Barnsley Hospital - CAU & ED

Geotechnical and geoenvironmental desk study

06 July 2018

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Executive summary

Mott MacDonald Limited has been appointed by Race Cottam Associates (in partnership with Barnsley Facilities Services) to provide a geotechnical and geoenvironmental desk study for the proposed extension to Barnsley Hospital. The extension is to facilitate the Children's Assessment Unit and Emergency Department. The proposed works comprise a single storey, steel framed extension with relatively low structural loads.

The development is likely to require shallow pad foundations to support the structural loads due to potentially shallow rock.

Historical mapping indicates the southern part of the proposed development area (away from the proposed building but to be developed for an access road) was part of a sandstone quarry in 1850. Since then, the site has undergone significant redevelopment, with residential buildings being constructed around the site, and a workhouse shown on the site from 1890. The Barnsley Workhouse has seen changes throughout, eventually becoming a hospital in 1966. The hospital was demolished and redeveloped in 1971. The area to be developed is currently in use as an ambulance drop off zone and an access road for public car parking.

The following geotechnical and geoenvironmental risks have been determined for the site:

- Made ground is likely to be present across the site due to the previous land use as a workhouse, and later as a hospital. Made ground is typically variable in composition and thickness and generally unsuitable for supporting foundations;
- Made ground has the potential to generate ground gases;
- Potential contamination in the made ground and from current use as a road and historical land use as the Barnsley workhouse. Possible contaminants include asbestos, heavy metals and hydrocarbons.

A ground investigation is recommended to reduce geotechnical and geoenvironmental risk, followed by laboratory geotechnical and contamination testing and on-site gas and groundwater monitoring post site works.

1 Introduction

Mott MacDonald Limited has been appointed by Race Cottam Associates in partnership with Barnsley Facilities Services to provide a geotechnical and geo-environmental desk study for an extension to Barnsley Hospital, South Yorkshire. The report is intended to provide information for planning and to inform the design. The site location is presented in Appendix A.

1.1 Background

The proposed site currently comprises access roads for ambulance drop-offs for the hospital, access roads to public car parks, and open 'green' space. The site is located at National Grid Reference (NGR) 433309, 407057.

It is understood from the current outline design that the proposed works are for the construction of a single storey extension to the original building, to facilitate the Children's Assessment Unit (CAU) and Emergency Department (ED).

The site location is detailed within Appendix A.

This desk study will be used to inform the scope of the ground investigation and will identify the overall geotechnical and geo-environmental conditions and risks.

1.2 Scope of work

The objectives of this report are to:

- Establish the geological and hydrogeological conditions using existing available information;
- Summarise available information and identify site specific geotechnical and geo-environmental hazards and risks which may place a constraint upon the proposed development; and
- Provide recommendations for further assessment including ground investigation, if required.

1.3 Primary sources of information

- Groundsure GIS report (ref: Motts_Barnsley_Insights_TB), June 2018 (1)
- British Geological Survey, Sheet 87, 1:50,000, 2008 (2)
- The Coal Authority Consultants Coal Mining Report, Barnsley A&E Department, 18 June 2018. (3)
- Zetica (2018) Pre-desk study assessment, 15th June 2018 (5)

1.4 Limitations

This document has been prepared for the titled project or named part thereof and should not be relied upon or used for any other project without an independent check being carried out as to its suitability and prior written authority by Mott MacDonald being obtained.

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To the extent that this document is based on information obtained in previous or recent ground investigations, persons using or relying on it should recognise that any such investigation can examine only a fraction of the subsurface conditions. In any ground investigation there remains that pockets or “hot-spots” of contamination or other ground hazards may not be identified, because investigations are necessarily based on sampling at localised points. Certain indicators or evidence of hazardous substances or conditions may have been outside the portion of the subsurface investigated or monitored, and thus may not have identified or their full significance appreciated.

Mott MacDonald is not insured for, and therefore will not undertake surveys to identify asbestos or provide any guidance on the treatment of asbestos, or similarly for toxic mould. Should the presence of asbestos or toxic mould be suspected during the course of the study, Mott MacDonald would recommend the appointment of a specialist contractor to address the issue and would not provide advice on risk or remedial measures.

2 Site details

2.1 Sources of information

The site description and topography of the area has been summarised from the Groundsure report (1). The Barnsley Hospital GIS package will be made available upon request.

2.2 Site description

The site is centred at NGR 433309, 407057 and is currently an access road for public car parking and an ambulance drop off zone. Gawber Road marks the northern boundary of the site, the existing Barnsley hospital the southern and western boundary, and hospital grounds and car parking mark the eastern boundary of the site.

The topography indicates that the site slopes from approximately 145mAOD in the south west towards 137mAOD at the north-west boundary of the site.

The site location plan is presented within Appendix A.

2.3 Site history

The history of this area has been summarised from the available 1:10,000, 1:10,560, 1:1,250, and 1:2,500 historical land use mapping (from 1850 – 1993), provided by Groundsure (1).

Table 1: Site history

Year	Description
1850 (1:10,560)	Most of the site is open land (Appendix C, Figure 1) with exception to the southern section, where a sandstone quarry labelled “Summer Quarry” is located. Another sandstone quarry (Bogend Quarry) is located approximately 76m south of the site. A well is situated 160m east of the site. The northern boundary runs along the edge of a road.
1890 (1:10,560)	The area surrounding the site has undergone significant development (Appendix C, Figure 2). The two quarries located on or near the site no longer appear on the maps. A series of buildings have been constructed on the site, and to the south west, however its purpose is unknown. A boiler works has been constructed approximately 184m to the north east. The road running along the site’s northern edge is now labelled “Gawber Road”. Some residential buildings have been built across Gawber Road to the north east of the site. A school has been constructed 238m to the south east of the site.
1893 (1:2,500)	“Barnsley Union Workhouse” is labelled to the south-west of the site. One of the workhouse buildings encroaches onto the site.
1904 - 1906 (1:10,560 & 1:2,500)	Not much further development has occurred on site or within the surrounding area. An old shaft is located 187m north east of the site.
1929 (1:10,560)	No major development has occurred on site, however one building is labelled a mortuary. Housing development has taken place approximately 177m north west of the site. Some allotments have been constructed near to the school, approximately 109m east of the site.
1938 (1:10,560)	No further development on site, a church has been constructed approximately 212m north of the site.
1948 (1:10,560)	Further housing development has taken place on the northern side of Gawber Road.
1956 - 1960 (1:10,560, 1:2,500 & 1:1,250)	“St Helen Hospital” (Appendix C, Figure 3) is shown 133m south of the site. Playing fields are located 187m south west of site. The church located to the north east of the site has been re-labelled “St Paul’s Church”.

Year	Description
1965 – 1966 (1:1,250 & 1:10,560)	A school has been built approximately 103m east of the site. The complex relating to the site has been re-labelled “hospital”.
1971 – 1973 (1:1,250 & 1:10,000)	The complex labelled hospital has been demolished (Appendix C, Figure 4). The site is open land, with new buildings having been constructed approximately 10 – 20m east and south of the site. Further housing development has occurred approximately 100m west of site. A nursing school has been constructed on the playing fields approximately 187m south-west. Further housing development has taken place approximately 168m south of the site.
1978 – 1982 (1:1,250 & 1:10,000)	The hospital has been redeveloped adjacent to the site, labelled “Barnsley & District General Hospital”. More buildings have been constructed surrounding the newly constructed school south-west of the site.
1991 – 1993 (1:1,250 & 1:10,000)	No further development on the proposed site. Some additional housing in the surrounding area (Appendix C, Figure 5). A sub-station is located 45m south-east, and another sub-station 210m south-west of the site. Further infrastructure has been developed over the eastern section of the site.

3 Geology

3.1 Sources of information

The geology has been summarised from the available information:

- Groundsure GIS report (1)
- British Geological Survey, Sheet 87, 1:50,000, 2008 (2)
- The Coal Authority Consultants Coal Mining Report, Barnsley A&E Department, 18 June 2018. (3)
- The Coal Authority Interactive Map View (http://mapapps2.bgs.ac.uk/coalauthority/home.html), viewed 20th June 2018 (4)

3.2 Geology

3.2.1 Made ground

The site is shown to be free of made ground, however made ground is expected to be encountered due to previous site use as a hospital and current use as a car park. Made ground is shown approximately 200m south-east of the site.

3.2.2 Superficial deposits

No superficial deposits are recorded beneath the site.

3.2.3 Solid geology

Pennine Middle Coal Measures (PMCM) comprising interbedded sandstone, mudstone and siltstone are present beneath the site (Appendix C, Figure 6). The northern section of the site is underlain by mudstone with low to moderate permeability, whilst the southern section is underlain by sandstone with moderate to high permeability. A corner of the western section of the site is also underlain by sandstone.

The BGS rock lexicon describes the PMCM as “interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams”.

An inferred fault is located approximately 91m south-east of the site, orientated north-east to south-west.

Two inferred coal seams are located to the east of the site. Kent’s Thick Coal seam outcrops approximately 70m north-east of the site. Kent’s Thick Coal seam is down-thrown due to the inferred fault, and is located approximately 135m south-west of the site. Kent’s Thin Coal seam is located approximately 75m east of the site.

3.2.4 BGS boreholes

One BGS borehole (SE30NW33/F) is available on site. The borehole indicates made ground up to 0.06m comprising tarmac, slag and loose gravel.

The PMCM was encountered beneath the made ground, comprising highly weathered sandstone.

A number of available boreholes are located surrounding the site (SE30NW3, SE30NW4, SE30NW5, SE30NW6, SE30NW7, SE30NW33/A, SE30NW33/B, SE30NW33/D, SE30NW33/E).

The boreholes did not record the depth of the made ground, only recording from a depth of 1.20m. The borehole records indicate weathered mudstone (described as a clay) from 1.20m. Underlying the weathered mudstone was interbedded mudstone with sandstone from approximately 4m. Some of the boreholes near to site found the Barnsley Coal Seam at approximately 55 mbgl.

