co.uk SSV's derived using CLEA for 1 or 6% SOM. Residential with home grown produce.2017*

APPENDIX A

(i) Site Location Plan



Site Location Plan

The site is located to the south of Bridge Street and north of Ramsbottom Cricket Club in Ramsbottom. The site has an approximate postcode of BL0 9AL, with coordinates on the British National Grid of 379433,416756. The proposed site is approximately 4.61 hectares in total.

APPENDIX B

(i) Exploratory Hole Location Plan

APPENDIX C

(i) Historical Maps

APPENDIX D

- (i) GroundSure Report
- (ii) Coal Authority Report

APPENDIX E

(i) Exploratory Hole Logs

APPENDIX F

(i) Contamination Testing Results

APPENDIX G

- (i) Geotechnical Testing Results (N/A)

APPENDIX H

(i) Gas Monitoring Data

APPENDIX I

(i) Conceptual Model

The report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

The assessment also aims to identify land which would be regarded as 'contaminated land' under the terms of the Environmental Protection Act 1990, Part IIa. This act includes a stricter test for contaminated land than that outlined above. Land is considered to be contaminated if either:

- the land is causing significant harm to people, ecosystems or infrastructure; or
- there is a significant possibility that such harm could be caused; or
- Pollution of controlled waters is being, or is likely to be, caused.

The following situations are defined as being where harm is to be regarded as significant:

- chronic or quite toxic effect, serious injury or death to humans;
- irreversible or other adverse harm to the ecological system;
- substantial damage to or failure of buildings;
- death of, or disease or other physical damage affecting, livestock or crops;
- Pollution of controlled waters.

The risk assessment uses a 'Source-Pathway-Receptor' methodology for assessing whether a source of contamination could potentially lead to harmful consequences. This means that there needs to be a pollutant linkage from source to receptor for harm to be caused, this linkage consisting of:

- a source of pollution;
- a pathway for the pollutant to move along;
- A receptor that is affected by the pollutant.

As an example, the pollutant source could be an identified leak of oil or an area of dumped waste.



The pathways could include transport of the contaminant by groundwater, surface water, windblown dust, or vapours, and for human receptors will include the means, by which contaminants enter the body, for example skin contact, ingestion and inhalation.

Receptors include people, other living organisms, the built environment and groundwater and surface waters (these latter two also being contaminant pathways).

The source-pathway-receptor methodology relationship allows an assessment of the environmental risk to be determined, based on the nature of the source, the degree of exposure of the receptor to the source and the sensitivity of the receptor.

This section of the report is based on the information set out in the previous sections of the report and should not be read independently of such sections.

Initial Conceptual Model

From the available information the preliminary conceptual model is visualised as follows:

Target (Receptor)	POTENTIAL SOURCE-PATHWAY LINKAGE
Site Users / Residents	Inhalation of soil gas, odours or dust.
	Ingestion of, and skin contact with, contaminated soil.
	Ingestion of contaminants in vegetables etc. or in soils adhering to vegetables, etc.
Construction/ Maintenance Workers.	Inhalation of soil gas, odours or dust
	Ingestion of, and skin contact with, contaminated soil
Plants	Adverse effects on growth caused by presence of contaminants in soil
Buildings and Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion and fire hazards
	Sulphate attack of foundations
	Hydrocarbons penetrating plastic water supply pipes
Groundwater	Migration of soluble contaminants into groundwater on or off site. Migration of oils into groundwater on or off site.
Surface Water	Migration of soluble contaminants and/or direct run-off of contaminants. Migration of oils into groundwater on or off site.

Initial Environmental Risk Assessment

General

It is accepted that an environmental risk assessment can be based on a source-pathway-target model. An examination is carried out as to whether a target will be at risk from a contamination source, that a source exists, and whether there are any pathways (routes of exposure) which might actually link the source to the target.