3.2.5 Mining

The Coal Authority Consultants Coal Mining Report is included within Appendix B.

- The proposed development is within an area of historical coal mining activity; the shallowest seam worked beneath the site is the Top Haigh Moor seam, at 124m depth. The extracted seam thickness was 1.32m and was last worked in 1964.
- The property is not within a surface area that could be affected by present underground mining.
- There are no known coal mine entries within 100m of the boundary of the property.
- There are no coal outcrops within the site boundaries.
- There are no opencast mines or Coal Authority managed tips recorded within 500m of the site boundary.
- There is no recorded mine gas within 500m of the site boundary.
- The Coal Authority has not received a damage notice or claim due to coal mining subsidence for any property within 50m of the site.
- There are no mine water treatment schemes within 500m of the site.
- The proposed development is not in an area where the Coal Authority has plans to grant a licence to remove coal using underground methods.

The Coal Authority Interactive Map Viewer (http://mapapps2.bgs.ac.uk/coalauthority/home.html) (4) shows the site not to be within a High Risk Development Area.

Given the depth of the worked seams it is considered unlikely that any collapse of the seams would impact the surface.

4 Environmental information

4.1 Hydrology and hydrogeology

4.1.1 Hydrology

There are no water features within 250m of the site. The site is shown to be outside of any fluvial flood risk, and so can be classified as a Flood Zone 1, an area of low flood risk.

The BGS groundwater flooding susceptibility identified the southern section of the site to have limited potential for groundwater flooding to occur (very low – low risk).

4.1.2 Hydrogeology

The BGS designates the bedrock (MPCM) as a Secondary A aquifer beneath the whole of the site. The Environment Agency (EA) identifies the Secondary A aquifer as a potential for high leaching. The soils are assumed to be highly permeable in the absence of site-specific information.

Secondary A aquifer has been defined as “permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formally classed as minor aquifers”.

4.2 Soil chemistry

The general soil chemistry taken from Groundsure (1) identified the following:

- Soil sample type – rural soil
- Arsenic concentration – 15-25 mg/kg
- Cadmium concentration – <1.8 mg/kg
- Chromium concentration – 120-180 mg/kg
- Nickel concentration – 30-45 mg/kg
- Lead concentration – 100-200 mg/kg

Within the south-east section of the site:

- Soil sample type – rural soil
- Arsenic concentration – 25-35 mg/kg
- Cadmium concentration – <1.8 mg/kg
- Chromium concentration – 90-120 mg/kg
- Nickel concentration – 30-45 mg/kg
- Lead concentration – <100 mg/kg

These levels are a general background guide only, site specific contamination testing will need to be undertaken to enable a risk assessment to be undertaken.

4.3 Designated Environmentally Sensitive Sites

DEFRA designates the site to be a nitrate vulnerable zone.

4.4 Local authority air pollution consents

One registered air pollution consent recorded within 250m of the site:

- Barnsley District General Hospital for incineration (not crematoria processes).

4.5 Registered radioactive substances

One Registered Radioactive Substance record within 250m of the site:

Barnsley Hospital NHS Foundation Trust hold authorisation for the disposal of radioactive waste and the keeping and use of radioactive materials.

4.6 Historical Industrial Use

There are various historical industrial uses within 250m of the site:

- Seven electricity sub-stations;
- Site of former hospital before redevelopment;
- Boiler works approximately 184m north-east;
- Three unspecified tanks.

4.7 Contemporary Trade Directory Entries

There are a number of contemporary trade directory entries identified within the Groundsure Report within 250m of the site. Active entries include Barnsley hospital, electrical equipment, chimney manufacturers, container and storage depot, commercial travel services and numerous electricity sub-stations.

4.8 Radon

The site is in an intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level).

No radon protective measures are necessary in the construction of new dwellings or extensions.

4.9 Ground gas

Ground gas monitoring has not been carried out at the site to date and no historical information is available. Ground gas monitoring is recommended as part of the ground investigation to determine the level of risk posed by ground gas at the site, this will be determined in the preliminary contaminated land risk assessment.

4.10 Unexploded ordnance

A pre-desk study assessment was obtained from Zetica (Appendix E). This desk study identified that “no records have been found to indicate that the site was bombed”. Given this, a detailed desk study, whilst always prudent, is not considered essential in this instance.

5 Geotechnical assessment

It is proposed to construct a single storey extension to the existing Barnsley Hospital to facilitate the CAU and ED.

It is anticipated that made ground will be present due to former hospital buildings being present on the site and the current use as a car park and access road.

It is anticipated that weathered Pennine Middle Coal Measures deposits will be present beneath any made ground. BGS boreholes in the area indicate these deposits to be typically fine grained in nature and of variable strength where mudstone is present. The deposits become rock strength at approximately 4.0m below existing ground level. The southern part of the site is anticipated to be underlain by sandstone, which typically weathers to coarse grained, non-plastic soils.

Groundsure (1) identified the following for the site:

- Potential for collapsible ground stability hazards – classified as B, “deposits with potential to collapse when loaded and saturated are unlikely to be present”.
- Potential for compressible ground stability hazards – classified as A, “compressible strata are not thought to occur”.
- Potential for ground instability hazards – classified as B, “slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered”.
- Potential for running sand ground stability hazards – classified as A, “running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions”.
- Potential for shrinking or swelling clay ground stability hazards – northern section classified as B, “ground conditions predominantly low plasticity”. Southern section classified as A, “ground conditions predominantly non-plastic”.
- Potential for soluble rock hazards – classified as A, “soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present”.

Table 2 identifies the potential ground related constraints to the proposed development.

Table 2: Ground related constraints

Constraint	Explanation	Mitigation
Made ground/fill	Highly variable in composition and thickness. Soft/loose made ground deposits offer poor founding material.	Ground investigation to determine presence, depth and composition of made ground.
Pennine Middle Coal Measures	Potentially highly fractured strata, unknown depth to bedrock.	Ground investigation to determine depth to bedrock and presence of weathered zones. This information will be required for foundation design.
Contamination	There is a possibility of contamination in the made ground and superficial deposits. Possible contaminants include heavy metals, hydrocarbons and	Ground investigation to adequately assess the type and distribution of contaminants in the soil and groundwater at the site.

Constraint	Explanation	Mitigation
	asbestos. Historical and current off-site sources could have caused contamination via migration through groundwater.	Monitoring standpipes to be installed to assess risk from ground gas. Waste assessment to be undertaken. It is likely that made ground re-used as landscape fill will need to be placed under a Materials Management Plan.
Ground gas	Made ground has the potential to generate ground gases.	Standpipes installed across the site to monitor ground gas levels over a six-week period, with at least one visit carried out during low and falling atmospheric pressure.
Ground surcharging	Pad foundations for the extension could create a surcharge against the hospital's basement wall.	If the structural loads are found to be high, then mini pile solutions could be used to mitigate the effect of ground surcharging.
UXO	A pre-desk study assessment was obtained from Zetica which identified no readily available records have been found indicating that the site was bombed.	Recommendation from Zetica indicates that a detailed desk study, whilst prudent, is not considered essential in this instance.
Underground services	Services likely to be present on site	Ground Penetrating Radar (GPR) survey recommended to identify location of services beneath the site and in the roads surrounding the site. Services could be sensitive to pile installation and ground movements.
Previous foundations and underground structures	Former buildings were present on the site and foundations and basement structures could be present in the ground.	Earthworks and piling contractors to be made aware of risks. A GPR survey could identify the presence of former foundations and basements.

6 Qualitative contaminated land assessment

The primary regulatory regime, under which contaminated land in the UK is managed, is Part II A of the Environmental Protection Act (EPA), 1990, although numerous other subsidiary regulations are also relevant. This report adopts a strategy for the assessment of potential land contamination based on current guidance documents related to Part II A of the EPA. Particular reference is made to CIRIA Report C552 (6) and to the Model Procedures for the Management of Land Contamination, CLR 11 (7)

Following the procedures in CLR 11, a key element of the Preliminary Risk Assessment is the development of a conceptual model which may be refined or revised as more information and understanding is obtained through the risk assessment process. The conceptual model is described in terms of the contaminant Sources, transport Pathways and possible Receptors that may be present, and the potential "Pollutant Linkages" between them, as defined in the relevant legislation and guidance. The activities are described in CIRIA C552 as "hazard identification".

A key element of an environmental risk assessment is the development of a conceptual model which is done by undertaking a Source – Pathway – receptor analysis of the site:

- Sources (S) are potential or known contaminant sources e.g. a former land use;
- Pathways (P) are environmental systems through which a contaminant could migrate e.g. air, groundwater
- Receptors (R) are sensitive environmental receptors that could adversely affected by a contaminant e.g. site occupiers, groundwater resources.

Where a source, relevant pathway and receptor are resent, a pollutant linkage is considered to exist whereby there is a circumstance through which environmental harm could occur and a potential environmental liability is considered to exist.

The conceptual model for the site is presented in table 3, with a graphical representation included in Appendix C. A qualitative risk assessment has been undertaken as described in Appendix B.

6.1 Development of conceptual model: hazard identification

For the proposed development site, the following sources, pathways and receptors have been identified.

It is assumed that a robust environmental management plan will be adopted during the construction works and as a result, no contamination will occur because of leaks and spills during construction.

Similarly, it is assumed that no contaminated material will be brought onto the site for use in the proposed development and all imported topsoil will be compliant with BS 3882:2015 (8).

Asbestos and non-radon radioactivity risks and associated remedial requirements have not been assessed.