Environmental risk assessments rely heavily on numerical trigger concentrations or guidelines because exposure of targets to contamination is difficult to quantify directly. Quantification of risk is therefore mainly undertaken for general scenarios in order to derive trigger levels. These are derived for various contaminants for particular targets and routes of exposure. An example of a sensitive target would be users of a domestic back garden, where routes of exposure might be skin contact, dust inhalation, direct ingestion and indirect ingestion via cultivation and consumption of fruit and vegetables.

In March 2002, the first parts of the new CLEA risk assessment guidance were released by DEFRA/Environment Agency.

The risk assessment approach is an extension of the 'fit for use' concept whereby land is cleaned up to a standard fit for the proposed use, that is, so all remaining risks are acceptable. However, as well as being 'fit for use', the environmental risk assessment approach also addresses the soil and water environment so that these are also safeguarded where necessary. For example if a site was contaminated with heavy metals and the development comprised the proposed construction of hard standings and buildings only, the fit-for-use approach might require no remediation for the site. However, consideration of the wider environment needs to address whether groundwater is being contaminated, and if so whether remediation is required for this reason.

The following classification presented by CIRIA has been used in the assessment of risk:

Estimation of risk from consideration of magnitude, consequences and probabilities				
Probability	Consequences			
	Severe	Moderate	Mild	Minor
High	Very high	High	Moderate	Moderate / Low
Medium	High	Moderate	Moderate / Low	Low
Low	Moderate	Moderate / Low	Low	Very Low
Unlikely	Moderate / Low	Low	Very Low	Very Low

Reference: Contaminated Land Risk Management; A Guide to Good Practice, CIRIA C552:2001.

CIRIA C665 Situation A Ground Gas Conceptual Model

The risk table contained in C665 is basically a modified risk assessment from CIRIA 152 1995, by which a conceptual model and semi-quantitative risk assessment can be made.

APPENDIX J

(i) Notes on Ground Gas

Ground Gas

The Building Regulations and BRE Report 212 state that precautions are not mandatory against carbon dioxide unless 5.0% volume is exceeded. These documents do not give a threshold level for methane, but Baker suggests that this level is 0.1% volume. For methane up to 1.0% volume, and carbon dioxide above 5.0% volume, the Building Regulations and BRE Report state that passive measures may be adopted. Above 1.0% methane further specific guidance must be sought.

CIRIA Report 149 gives further guidance on the appropriate precautions for various gas regimes, called characteristic situations in this report. In the DETR Guide for Design by Ove Arup, various types of passive measures are assessed for performance with different gas regimes. The assessments used computational fluid dynamic (CFD) modelling.

A gas regime is essentially defined by two parameters:

- i) The concentration of the gas (e.g. % methane)
- ii) The emission rate of the gas from the ground.

The fact that two parameters are used is problematic if the site is to be classified on the basis of Table 28 in CIRIA Report 149. This is because high gas concentrations are often encountered which fall into an onerous gas regime; whereas the low flow rates which are also frequently encountered fall into less onerous gas regimes.

In order to use the Guide for Design to decide if passive measures are suitable, it is necessary to combine the gas concentration and the emission rate.

Three recent publications are used for ground gas risk assessment:

- CIRIA C665 (2007) for high rise residential / flats,
- 'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present' Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties,
- BS8485:2015 (June 2015) 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'

These documents improve upon the approach used in previous CIRIA and Wilson /Card Papers, by placing emphasis on gas flow rates, but still retain some reliance on the gas concentrations themselves.

CIRIA C665 Situation A Ground Gas Conceptual Model

The risk table contained in C665 is basically a modified risk assessment from CIRIA 152 1995, by which a conceptual model and semi-quantitative risk assessment can be made.