6.1.1 Sources of contamination

S1: On site made ground associated with historical land use

S2: Off site current and historical land uses

S3: Electrical sub-stations within 250m of the site – PCBs and coolant oils

S4: Nearby roads

S5: Existing car park/ambulance drop off – contamination from vehicles

6.1.2 Potential contamination pathways

P1: Human uptake pathways

- P1a: Direct soil and dust ingestion
- P1b: Dermal uptake (indoor and outdoor)
- P1c: Inhalation of dust and vapours (indoor and outdoor)

P2: Vertical and horizontal migration of contaminants and leachates

P3: Ground gas migration

P4: Man made pathways – e.g. utilities

P5: Surface runoff

P6: Direct contact with buried structures and infrastructure

P7: Possible piling

6.1.3 Potential contamination receptors

R1: Final end users – hospital employees and patients

R2: Construction and maintenance workers

R3: Occupants of nearby residential and commercial buildings

R4: Groundwater in the underlying secondary A aquifer (PMCM).

R5: Local flora and fauna

R6: Buried structures – concrete foundations

6.2 Qualitative risk assessment

The qualitative contaminated land risk assessment is shown in table 3.

Table 3: Conceptual model

			Unmitigated risk					Mitigated risk		
Source	**Pathway**	**Receptor**	**Consequence**	**Probability**	**Risk**	**Comments**	**Risk control measures (RCM)**	**Consequence**	**Probability**	**Risk**
S1: On site made ground associated with historical land use S2: Off site current and historical land uses S3: Electrical sub-stations within 250m of the site – PCBs and coolant oils S4: Nearby roads S5: Existing car park/ambulance drop off – contamination from vehicles	P1a: Direct soil and dust ingestion	R1: Final end users – hospital employees and patients	Medium	Low	Moderate	Following the completion of the proposed development new hardstanding will be installed, however there may be landscaped areas.	Any contaminated material encountered during the works will either be disposed of off-site or re-used in accordance with the CL:AIRE Definition of Waste Code of Practice (DoWCoP).	Mild	Unlikely	Very low
		R2: Construction and maintenance workers	Medium	Likely	Moderate	Workers are likely to come into contact with made ground in excavations	Dust suppression and dampening down during construction works (if required) Any contaminated material encountered during the works will either be disposed of off-site or re-used in accordance with the CL:AIRE Definition of Waste Code of Practice (DoWCoP).	Medium	Unlikely	Low
		R3: Occupants of nearby residential and commercial buildings	Medium	Likely	Moderate	Residents are unlikely to come into direct contact with soils except where dust is generated during the proposed works. Following the completion of the proposed development new hardstanding will be installed, however there may be landscaped areas	Risks to be addressed through CDM process and potential COSHH risk assessments. The probability of contact with contaminants is assessed as unlikely based on the assumption that construction workers adopt appropriate working practices following evaluation of risks.	Mild	Unlikely	Very low
	P1b: Dermal uptake (indoor and outdoor)	R2: Construction and maintenance workers	Medium	Likely	Moderate	Workers are likely to come into contact with made ground in excavations.	Risks to be addressed through CDM process and potential COSHH risk assessments. The probability of contact with contaminants is assessed as unlikely based on the assumption that construction workers adopt appropriate working practices following evaluation of risks.	Medium	Unlikely	Low
	P1c: Inhalation of dust and vapours (indoor and outdoor) P3: Ground gas migration P4: Man made pathways – e.g. utilities	R2: Construction and maintenance workers	Severe	Low	Moderate	Made ground and coal seams are a potential source of ground gas.	Ground gas monitoring and risk assessment to be undertaken and suitable mitigation put in place if required.	Severe	Unlikely	Low
		R3: Occupants of nearby residential and commercial buildings	Severe	Low	Moderate	Made ground and coal seams are a potential source of ground gas. This could accumulate in any excavations.	Risks to be addressed through CDM process and potential COSHH risk assessments.	Severe	Unlikely	Low
	P2: Vertical and horizonal migration of contaminants and leachates	R3: Construction and maintenance workers	Medium	Likely	Moderate	Workers could come into contact with groundwater in excavations.	Risks to be addressed through CDM process and potential COSHH risk assessments. The probability of contact with contaminants is assessed as unlikely based on the assumption that construction workers adopt appropriate working practices following evaluation of risks.	Medium	Unlikely	Low
		R4: Groundwater in the underlying secondary A aquifer (MPCM)	Medium	Likely	Moderate	The proposed works may disturb and mobilise contaminated material.	Ground investigation carried out in accordance with BS 5930:2015 to assess the extent and severity of any contamination and confirm the presence of any low permeability clay deposits. This risk assessment should be updated following receipt of this information and additional mitigation identified if necessary.	Medium	Unlikely	Low
		R5: Local flora and fauna	Medium	Low	Moderate	Potential landscaping are proposed as part of the design.	Ground investigation carried out in accordance with BS 5930:2015 to assess the extent and severity of any contamination and confirm the presence of any low permeability clay deposits. This risk assessment should be updated following receipt of this information and additional mitigation identified if necessary.	Medium	Unlikely	Low
		R7: Buried structures – concrete foundations	Mild	Likely	Moderate	The proposed works may disturb and mobilise contaminated material.	Ground investigation carried out in accordance with BS 5930:2015 to assess the extent and severity of any contamination and confirm the presence of any low permeability clay deposits. This risk assessment should be updated following receipt of this information and additional mitigation identified if necessary. Suitable materials should be specified for the construction of any below ground structures.	Mild	Unlikely	Very low
	P6: Direct contact with buried structures and infrastructure	R7: Buried structures – concrete foundations	Moderate	Likely	Moderate	-	Ground investigation carried out in accordance with BS 5930:2015 to assess the extent and severity of any contamination and confirm the presence of any low permeability clay deposits. This risk assessment	Medium	Unlikely	Low

			Unmitigated risk					Mitigated risk		
Source	**Pathway**	**Receptor**	**Consequence**	**Probability**	**Risk**	**Comments**	**Risk control measures (RCM)**	**Consequence**	**Probability**	**Risk**
							should be updated following receipt of this information and additional mitigation identified if necessary. Suitable materials should be specified for the construction of any below ground structures. Design Sulphate Class and ACEC class to be determined from BRE Special Digest 1 (2005).			
	P4: Man made pathways – e.g. utilities P7: Possible Piling	R4: Groundwater in the underlying secondary A aquifer (PMCM)	Medium	Likely	Moderate	-	Ground investigation carried out in accordance with BS 5930:2015 to assess the extent and severity of any contamination and confirm the presence of any low permeability clay deposits. This risk assessment should be updated following receipt of this information and additional mitigation identified if necessary.	Mild	Likely	Low
	P5: Surface runoff	R5: Local flora and fauna	Medium	Low	Moderate	Working and/or stockpiling contaminated material may result in the generation of contaminated runoff.	Ground investigation carried out in accordance with BS 5930:2015 to assess the extent and severity of any contamination and confirm the presence of any low permeability clay deposits. This risk assessment should be updated following receipt of this information and additional mitigation identified if necessary.	Medium	Unlikely	Low

7 Conclusions and recommendations

This section contains an overview of the key findings and conclusions of this report. However, no reliance should be placed on any part of this summary without referring to the relevant sections in the report.

7.1 Further assessment/consideration

From this desk study review, consideration should be given to the following:

- Interbedded mudstone, siltstone and sandstone (PMCM) – thickness and properties of the weathered zone and depth to bedrock and properties of rock will be required.
- Contamination – the contamination status is uncertain. There is some potential contamination from past and present uses including the old hospital, and from nearby current and former land uses. Possible contaminants include heavy metals, hydrocarbons and asbestos. Sampling and testing of soils and groundwater is required to confirm contamination concentrations. Further risk assessment including a site-specific risk assessment will be required upon completion of the ground investigation. A specialist asbestos contractor may be to be engaged if asbestos is present at the site.
- Existing infrastructure – there is a basement below the existing hospital structure that facilitates the electronic needs of the hospital (database servers etc.), the proposed pad foundations should be designed to avoid surcharging the external basement wall. If the design cannot mitigate against this risk, then a mini pile solution might be required as an alternative foundation solution.
- Construction vibrations – some areas of the hospital will be very sensitive to vibrations (e.g. operating theatres), so vibrations from construction should be mitigated against or kept to a minimum.

7.2 Ground Investigation

A ground investigation carried out in accordance with BS 5930:2015 (9) and BS 10175:2017+A2:2017 (10) is recommended to mitigate the constraints identified by this desk study report. The investigation is likely to comprise the following:

- Windowless sampling boreholes to bedrock, to provide parameters for foundation design with standpipe monitoring installations. The exact number and depth of the boreholes required will depend the likely loads for the foundations, although a borehole spacing of 25-50m is considered appropriate, with boreholes extending to bedrock at approximately 4m below ground level.
- Determination of geotechnical properties of the materials encountered via Standard Penetration Tests (SPTs) and laboratory testing, including moisture content, plasticity index, compressibility tests and and undrained shear strength of cohesive materials.
- California Bearing Ratio (CBR) tests to aid road and pavement design.
- Testing of soils for sulphates and pH to determine the design sulphate class.
- Testing of soils for a range of contaminants to quantify the risks to construction works and final end users. The suites are detailed within Table 4. Further detail of the comprehensive contamination suites specified within the Mott MacDonald Framework Agreement which are used as part of the Contract with the Contractor are included within Appendix G.

- Groundwater level monitoring and gas monitoring (one visit on a day with low and falling atmospheric pressure) should be undertaken for a minimum of six visits. Groundwater samples should be obtained from the standpipes on the first three visits and tested to assess the risk to controlled groundwaters. The suites are detailed in Table 5.

Table 4: Comprehensive soil and leachate suites

Testing	Determinands
Soil Tests	**Metals** Antimony, Arsenic, Asbestos Screen, Barium, Beryllium, Boron, Cadmium, Chromium (III), Chromium (VI), Copper, Iron, Lead, Manganese, Total Mercury, Molybdenum, Nickel, Selenium, Vanadium, Zinc **Inorganics** Cyanide (Free), pH, Sulphate (Water soluble), Sulphur (Total) **Organics** BTEX (speciated), Fraction of Organic Carbon, Phenols (speciated: phenol, cresols, dimethylphenols, trimethylphenols) Polyaromatic Hydrocarbons (USEPA 16 speciated), Total Petroleum Hydrocarbon – Criteria Working Group: Ali-Aro Split, TPHCWG Bands, Volatile Organic Compounds (Speciated USEPA Method 8260 Target List)
Leachate Tests	**Metals** Arsenic, Antimony, Barium, Beryllium, Boron, Cadmium, Chromium (III), Chromium (VI), Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Selenium, Vanadium, Zinc **Inorganics** Calcium, Chloride, Cyanide (Free), Cyanide (Complex), Fluoride, pH, Sulphate **Organics** Ammoniacal Nitrogen, Phenols (speciated: phenol, cresols, dimethylphenols, trimethylphenols) Polyaromatic Hydrocarbons (USEPA 16 speciated),

Source: Mott MacDonald Ground Investigation Services, Framework Agreement 2014

Table 5: Comprehensive groundwater suites

Testing	Determinands
Water Tests	**Metals** Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chloride, Chromium (III), Chromium (VI), Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Selenium, Sodium, Vanadium, Zinc **Inorganics** Calcium, Cyanide (Free), Cyanide (Complex), Fluoride, Hardness ($CaCO_3$), pH, Total Dissolved Solids, Sulphate, Sulphur, Alkalinity Bicarbonate. **Organics** Ammoniacal Nitrogen, Nitrate as NO_3 Phenols (speciated: phenol, cresols, dimethylphenols, trimethylphenols) Polyaromatic Hydrocarbons (USEPA 16 speciated) Total Petroleum Hydrocarbon – Criteria Working Group: Ali-Aro Split, TPHCWG Bands

Source: Mott MacDonald Ground Investigation Services, Framework Agreement 2014

8 References

1. Groundsure GIS report (ref: Motts_Barnsley_Insights_TB), June 2018
2. British Geological Survey, Sheet 87, 1:50,000, 2008
3. The Coal Authority Consultants Coal Mining Report, Barnsley A&E Department, 18 June 2018.
4. The Coal Authority Interactive Map View (http://mapapps2.bgs.ac.uk/coalauthority/home.html), viewed 20th June 2018
5. Zetica (2018) Pre-desk study assessment, 19th June 2018
6. CIRIA C552: Contaminated Land Risk Assessment. A Guide to good practice. 2001
7. Department of the Environment Food and Rural Affairs/Environment Agency. Model Procedures for the Management of Land Contamination. Contaminated Land Report. 2004
8. British Standards Institution. Specification for topsoil. BS 3882:2015. 2015
9. British Standards Institution. Code of Practice for ground investigation. BS 5930:2015. 2015.
10. British Standards Institution. BS 10175 British Standards Institution. Code of Practice for the Investigation of Potentially Contaminated Sites. BS10175:2017+A2:2017
11. Department of the Environment Food and Rural Affairs (DEFRA) (2012) Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance, April 2012;
12. Environment Agency (2009) “Human Health Toxicological Assessment of Contaminants in Soil”, Science Report – SC050021/SR2;
13. Environment Agency. Groundwater Protection. Retrieved from GOV.UK: https://www.gov.uk/government/collections/groundwater-protection
14. NHBC, EA, CIEH (2008) “Guidance for the Safe Development of Housing on Land Affected by Contamination”, R&D Publication 66: 2008;
15. Department for Communities and Local Government (2012) (15) “National Planning Policy Framework”.

Appendices

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A. Site location plan

Title

Barnsley Hospital - CAU & ED

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Date	Drawn	Checked	Approved	Scale at A4	Report Number	Status	Rev
05/07/18	T Beeson	M Rochester	I Hurst	1:2,500	397596/001/A	FINAL	P1

C:\Users\bee85346\OneDrive - Mott MacDonald\Projects\Barnsley Hospital\site plan.mxd

B. Coal Authority Consultants Coal Mining Report

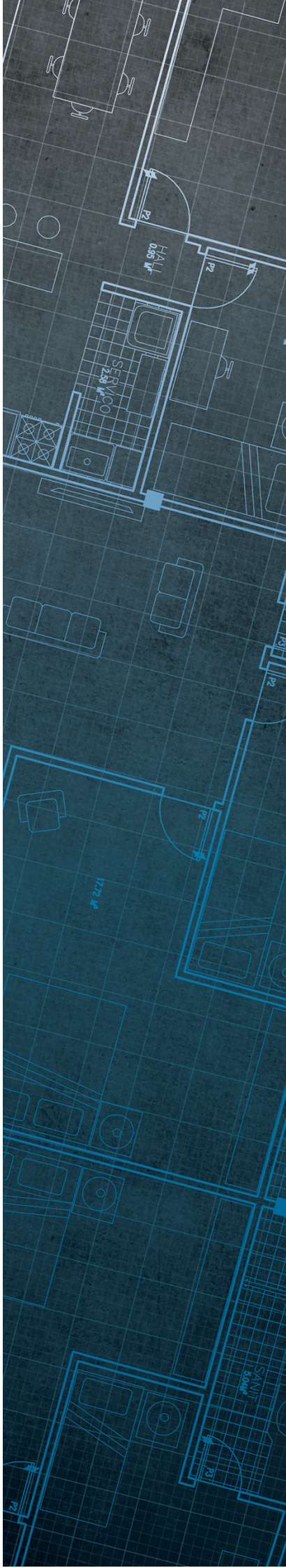
The Coal Authority

Consultants

Coal Mining Report

Barnsley Hospital A&e Department
South Yorkshire

Date of enquiry:	**18 June 2018**
Date enquiry received:	**18 June 2018**
Issue date:	**18 June 2018**
Our reference:	**51001858759001**
Your reference:	**397596BA01**



Consultants
Coal Mining Report

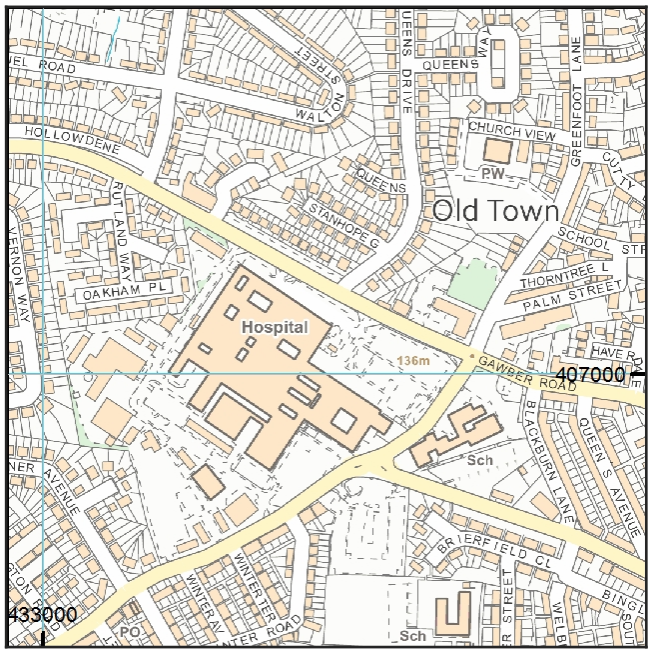
This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

GROUNDSURE LIMITED

Enquiry address

Barnsley Hospital A&e Department
South Yorkshire



Approximate position of property

How to contact us

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Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

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/company/the-coal-authority
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/thecoalauthority

Section 1 – Mining activity and geology

Past underground mining

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
DODWORTH	TOP HAIGH MOOR	Coal	6Z6X	124	Beneath Property	4.2	North-East	132	1964
DODWORTH	TOP HAIGH MOOR	Coal	6Z7F	124	South-East	4.8	North-East	124	1964
DODWORTH	FLOCKTON THICK	Coal	6Z6U	218	North-West	4.1	North-East	76	1950
DODWORTH	TOP FENTON	Coal	6Z6S	261	North-East	4.7	North-East	81	1937
DODWORTH	SILKSTONE	Coal	6Z70	355	North-West	4.3	North-East	105	1973
WOOLLEY/REDBROOK	WHINMOOR	Coal	Z75	405	North-West	4.9	North-East	113	1982

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

The following abandoned mine plan catalogue numbers intersect with some, or all, of the enquiry boundary:

3792	NE584	NE919
NE1034	SCC6	FGB146
SY213	PO0	NE763

Our records show we have more plans than those shown above which could affect the enquiry boundary.

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

Outcrops

No outcrops recorded.

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

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

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 31st 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.

Withdrawal of support notices
The property is in an area where notices to withdraw support were given in 1944 and 1948.

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.

Payments to owners of former copyhold land
The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Section 4 – Further information

The following potential risks have been identified and as part of your risk assessment should be investigated further.

Development advice

The site is within an area of historical coal mining activity. Should you require advice and/or support on understanding the mining legacy, its risks to your development or what next steps you need to take, please contact us.

For further information on specific site or ground investigations in relation to any issues raised in Section 4, please call us on 0345 762 6848 or email us at groundstability@coal.gov.uk.

Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk.**

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

Opencast mines
Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips
Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations
Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites
Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence
Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas
Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

Mine water treatment schemes
Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining
Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing
Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders
Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

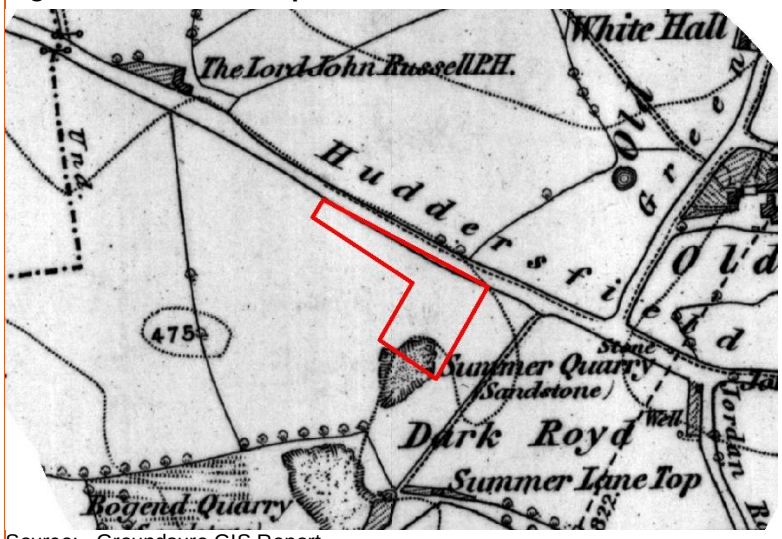
Section 46 notices
Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices
Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land
Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

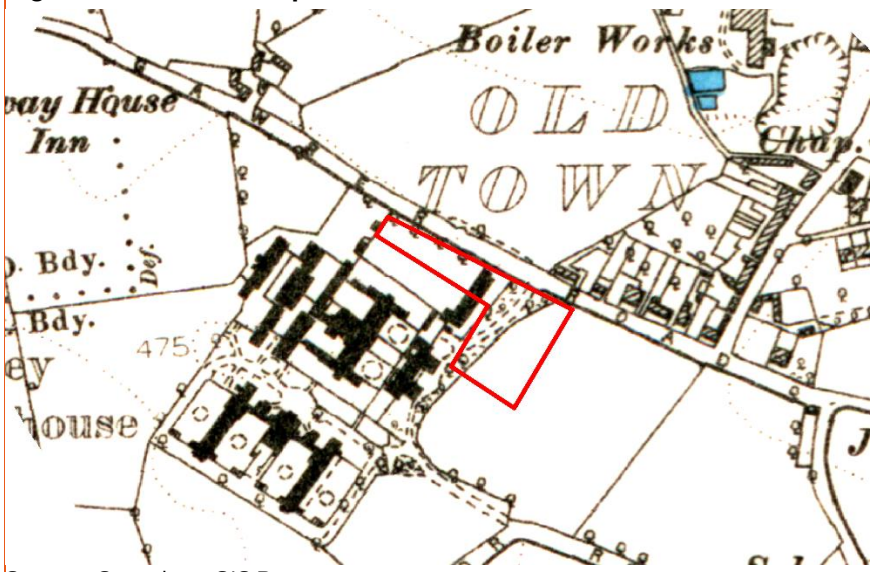
C. Groundsure GIS Report figures

Figure 1: Historical Map - 1850



Source: Groundsure GIS Report

Figure 2: Historical Map - 1890

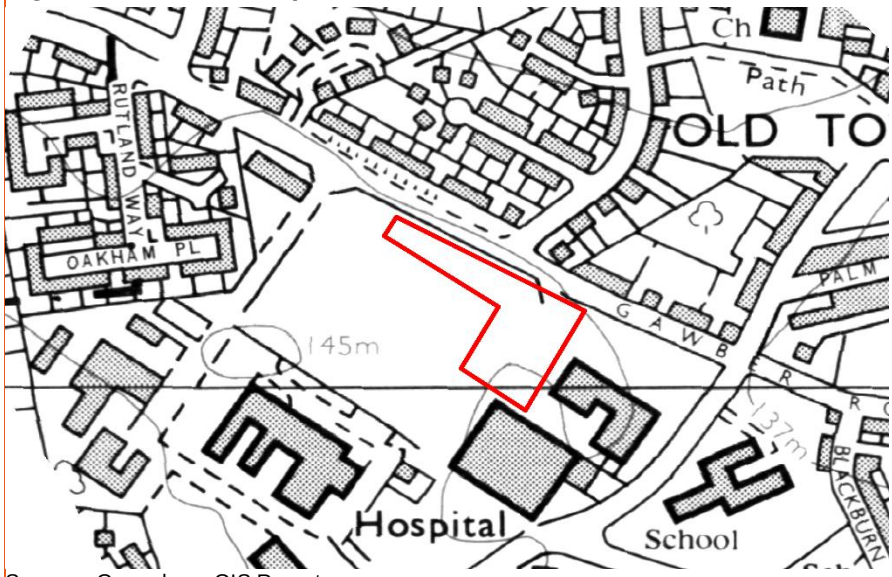


Source: Groundsure GIS Report

Figure 3: Historical Map - 1956

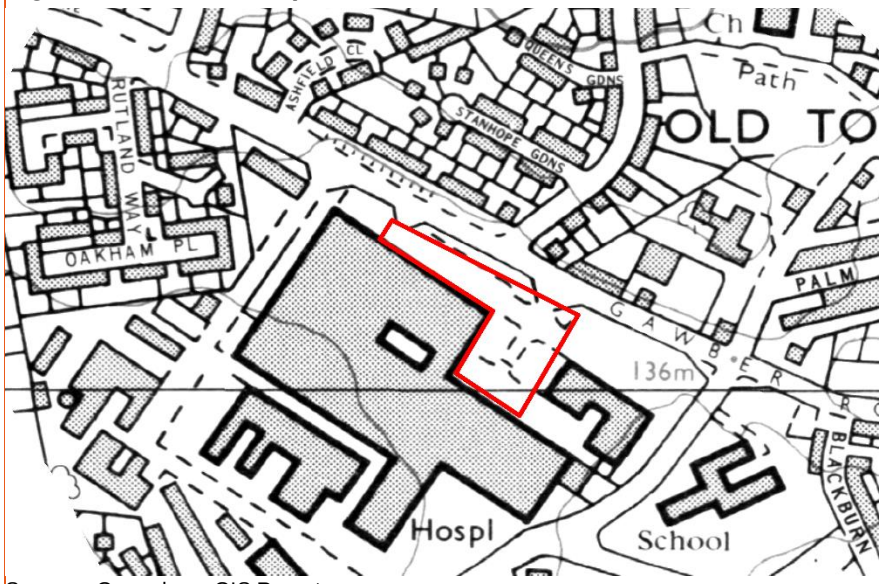
Source: Groundsure GIS Report

Figure 4: Historical Map - 1973



Source: Groundsure GIS Report

Figure 5: Historical Map - 1982



Source: Groundsure GIS Report

Figure 6: Solid geology

Source: Groundsure GIS Report

D. Contaminated land risk methodology

D.1 Regulatory context

The primary legislative regime under which historic contaminated land is managed in the UK is Part IIA of the Environmental Protection Act (EPA), 1990. The framework for the assessment of potential land contamination adopted in this report is based on current guidance documents regarding the implementation of Part IIA of the EPA and the assessment of potentially contaminated land, with particular reference to:

- Department of the Environment Food and Rural Affairs (DEFRA) (2012) (11) Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance, April 2012;
- Environment Agency (2009) (12) "Human Health Toxicological Assessment of Contaminants in Soil", Science Report – SC050021/SR2;
- British Standard (BS) 10175:2017+A2:2017 (10) "Investigation of Potentially Contaminated Sites";
- Environment Agency. (2017, December 12). (13) Groundwater Protection. Retrieved from GOV.UK: https://www.gov.uk/government/collections/groundwater-protection
- NHBC, EA, CIEH (2008) (14) "Guidance for the Safe Development of Housing on Land Affected by Contamination", R&D Publication 66: 2008;
- Department for Communities and Local Government (2012) (15) "National Planning Policy Framework".

Part IIA principally deals with sites where individual historic contamination linkages present a "Significant Possibility of Significant Harm" (SPOSH) or a Significant Possibility of Significant Pollution to Controlled Waters (SPOSPCOW) representing an unacceptable level of contamination risk for each linkage. The Part IIA clean-up is the minimum which can be done on a cost basis to make and keep the site in a "just safe" condition for an existing use.

Elimination of liability under Part IIA is not always achievable largely because of the inherent risk basis of the statutory regime, the technical difficulty in establishing levels of contamination that are likely to represent SPOSH, and the variable distribution of contamination at many sites. Statutory guidance on Part IIA DEFRA, 2012 (11) recognises that sites require prioritisation by Local Authorities under the statutory Part IIA site inspection programme to ensure that only those sites likely to present the greatest risks are identified. However, it should be recognised that considerable investigation is often required to establish whether sites are likely to meet the definition of contaminated land under Part IIA. Such investigation may be beyond the scope of project budgets for nominally "low risk sites" necessitating judgement on an acceptable level of investigation. Since the designation of Contaminated Land is the responsibility of the Local Authority, it is advised that consensus is sought on any recommendations regarding the significance of contaminated land risks and remedial measures through consultation with the Regulator(s).

Section 161 of the Water Resources Act 1991 states that the Environment Agency can recover clean-up costs on person(s) who caused or knowingly permitted the entry or presence of any poisonous, noxious or polluting matter or any solid waste into controlled waters. Contamination and environmental considerations are studied by developing a conceptual model of the site that describes the environmental features of the site together with the expected interaction of potential contamination sources and the wider environment.

D.2 Planning context

The National Planning Policy Framework (15) includes the following policies in relation to contaminated land:

Policy 109: "The planning system should contribute to and enhance the natural and local environment by:

- preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and
- remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate"

Policy 120: "To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner."

Policy 121: "Planning policies and decisions should also ensure that:

- the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;
- after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and
- adequate site investigation information, prepared by a competent person, is presented"
- The glossary states the following relation to "site investigation information:
- "Site investigation information: Includes a risk assessment of land potentially affected by contamination, or ground stability and slope stability reports, as appropriate. All investigations of land potentially affected by contamination should be carried out in accordance with established procedures [such as BS10175:2017+A2:2017 Code of Practice for the Investigation of Potentially Contaminated Sites (10). The minimum information that should be provided by an applicant is the report of a desk study and site reconnaissance."

D.3 Qualitative contaminated land risk assessment

The methodology for the Phase II assessment of potential land contamination adopted in this report is based on current guidance documents, in particular CIRIA Report C552 (6).

Table 6: Classification of consequence

Classification	Definition of consequence
Severe	Short-term (acute) risks to human health. Short-term risk of pollution of sensitive water resource or ecosystem. Catastrophic damage to crops/buildings/property/infrastructure, including off-site soils.
Medium	Medium/long-term (chronic) risks to human health. Medium/long-term risk of pollution of sensitive water resource or ecosystem. Significant damage to crops/buildings/property/infrastructure (on or off-site).