High Rise / Flats (CIRIA 665 Table 8.5)

Characteristic Situation (CIRIA Report 149)	Risk Classification	Gas Screening Value (CH₄ or CO₂) (l/hr) ¹	Additional Factors	Typical Source of Generation
1	Very Low Risk	<0.07	Typically methane $\leq 1\%v/v$ and/or carbon dioxide $\leq 5\%v/v$. Otherwise consider increase to Situation 2	Natural soils with low Organic content. "Typical" Made Ground
2	Low risk	<0.7	Borehole flow rate not to exceed 70l/hr. Otherwise consider increase to Situation 3	Natural soil, high peat/organic content. "Typical" Made Ground
3	Moderate Risk	<3.5		Old landfill, inert waste, Mine working flooded
4	Moderate to High Risk	<15	Quantitative risk assessment required to evaluate scope of protective measures	Mine working susceptible to flooding, completed landfill (WMP 26B criteria)
5	High Risk	<70		Mine working unflooded inactive with shallow workings near surface
6	Very High Risk	>70		Recent landfill site
Notes: 1. Gas screening value: litres of gas/hour is calculated by multiplying the gas concentration (%) by the measured borehole flow rate (l/hr); 2. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods as defined within within CIRIA Report 665; 3. Source of gas and generation potential/performance must be identified; 4. Soil gas investigation to be in accordance with guidance contained within CIRIA Report 665; 5. If there is no detectable flow, use the limit of detection of the instrument; 6. The boundaries between the Partners in Technology classifications do not fit exactly with the boundaries for the above classification.				

Typical scope of protective measures (extract from CIRIA Report 665 Table 8.6)

Characteristic Situation (from Table 8.5)	Number of Levels of Protection	Typical Scope of Protective Measures for Residential Building (not low-rise traditional housing) ¹
1	None	No special precautions
2	2	a) Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g DPM and under-floor venting b) Beam and block or pre-cast concrete and 2000 g DPM/reinforced gas membrane and under-floor venting. All joints and penetrations sealed.
3	2	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised under-floor sub-space.
4	3	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated under-floor subspace or positively pressurised under-floor sub-space, over-site capping or blinding and in ground venting layer
5	4	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and ventilated or positively pressurised under-floor sub-space, over-site capping and in ground venting layer and in ground venting wells or barriers.
6	5	Not suitable unless gas regime is reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design.

Notes:

1. Not suitable for use with low rise traditional housing. (Use the NHBC document instead);
2. Typical scope of protective measures may be rationalised for specific developments on the basis of quantitative risk assessments;
3. Note the type of protection is given for illustration purposes only. Information on the detailing and construction of passive protection measures is given in BR414 (Johnson, 2001). Individual site specific designs should provide the same number of separate protective methods for any given characteristic situation. See CIRIA Report 49;
4. In all cases there should be minimum penetration of ground slabs by services and minimum number of confined spaces such as cupboards above the ground slab. Any confined spaces should be ventilated;
5. Foundation design must minimise differential settlement particularly between structural elements and ground-bearing slabs;
6. Commercial buildings with basement car parks, provided with ventilation in accordance with the Building Regulations, may not require gas protection for Characteristic Situations 3 and 4;
7. Floor slabs should provide an acceptable formation on which to lay the gas membrane. If a block beam floor is used it should be well detailed so it has no voids in it that membranes have to span, and all holes for service penetrations should be filled. The minimum density of the blocks should be 600kg/m³ and the top surface should have a 4:1 ratio sand to cement grout brushed into all joints before placing any membrane (this is also good practice to stabilise the floor and should be carried out regardless of the need for ground gas membranes);
8. The ground gas-resistant membrane can also act as the damp-proof membrane;
9. Based on Building Regulations Approved Document C (Office of the Deputy Prime Minister, 2004a), which states that "a membrane below the concrete could be formed with a sheet of polyethylene, which should be at least 300µ thick (1200 gauge)". Please note the alteration from 300mm (as stated in the Approved Document C) to 300µ, as 300mm is a typographical error that has been recognised and corrected for within this report and CIRIA Report 665.