Classification	Definition of consequence
	Contamination of off-site soils.
Mild	Easily preventable, permanent health effects on humans. Pollution of non-sensitive water resources. Localised damage to crops/buildings/property/infrastructure (on or off-site).
Minor	Easily preventable, non-permanent health effects on humans, or no effects. Minor, low-level and localised contamination of on-site soils. Easily repairable damage to crops/buildings/property/infrastructure.

The probability of contamination risks occurring at this site will be classified in accordance with the table below which is also adapted from the CIRIA guidance. Note that for each category, it is assumed that a pollution linkage exists. Where a pollution linkage does not exist, the likelihood is zero, as is the risk.

Table 7: Classification of probability

Classification	Definition of probability
High Likelihood	Circumstances are such that an event appears very likely in the short-term or almost inevitable in the long-term; or there is already evidence that such an event has occurred.
Likely	Circumstances are such that such an event is not inevitable, but is possible in the short-term and is likely over the long-term.
Low Likelihood	Circumstances are such that it is by no means certain that an event would occur even over a longer period, and it is less likely in the short-term.
Unlikely	Circumstances are such that it is improbable that an event would occur even in the very long-term.

For each possible pollution linkage (source-pathway-receptor) identified, the potential risk can be evaluated, based on the following principle:

Contamination risk = Probability of event occurring x Consequence of event occurring

This relationship can be represented graphically as a matrix seen in the table below, which is adapted from the CIRIA guidance.

Table 8: Overall contamination risk matrix

	Consequence			
Probability	**Severe**	**Medium**	**Mild**	**Minor**
High likelihood	Very high risk	High risk	Moderate risk	Low risk
Likely	High risk	Moderate risk	Moderate risk	Low risk
Low likelihood	Moderate risk	Moderate risk	Low risk	Very low risk
Unlikely	Low risk	Low risk	Very low risk	Very low risk

The definitions of the risk categories identified in the above matrix are given in the table below, together with the investigatory and remedial actions that are likely to be necessary in each case. The risk categories apply to each pollutant linkage, not just to each hazard or receptor.

Table 9: Definition of risk categories and likely actions required

Risk category	Definition and likely actions required
Very high	Severe harm to a defined receptor is very likely, or has already occurred. The risk is likely to result in a substantial liability. Urgent investigation (if not already undertaken) is likely to be required. Urgent remediation is likely to be required.
High	Harm to a defined receptor is likely. The risk, if realised, may result in a substantial liability.

Risk category	Definition and likely actions required
	Urgent investigation (if not already undertaken) is likely to be required. Remediation is likely to be required in the long term, possibly sooner.
Moderate	Harm to a defined receptor is possible, but severe harm is unlikely. Investigation is likely to be required to clarify the level of potential liability and risk. Some remediation may be required in the longer term.
Low	Harm to a defined receptor is possible, but is likely to be mild at worst. Liabilities could theoretically arise, but are unlikely. Further investigation is not required at this stage. Remediation is unlikely to be required.
Very low	Harm to a defined receptor is unlikely, and would be minor at worst. No liabilities are likely to arise. Further investigation is not required at this stage. Remediation is very unlikely to be required.

E. Conceptual model schematic

Sources:

S1: On site made ground associated with historical use

S2: Off site current and historical land uses

S3: Electrical sub-stations within 250m of the site – PCBs and coolant oils

S4: Nearby roads

S5: Existing car park/ambulance drop off – contamination from vehicles

Pathways:

P1: Human uptake pathways

P2: Vertical and horizontal migration of contaminants and leachates

P3: Ground gas migration

P4: Man made pathways – e.g. utilities

P5: Surface runoff

P6: Direct contact with buried structures and infrastructure

P7: Possible Piling

Receptors:

R1: Final end users – hospital employees and patients

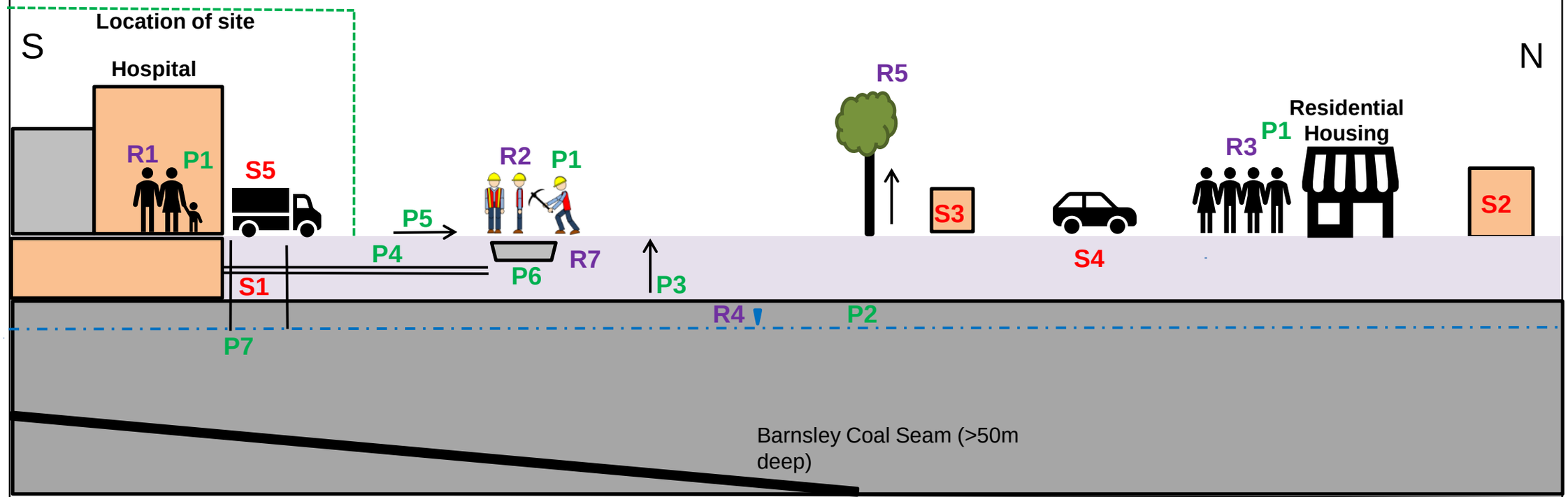
R2: Construction and maintenance workers

R3: Occupants of nearby residential and commercial buildings

R4: Groundwater in the underlying secondary A aquifer (PMCM)

R5: Local flora and fauna

R6: Buried Structures – concrete foundations



Mott MacDonald
4th Floor, Derwent House
150 Arundel Gate
Sheffield S1 2JY
United Kingdom

Key:

- Made ground
- Pennine Middle Coal Measures
- Inferred groundwater level

	Drawn	TB	
	Checked	MR	
NOT TO SCALE	Approved	IH	

Client:
Race Cottam Associates

Project:
Barnsley Hospital – CAU & ED

Title:

Conceptual Model Schematic

F. Zetica pre-desk study assessment

Pre-Desk Study Assessment

Site:	Barnsley Hospital
Client:	Mott MacDonald
Contact:	Tom Beeson
Date:	12th June 2018
Pre-WWI Military Activity on or Affecting the Site	None identified.
WWI Military Activity on or Affecting the Site	None identified.
WWI Strategic Targets (within 5km of Site)	The following strategic targets were located in the vicinity of the Site: ■ Transport infrastructure and public utilities. ■ Industries important to the war effort, including engineering and munitions factories, and iron works. ■ Military training areas.
WWI Bombing	None identified on the Site.
Interwar Military Activity on or Affecting the Site	None identified.
WWII Military Activity on or Affecting the Site	None identified.
WWII Strategic Targets (within 5km of Site)	The following strategic targets were located in the vicinity of the Site: ■ Transport infrastructure and public utilities. ■ Industries important to the war effort, including iron works and engineering factories.
WWII Bombing Decoys (within 5km of Site)	None.
WWII Bombing	During WWII the Site was located in the County Borough (CB) of Barnsley, which officially recorded no High Explosive (HE) bombing. No readily available records have been found to indicate that the Site was bombed.
Post-WWII Military Activity on or Affecting the Site	None identified.
Recommendation	A detailed desk study, whilst always prudent, is not considered essential in this instance.

This summary is based on a cursory review of readily available records. Caution is advised if you plan to action work based on this summary.

It should be noted that where a potentially significant source of UXO hazard has been identified on the Site, the requirement for a detailed desk study and risk assessment has been confirmed and no further research will be undertaken at this stage. It is possible that further in-depth research as part of a detailed UXO desk study and risk assessment may identify other potential sources of UXO hazard on the Site.

G. Contamination testing suites for land affected by contamination

G.1 General

The following are the recommended testing suites for contamination testing at the site.

G.2 Soil Suites

G.2.1 Mott MacDonald Comprehensive Soil Suite

Table 10: Comprehensive Soil Suite

Determinand	Unit	Detection limits	Accreditation
		Required	Required
Antimony	mg/kg	1	*
Arsenic	mg/kg	1	*
Asbestos Screen	Type and presence	N/A	*
Barium	mg/kg	1	*
Beryllium	mg/kg	1	*
Boron	mg/kg	1	*
BTEX (speciated)	mg/kg	0.02	*
Cadmium	mg/kg	1	*
Chromium (III)	mg/kg	1	*
Chromium (VI)	mg/kg	1	*
Copper	mg/kg	1	*
Cyanide (Free)	mg/kg	1	*
Fraction of Organic Carbon	%	0.1	*
Iron	mg/kg	36	*
Lead	mg/kg	1	*
Manganese	mg/kg	1	*
Inorganic Mercury	mg/kg	1	*
Methylmercury	mg/kg	1	*
Total Mercury	mg/kg	1	*
Molybdenum	mg/kg	1mg/kg	*
Nickel	mg/kg	1	*
pH	N/A	-	N/A
Phenols (speciated: phenol, cresols, dimethylphenols, trimethylphenols)	mg/kg	0.6	*
Polyaromatic Hydrocarbons (USEPA 16 speciated),	mg/kg	0.1	*
Selenium	mg/kg	1	*
Sulphate (Water soluble),	mg/l	10	*
Sulphur (Total),	%	0.01	*

Determinand	Unit	Detection limits	Accreditation
		Required	Required
Total Petroleum Hydrocarbon – Criteria Working Group: Ali-Aro Split, TPHCWG Bands	mg/kg	4	*
Vanadium	mg/kg	1	*
Volatile Organic Compounds, (Speciated USEPA Method 8260 Target List – Refer Table 11)	µg/kg	1	*
Zinc	mg/kg	3	*

* = BS EN ISO/IEC 170025:2005 / MCERTS unless otherwise stated

G.2.2 Mott MacDonald VOC Soil Suite

Table 11: VOC Soil Suite Speciated USEPA Method 8260 Target List

Determinand	Unit	Detection Limits	Accreditation
		Required	Required
C10-13 Chloroalkanes	µg/kg	1	*
Benzene	µg/kg	1	*
Bromobenzene	µg/kg	1	*
Bromochloromethane	µg/kg	1	*
Bromodichloromethane	µg/kg	1	*
Bromoform	µg/kg	1	*
Bromomethane	µg/kg	1	*
n-Butylbenzene	µg/kg	1	*
sec-Butylbenzene	µg/kg	1	*
tert-Butylbenzene	µg/kg	1	*
Carbon tetrachloride	µg/kg	1	*
Chlorobenzene	µg/kg	1	*
Chlorodibromomethane	µg/kg	1	*
Chloroethane	µg/kg	1	*
Chloroform	µg/kg	1	*
Chloromethane (methyl chloride)	µg/kg	1	*
2-Chlorotoluene	µg/kg	1	*
4-Chlorotoluene	µg/kg	1	*
1,2-Dibromo-3-chloropropane	µg/kg	1	*
1,2-Dibromoethane	µg/kg	1	*
Dibromomethane	µg/kg	1	*
1,2-Dichlorobenzene	µg/kg	1	*
1,3-Dichlorobenzene	µg/kg	1	*
1,4-Dichlorobenzene	µg/kg	1	*
Dichlorodifluoromethane	µg/kg	1	*
1,1-Dichloroethane	µg/kg	1	*
1,2-Dichloroethane	µg/kg	1	*

Determinand	Unit	Detection Limits	Accreditation
		Required	Required
1,1-Dichloroethene	µg/kg	1	*
cis-1,2-Dichloroethene	µg/kg	1	*
trans-1,2-Dichloroethene	µg/kg	1	*
1,2-Dichloropropane	µg/kg	1	*
2,2-Dichloropropane	µg/kg	1	*
1,3-Dichloropropane	µg/kg	1	*
1,1-Dichloropropene	µg/kg	1	*
Ethylbenzene	µg/kg	1	*
Hexachlorobutadiene	µg/kg	1	*
Isopropylbenzene	µg/kg	1	*
p-Isopropyltoluene	µg/kg	1	*
Methylene chloride (dichloromethane)	µg/kg	1	*
Naphthalene	µg/kg	1	*
n-Propylbenzene	µg/kg	1	*
Styrene	µg/kg	1	*
1,1,1,2-Tetrachloroethane	µg/kg	1	*
1,1,2,2-Tetrachloroethane	µg/kg	1	*
Tetrachloroethene	µg/kg	1	*
Toluene	µg/kg	1	*
1,2,4-Trichlorobenzene	µg/kg	1	*
1,2,3-Trichlorobenzene	µg/kg	1	*
1,1,1-Trichloroethane	µg/kg	1	*
1,1,2-Trichloroethane	µg/kg	1	*
Trichloroethene	µg/kg	1	*
Trichlorofluoromethane	µg/kg	1	*
1,2,3-Trichloropropane	µg/kg	1	*
1,2,4-Trimethylbenzene	µg/kg	1	*
1,3,5-Trimethylbenzene	µg/kg	1	*
Vinyl chloride	µg/kg	1	*
o-Xylene	µg/kg	1	*
m-Xylene	µg/kg	1	*
p-xylene	µg/kg	1	*
Methyl-t-butyl ether	µg/kg	1	*
Dichlorofluoromethane	µg/kg	1	*

* = BS EN ISO/IEC 170025:2005 / MCERTS unless otherwise stated

G.2.3 Mott MacDonald PCB Soil Suite

Table 12: PCB Soil Suite

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Polychlorinated Biphenyls (PCB's) 12 Congeners (WHO Standard): 77, 167, 169, 189, 81, 105, 114, 118, 123, 126, 156, 157	mg/kg	0.003		*	

* = BS EN ISO/IEC 17025:2005 / MCERTS unless otherwise stated

G.2.4 Mott MacDonald Blacktop Soil Suite

Table 13: Blacktop Soil Suite

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Polyaromatic Hydrocarbons (USPA 16 speciated)	mg/kg	0.1		*	
Total Petroleum Hydrocarbon- Criteria Working Group: Ali-Aro Split, TPHCWG Bands	mg/kg	4		*	

* = BS EN ISO/IEC 17025:2005 / MCERTS unless otherwise stated

G.3 Leachate Suites

G.3.1 Mott MacDonald Comprehensive Leachate Suite (BS EN 12457)

Table 14: Comprehensive Leachate Suite (2:1 Liquid:Solid ratio)

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Arsenic	mg/l	0.001		*	
Ammoniacal Nitrogen	mg/l	0.01		*	
Antimony	mg/l	0.005		*	
Barium	mg/l	0.01		*	
Beryllium	mg/l	0.01		*	
Boron	mg/l	0.01		*	
Cadmium	mg/l	0.00008		*	
Calcium	mg/l	1		*	
Chloride	mg/l	1		*	
Chromium (III)	mg/l	0.004		*	
Chromium (VI)	mg/l	0.0006		*	
Copper	mg/l	0.001		*	
Cyanide (Free)	mg/l	0.001		*	

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Cyanide (Complex)	mg/l	0.02		*	
Fluoride	mg/l	1		*	
Iron	mg/l	0.01		*	
Lead	mg/l	0.001		*	
Magnesium	mg/l	1		*	
Manganese	mg/l	0.002		*	
Mercury	mg/l	0.00001		*	
Molybdenum	mg/l	0.07		*	
Nickel	mg/l	0.001		*	
pH		-		*	
Phenols (speciated: phenol, cresols, dimethylphenols, trimethylphenols)	mg/l	0.0005		*	
Selenium	mg/l	0.001		*	
Sulphate	mg/l	3		*	
Vanadium	mg/l	0.001		*	
Zinc	mg/l	0.001		*	

* = BS EN ISO/IEC 17025:2005 / MCERTS unless otherwise stated

G.3.2 Mott MacDonald VOC Leachate Suite (BS EN 12457)

Table 15: VOC Leachate Suite

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
C10-13 Chloroalkanes	µg/l	0.4		*	
Benzene	µg/l	1		*	
Bromobenzene	µg/l	5		*	
Bromochloromethane	µg/l	5		*	
Bromodichloromethane	µg/l	5		*	
Bromoform	µg/l	5		*	
Bromomethane	µg/l	5		*	
n-Butylbenzene	µg/l	5		*	
sec-Butylbenzene	µg/l	5		*	
tert-Butylbenzene	µg/l	5		*	
Carbon tetrachloride	µg/l	0.1		*	
Chlorobenzene	µg/l	5		*	
Chlorodibromomethane	µg/l	5		*	
Chloroethane	µg/l	5		*	
Chloroform	µg/l	0.1		*	
Chloromethane (methyl chloride)	µg/l	5		*	
2-Chlorotoluene	µg/l	5		*	
4-Chlorotoluene	µg/l	5		*	
1,2-Dibromo-3-chloropropane	µg/l	0.1		*	
1,2-Dibromoethane	µg/l	0.4		*	
Dibromomethane	µg/l	5		*	

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
1,2-Dichlorobenzene	µg/l	5		*	
1,3-Dichlorobenzene	µg/l	5		*	
1,4-Dichlorobenzene	µg/l	5		*	
Dichlorodifluoromethane	µg/l	5		*	
1,1-Dichloroethane	µg/l	5		*	
1,2-Dichloroethane	µg/l	1		*	
1,1-Dichloroethene	µg/l	5		*	
cis-1,2-Dichloroethene	µg/l	5		*	
trans-1,2-Dichloroethene	µg/l	5		*	
1,2-Dichloropropane	µg/l	0.1		*	
2,2-Dichloropropane	µg/l	5		*	
1,3-Dichloropropane	µg/l	5		*	
1,1-Dichloropropene	µg/l	5		*	
Ethylbenzene	µg/l	2		*	
Hexachlorobutadiene	µg/l	0.005		*	
Isopropylbenzene	µg/l	5		*	
p-Isopropyltoluene	µg/l	5		*	
Methylene chloride (dichloromethane)	µg/l	5		*	
Naphthalene	µg/l	1		*	
n-Propylbenzene	µg/l	5		*	
Styrene	µg/l	4		*	
1,1,1,2-Tetrachloroethane	µg/l	5		*	
1,1,2,2-Tetrachloroethane	µg/l	5		*	
Tetrachloroethene	µg/l	0.1		*	
Toluene	µg/l	4		*	
1,2,4-Trichlorobenzene	µg/l	0.01		*	
1,2,3-Trichlorobenzene	µg/l	0.01		*	
1,1,1-Trichloroethane	µg/l	0.1		*	
1,1,2-Trichloroethane	µg/l	0.1		*	
Trichloroethene	µg/l	0.1		*	
Trichlorofluoromethane	µg/l	5		*	
1,2,3-Trichloropropane	µg/l	5		*	
1,2,4-Trimethylbenzene	µg/l	5		*	
1,3,5-Trimethylbenzene	µg/l	5		*	
Vinyl chloride	µg/l	0.3		*	
o-Xylene	µg/l	3		*	
m-Xylene	µg/l	3		*	
p-Xylene	µg/l	3		*	
Methyl-t-butyl ether	µg/l	5		*	
Dichlorofluoromethane	µg/l	5		*	