Low Rise Residential (NHBC)

Table 14.1: Gas Risk Assessment - Traffic Lights with Typical Maximum Concentrations and Gas Screening Values

Classification	Methane ¹		Carbon Dioxide ¹	
	Typical Maximum Concentration ³ (%v/v)	Gas Screening Value ^{2,4} (l/hr)	Typical Maximum Concentration ³ (%v/v)	Gas Screening Value ^{2,4} (l/hr)
Green				
Amber 1	1	0.13	5	0.78
	5	0.63	10	1.60
Amber 2	20	1.60	30	3.10
Red				

Notes:

1. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst case temporal conditions that the site may be expected to encounter will be the decider as to what Traffic Light is allocated;
2. Borehole Gas Volume Flow Rate, in litres per hour as defined in Wilson and Card (1999), is the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered;
3. The Typical Maximum Concentrations can be exceeded in certain circumstances should the Conceptual Site Model indicate it is safe to do so;
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.

Table 14.2: Ground Gas Protection Measures Required for the Traffic Lights

Traffic Light	Ground Gas Protection Measures Required
Green	Ground gas protection measures are not required. (note based on standard NHBC house detail with 150mm void space under suspended floor)
Amber 1	Low-level ground gas protection measures are required, using a membrane and ventilated sub-floor void that creates a permeability contrast to limit the ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Amber 2	High-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Membranes used should always be fitted by a specialist contractor and should be fully certified (see Appendix G). As with Amber 1, ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Red	Standard residential housing is not normally acceptable without further Ground Gas Risk Assessment and/or possible remedial mitigation measures to reduce/remove the source of the ground gases. In certain circumstances, active protection methods could be applied, but only when there is a legal agreement assuring the management and maintenance of the system for the life of the property.

BS8485:2015 Code of Practice for design of protective measures for CH₄ and CO₂ ground gases for new buildings

Table 3 page 21: Building Types

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/public, possible multiple	Commercial/Public	Commercial/Industrial
Control (change of use, structural alterations, ventilation)	None	Some but not all	Full	Full
Room Sizes	Small	Small/medium	Small to large	large industrial/retail park style

Type A) Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of the rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.

Type B) Private or commercial property with central building management control of any alterations to the buildings or its uses but limited or no central building management control of the maintenance of the building, including gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout the ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of public buildings (such as schools, hospitals and leisure centres) and parts of hotels.

Type C) Commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Small to large rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).

Type D) Industrial style building having large volume internal spaces that are well ventilated. Corporate ownership with building management controls on alterations to the ground floor and basement of the building and on maintenance of ground gas protective measures. Probably civil engineering construction. Examples are retail park sales buildings, factory shop floors, warehouses. (Small rooms within these style buildings should be separately categorised as Type B or Type C).

Table 4 page 22: Gas Protection Score by CS and Type of Building

Characteristic Gas Situation, CS	NHBC Traffic Light	Required Gas Protection High Risk			
		High Risk		Medium Risk	Low Risk
		Type A Building	Type B Building	Type C Building	Type D Building
1	Green	0	0	0	0
2	Amber 1	3.5	3.5	2.5	1.5
3	Amber 2	4.5	4	3	2.5
4	Red	6.5 ^{A)}	5.5 ^{A)}	4.5	3.5
5		- B)	6.5 ^{A)}	5.5	4.5
6		- B)	- B)	7.5	6.5

NOTE Traffic light indications are taken from NHBC Report No: 10627-R01 (04) [3] and are mainly applicable to low-rise residential housing. These are for comparative purposes but the boundaries between the traffic light indications and CS values do not coincide.

- A) Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated e.g. high performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system e.g. in institutional and/or fully service contractual situations.
- B) The gas hazard is too high for this empirical method to be used to define the gas protection measures.