* = BS EN ISO/IEC 17025:2005 / MCERTS unless otherwise stated

G.3.3 Mott MacDonald TPH Leachate Suite (BS EN 12457)

Table 16: Mott MacDonald TPH Leachate Suite (BS EN 12457, 2:1 Liquid:Solid Ratio)

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Total Petroleum Hydrocarbon – Criteria Working Group: Ali-Aro Split TPHCWG Bands	µg/l	10		*	

* = UKAS (BS EN ISO/IEC 17025:2005 unless otherwise stated)

G.3.4 Mott MacDonald PAH Leachate Suite (BS EN 12457)

Table 17: Mott MacDonald PAH Leachate Suite (BS EN 12457, 2:1 Liquid : Solid Ratio)

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Polyaromatic Hydrocarbons (USEPA 16 speciated)	µg/l	0.002		*	

* = UKAS (BS EN ISO/IEC 17025:2005 unless otherwise stated)

G.4 Water Suites

G.4.1 Mott MacDonald Comprehensive Water Suite

Table 18: Comprehensive Water Suite

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Ammoniacal Nitrogen	mg/l	0.01mg/l		*	
Antimony	mg/l	0.005mg/l		*	
Arsenic	mg/l	0.001mg/l		*	
Barium	mg/l	0.01mg/l		*	
Beryllium	mg/l	0.01mg/l		*	
Boron	mg/l	0.01mg/l		*	
Cadmium	mg/l	0.00008mg/l		*	
Calcium	mg/l	1mg/l		*	
Chloride	mg/l	1mg/l		*	
Chromium (III)	mg/l	0.004mg/l		*	
Chromium (VI)	mg/l	0.0006mg/l		*	
Copper	mg/l	0.001mg/l		*	
Cyanide (Free)	mg/l	0.001mg/l		*	
Cyanide (Total)	mg/l	0.02mg/l		*	
Fluoride	mg/l	1mg/l		*	

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Hardness ($CaCO_3$)	mg/l	10mg/l		*	
Iron	mg/l	0.01mg/l		*	
Lead	mg/l	0.001mg/l		*	
Magnesium	mg/l	1mg/l		*	
Manganese	mg/l	0.002mg/l		*	
Mercury	mg/l	0.00005mg/l		*	
Molybdenum	mg/l	0.07mg/l		*	
Nickel	mg/l	0.001mg/l		*	
Nitrate as NO_3	mg/l	1mg/l		*	
pH		-		*	
Phenols (speciated: phenol, cresols, dimethylphenols, trimethylphenols)	mg/l	0.0005mg/l		*	
Polyaromatic Hydrocarbons (USEPA 16 speciated)	µg/l	0.002µg/l (each and every PAH)		*	
Selenium	mg/l	0.001mg/l		*	
Sodium	mg/l	1mg/l		*	
Sulphate	mg/l	3mg/l		*	
Sulphur	mg/l	3mg/l		*	
Total Petroleum Hydrocarbon – Criteria Working Group: Ali-Aro Split TPHCWG Bands	µg/l	10µg/l (each and every TPH Band)		*	
Vanadium	mg/l	0.001mg/l		*	
Volatile Organic Compounds, (Speciated USEPA Method 8260 Target List) (detection limits detailed in Table 24	mg/l	Various: See Table 24		*	
Zinc	mg/l	0.001mg/l		*	
Total Dissolved Solids	mg/l	0.1		*	
Alkalinity – Bicarbonate	Mg/l	1		*	

* = UKAS (BS EN ISO/IEC 17025:2005 unless otherwise stated)

G.4.2 Mott MacDonald PCB Water Suite

Table 19: PCB Water Suite

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Polychlorinated Biphenyls (PCB's) 12Congeners (WHO standard)	µg/l	0.001		*	

* = UKAS (BS EN ISO/IEC 17025:2005 unless otherwise stated)

G.4.3 Mott MacDonald TPH Water Suite

Table 20: TPH Water Suite

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Total Petroleum Hydrocarbon – Criteria Working Group: Ali-Aro Split TPHCWG Bands	µg/l	10		*	

* = UKAS (BS EN ISO/IEC 17025:2005 unless otherwise stated)

G.5 Waste Acceptance Criteria

G.5.1 Mott MacDonald Waste Acceptance Suite

Table 21: Waste Acceptance Criteria

Determinand	Unit	Detection Limits		Accreditation	
		Required	Offered	Required	Offered
Total organic carbon	%	3		*	
Loss on ignition	%	10		*	
BTEX	mg/kg	6		*	
PCB's (7 congeners)	mg/kg	1		*	
Mineral Oil, C10 – C40	mg/kg	500		*	
PAH's (Total of 17)	mg/kg	100		*	
pH	N/A	N/A			
Arsenic, As	mg/kg	0.5		*	
Barium, Ba	mg/kg	20		*	
Cadmium, Cd	mg/kg	0.04		*	
Chromium, Cr	mg/kg	0.5		*	
Copper, Cu	mg/kg	2		*	
Mercury, Hg	mg/kg	0.01		*	
Molybdenum, Mo	mg/kg	0.5		*	
Nickel, Ni	mg/kg	0.4		*	
Lead, Pb	mg/kg	0.5		*	
Antimony, Sb	mg/kg	0.06		*	
Selenium, Se	mg/kg	0.1		*	
Zinc, Zn	mg/kg	4		*	
Chloride, Cl	mg/kg	800		*	
Fluoride, F	mg/kg	10		*	
Sulphate, SO_4	mg/kg	1000		*	
Total dissolved Solids (TDS)	mg/kg	4000		*	
Phenol index	mg/kg	1		*	
Dissolved organic carbon	mg/kg	500		*	

* = UKAS (BS EN ISO/IEC 17025:2005 unless otherwise stated)

H. Chemical testing suites for potentially aggressive ground/groundwater

H.1 General

.

The following are potentially aggressive ground/ groundwater testing suites, based on the likelihood that made ground will be present above potentially pyritic Pennine Middle Coal Measures. The testing suites present the recommended required detection limits for the testing..

H.2 Soil Suites

H.2.1 BRE SD1 Soils Suite B (Greenfield site – pyrite present)

Table 22: BRE SD1 Soils Suite B (Greenfield site – pyrite present)

Determinand	Test Method	Accreditation
		Required
pH in 2.5:1 water/soil extract	BR 279 BS1377 Part 3, Section 9	**
SO_4 in 2:1 water/soil extract	BR 279 BS1377 Part 3, Section 5 TRL Report 447, Test 1	**
Acid Soluble SO_4	BR 279 BS1377 Part 3, Section 5 TRL Report 447, Test 2	**
Total sulphur	BR 279 TRL Report 447, Test 4A TRL Report 447, Test 4B	**

** = UKAS (BS EN ISO/IEC 17025:2005)

H.2.2 BRE SD1 Soils Mg – Dependent Option (Brownfield Site)

Table 23: BRE SD1 Soils Mg – Dependent Option (Brownfield site)

Determinand	Test Method	Accreditation	
		Required	Offered
Mg (only required if water soluble SO_4 >3000mg/l)	BR279 AAS method	**	

** = UKAS (BS EN ISO/IEC 17025:2005)

H.2.3 BRE SD1 Soils NO_3 – Dependent Option (Brownfield Site)

Table 24: BRE SD1 Soils NO_3 – Dependent Option (Brownfield site)

Determinand	Test Method	Accreditation	
		Required	Offered
NO_3 in 2:1 water/soil extract (only required if pH <5.5)	BR 279	**	

** = UKAS (BS EN ISO/IEC 17025:2005)

H.2.4 BRE SD1 Soils Cl – Dependent Option (Brownfield Site)

Table 25: BRE SD1 Soils Cl – Dependent Option (Brownfield site)

Determinand	Test Method	Accreditation	
		Required	Offered
Cl in 2:1 water/soil extract (only required if pH <5.5)	BR279 BS1377 Part 3, Section 7	**	

** = UKAS (BS EN ISO/IEC 17025:2005)

H.2.5 TRL447 Test 1

H.3 Waters/Leachate Suites

H.3.1 BRE SD1 Waters/ Leachate Suite A (Greenfield site – pyrite absent/present)

Table 26: BRE SD1 Waters/ Leachate Suite A (Greenfield site – pyrite absent)

Determinand	Test Method	Accreditation
		Required
pH	BR 279 BS1377 Part 3, Section 9	**
SO_4	BR 279 BS1377 Part 3, Section 5	**

** = UKAS (BS EN ISO/IEC 17025:2005)

H.3.2 BRE SD1 Waters/ Leachate Mg – Dependent Option (Brownfield Site)

Table 27: BRE SD1 Waters/ Leachate Mg – Dependent Option (Brownfield site)

Determinand	Test Method	Accreditation	
		Required	Offered
Mg (only required if water soluble SO_4 >3000mg/l)	BR279 AAS method	**	

** = UKAS (BS EN ISO/IEC 17025:2005)

H.3.3 BRE SD1 Waters/ Leachate NO_3 – Dependent Option (Brownfield Site)

Table 28: BRE SD1 Waters/ Leachate NO_3 – Dependent Option (Brownfield site)

Determinand	Test Method	Accreditation	
		Required	Offered
NO_3 (only required if pH <5.5)	BR279	**	

** = UKAS (BS EN ISO/IEC 17025:2005)

H.3.4 BRE SD1 Waters/ Leachate Cl – Dependent Option (Brownfield Site)

Table 29: BRE SD1 Waters/ Leachate Cl – Dependent Option (Brownfield site)

Determinand	Test Method	Accreditation	
		Required	Offered
Cl (only required if pH <5.5)	BR279 BS1377 Part 3, Section 7	**	

** = UKAS (BS EN ISO/IEC 17025:2005)

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