Selection of Appropriate Measures Section 7.2 BS8485:2015

Structural Barriers - Table 5 Gas Protection Scores for Structural Barriers pg 23

Floor and Substructure Design (Annex A)	Score ^{A)}
Precast suspended segmental subfloor (i.e. beam and block)	0
Cast in situ ground bearing floor slab (with nominal mesh reinforcement)	0.5
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations	1 or 1.5 ^{B)}
Basement floor and walls conforming to BS 8210:2009 Grade 2 waterproofing ^{C)}	2
Basement floor and walls conforming to BS 8210:2009 Grade 3 waterproofing ^{C)}	2.5
A) the scores are conditional on breaches of floor slabs etc being effectively sealed B) to achieve the score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations in cast in (A2.2.2) C) the score is conditional on the waterproofing not being used on the use of geosynthetic clay liner waterproofing product (see C3 Note 4)	

Ventilation Measures

Ventilation protection measures should be one of five types and points can only be scored for one of these measures;

- Pressure relief pathway only (no effective dispersal layer)
- Passive dispersal layer
- Active dispersal layer (fan suction)
- Active positive pressurisation (air blanket)
- Ventilated basement substructure present.

Note 1 - for Type A buildings active ventilation measures are inappropriate

Note 2 - There are a wide range of different media used to form gas dispersal layer for both passive and active systems, and are more likely to be developed

Note 3 - The types of media include expanded polystyrene void formers, geocomposite void formers, no (low) fines gravel and drains formed by perforated pipes or geocomposites.

Note 4 - The continuity of the media beneath the floor slab might be interrupted by ground beams, pile caps, edge beams and other intrusions extending below the level of the media blanket, which might significantly reduce the effectiveness of the dispersal layer.

Note 5 - The effective volume of the gas dispersal layer might be reduced by its placement on a soft layer (for example sand binding) which reduces its gas permeability and dispersal effectiveness. The effective volume would also be reduced or eliminated if the media became flooded with groundwater or clay heave.

Note 6 - The performance of passive systems can be significantly affected by the number and type of side ventilation terminals. Common side terminals are airbricks, low level vents and high level vent stacks. Guidance on side ventilation is given in Annex B

Table 6 Gas Protection Measures for Ventilation Protection Measures

Protection Element/System	Score	Comments
a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building).	0.5	Whenever possible a pressure relief pathway (as a min) should be installed in all gas protection measures systems. If the layer has a low perm and/or is not terminated in a venting trench (or similar) then the score is zero.
b) Passive sub floor dispersal layer: Very good performance Good performance Media used to provide dispersal layer are *Clear void *Polystyrene void former blanket *Geocomposite void former blanket *No fines gravel layer with gas drains *No fines gravel layer	2.5 1.5	Performance criteria for methane and carbon dioxide are shown in Fig B.6 and B.7 respectively. The ventilation effectiveness of different media depends on the number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B. Passive ventilation should be designed to meet at least good performance, see Annex B.
c) Active dispersal layer , usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers.	1.5-2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be a robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed for good performance as described in Annex B.
d) Active pressurisation by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to the points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket.	1.5-2.5	This system relies on continued operation of the pumps, therefore alarm and response systems in place. The score assigned should be based on the coverage of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least good performance.

Gas Membranes

Gas resistant membranes should be;

- Sufficiently impervious to methane (CH₄) and carbon dioxide (CO₂)
- Capable after installation of providing a complete barrier to the entry of the relevant gas
- Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions
- Sufficiently strong to withstand in service stresses (e.g. due to ground settlement if placed below floor slab)
- Sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it and dropping of tools)
- Chemically resistant to degradation by other contaminants that might be present

Note 1 – a methane gas transmission rate of <40ml/day/m²/atm(avg) for sheets and joints (BSISO15105-1) usually considered sufficient

Note 2 – Guidance on the relevant properties of a), c) and e) is provided in CIRIA C748 [10]

Note 3 – Advice on membrane selection is in Annex C.

Note 4 – The installation and subsequent protection of the membrane are key factors in its performance. A poorly installed membrane cannot perform, however a well detailed and irrespective of the performance of the material. Historically ref was made to verification and integrity testing without any referenced documents against which to judge. The verification process is now described in CIRIA C735 [N1] and as such confidence in the installation can be measured. The process removes the uncertainty of unqualified or inexperienced installation operatives by requiring a **verification plan** to be drawn up prior to installation, with frequency and type of verification being dependent on the qualifications of the operatives, site risk and design criteria. (see 8.3.2 pg 30)

Note 5 – Current guidance on verification recommendations takes in account the risk of the overall design and confidence of installation and sets a frequency and level of verification appropriate.

Protection Element/System	Score	Comments
Gas resistant membrane meeting all of the following criteria:	2	The performance of the membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example a minimum 0.4mm thickness (equivalent 370g/m ² for polyethylene) reinforced membrane (virgin polymer) meets performance in Table 7 (see C3). If a membrane is installed that does not meet all the criteria in Column 1 the score is Zero
* sufficiently impervious to the gases with a methane gas transmission rate <40ml/day/m ² atm(avg) for sheet and joints BS ISO15105-1		
*sufficiently durable to remain servicable for the anticipated life of the building and duration of gas emissions		
*sufficiently strong to withstand in-service stresses (eg settlement if placed below floor slab)		
*e) Sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it and dropping of tools		
*capable after installation of providing a complete barrier to the entry of relevant gases		
*verified in accordance with CIRIA C735 [N1]		

In-Ground Pathway Intervention - A sites in-ground pathways from offsite sources should be investigated for migratory gases – **Note 1** methods of pathway intervention include simple vertical membrane installations, vent trenches, rows of stone columns, activated trenches and proprietary systems. **Note 2** – for residential dwellings, management and maintenance is only acceptable where pathway intervention measures (e.g. venting trenches) are beyond the extent of the buildings, on or close to the boundary of the property in a position where access can be guaranteed.

Detailed Design – Once the design measures have been selected in accordance with Section 7.2, these should be developed into a detailed design supported by detailed drawings and specifications. The design should be described in the design report Section 8.3.

APPENDIX K

(i) Off-site Disposal of Surplus Soil Guidance Notes

The disposal of waste (including surplus soils and contaminated soils) to landfill sites is governed by the *Landfill (England & Wales) Regulations 2002*, the *Hazardous Waste Technical Guidance document WM2 (2003)* and associated legislation.

One of the aims of the above legislation is to encourage waste producers (including developers disposing of surplus soils etc) to reduce their waste (and not just discard and disown it). This can be achieved by recycling or reusing the waste. In the case of contaminated sites where leaving contaminated material in-situ poses a risk to a potential receptor such as groundwater resources, further testing and assessment for such risk could reduce the quantities requiring disposal. If there is still unacceptable risk from contaminated soil being left in place, then it may be possible to reduce the risk to an acceptable level (such that the material can be left in place) by in-situ or ex-situ clean-up of the soils.

Before waste can be disposed of, the producer of the waste must undertake a number of steps. '*Initial Waste Testing and Characterisation*' is firstly undertaken to determine whether the waste is non-hazardous or hazardous. The exceptions are that some wastes such as coal tars, 'tank bottom sludge's', etc are immediately classed as hazardous, regardless of any testing or threshold concentrations.

Any inert or hazardous waste destined for landfill must undergo '*Compliance Testing*' using the Waste Acceptance Criteria (WAC). There are different inert and hazardous WAC limits relating to landfill sites that are correspondingly licensed to accept inert or hazardous waste.

If the '*Initial Waste Testing and Characterisation*' shows a waste to be hazardous, then it is a requirement that the material be tested against the WAC-hazardous suite of tests. If it *passes* the WAC-hazardous testing, then it can be taken to a hazardous waste landfill site. If the material *fails* the WAC-hazardous testing, then the material must be treated before undergoing re-characterisation, further WAC-hazardous testing and then potential disposal at a hazardous waste disposal site.

If the '*Initial Waste Testing and Characterisation*' shows a waste to be non-hazardous, then it can be taken to a non-hazardous waste landfill site, without further testing. The producer may however decide to undertake WAC-inert testing, in an attempt to reclassify the waste as inert, in which case the waste could then go to an inert landfill site.

The volumes of soils associated with potential hotspots on a site (be they hazardous or non-hazardous) which might require off-site disposal, could potentially be reduced by further on-site sampling and subsequent testing.

With regard to the *Compliance Testing*, it should be noted that some landfill sites are permitted to increase the standard WAC-hazardous/inert limit concentrations, such that they might accept waste that would normally fail such limits.

We would recommend that the contamination testing results (including the history of the site) be presented to the proposed landfills, to determine if they will accept waste generated at the site and what classification they would impose.

APPENDIX L

(i) Validation Report Guidance Notes

Unforeseen Hotspots of Contamination

Given the existence of made ground on the site it would be prudent to maintain vigilance during site clearance and construction, in case any further areas of suspected contamination are encountered.

If areas are found then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.

Any hotspots encountered during site clearance, not previously encountered in the ground investigation, are to be removed to a suitably licensed landfill site.

A validation report (see below) will be produced on completion of these works. This report will serve to confirm that the works were undertaken in accordance with the relevant legislation, the method statement, specification and planning conditions.

Validation Report Recommendations

It is suggested that the following records will be kept on site to provide a basis for the validation report:

- Daily record sheets of the remediation works to include a summary of the day's activities
- Weather conditions
- Plant, personnel and visitors to the remediation site
- Aspects relating to Health & Safety, environmental control or non-compliance with the specification or the Method Statements.
- All in situ and laboratory testing results.

All requirements of the remediation specification should be complied with; on completion of the remediation a validation report should be provided. This report will comprise the relevant site records and act as certification that the remedial and ground preparation works have been carried out in accordance with the specification.

The validation report will include the following:

- A description of the works undertaken.
- Records of any remediation works, including daily diary sheets.
- Progress photographs.
- Any chemical and geotechnical validation test results.
- As built surveys, including base excavations and top and bottom of capping layer.
- A statement that the works have been undertaken in accordance with the agreed specification

APPENDIX M

(i) Notes on Limitations

This report does not consider ecological impacts (e.g. bats) or botanical risks (e.g. Japanese knotweed). It is recommended that these are considered as part of the assessment of development constraints for the site.

The assessment and judgements given in this report are directed by both the finite data on which they are based and the proposed works to which they are addressed. The data essentially comprised a study of available documented information from various sources (including Client Furnished reports) together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our environmental conclusions, we request the opportunity to review the information, reassess the potential concerns and modify our opinion if warranted.

It should be noted that any risks identified in this report are perceived risks based on the available information. Actual risks can only be assessed following a physical investigation of the site.

The site investigation has been carried out to provide information concerning the type and degree of contamination, and ground and groundwater conditions to allow a reasonable risk assessment to be made. Betts Geo Environmental Ltd undertake to exercise all reasonable skill, care and due diligence in the exercise of the investigation with respect to sampling techniques, sample storage and report interpretation.

The assessments and judgement given in this report are directed by both the finite data on which they are based and the proposed works to which they are addressed. Data acquisition is subject to the limitations of the methods of investigation used. Exploratory holes undertaken during fieldwork investigate small a small volume of ground in relation to the size of the site and as such can only provide an indication of site conditions. There may be conditions pertaining to the site and the proposed development i.e. localised "hotspots" of contamination, which have not been disclosed by the investigations.

The findings and opinions are relevant to the dates of our site works and should not be relied upon to represent conditions at substantially later dates. Conditions at the site will change over time due to natural variations and anthropogenic activities. Groundwater, surface water and soil gas conditions should be anticipated to change with diurnal, seasonal and meteorological variations.

The opinions expressed in this report regarding any contamination are based on simple statistical analysis and comparison with available guidance values. No liability can be accepted for the retrospective effects of any changes or amendments to these values.

This report was prepared by Betts Geo Environmental Ltd for the sole and exclusive use of Ecclestone Homes. In response to particular instructions, any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

This document has been prepared for the titled project only and should any third party wish to use or rely upon the contents of the report, written approval from Betts Geo Environmental Ltd must be sought.

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