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Engineering Geologists and Environmental Scientists

1: INTRODUCTION

This report describes the results of a Phase 1 Desk Study and Phase II Geoenvironmental Ground Investigation undertaken on land off West Road, Pogmoor, near Barnsley in South West Yorkshire in the UK. The work was commissioned by the clients Mr T Simpson and Mr D Lycett and was carried out by Ashton Bennett Consultancy.

The purpose of this Phase 1 Study was to collate and assess information on the site including geological, hydrogeological and mining information, archival maps and historical review to determine past use, a database review, environmental data on water and soil, and to undertake a site reconnaissance to enable a desk top assessment to determine the likely presence and areas of environmental concerns on the site and the presence of pathways of migration and potentially sensitive receptors.

The purpose of the Phase II intrusive investigation was to investigate the nature, depth and extent of any contamination on the site, by collection and testing of soil and water samples and to establish the presence of potential migration routes for contamination detected and to assess any environmental risk to sensitive receptors.

This report describes the research work carried out, presents the results of the desk study and ground investigation and makes recommendations regarding environmental risk for residential development and solutions to environmental risks and geotechnical concerns to development of the site for residential use.

2: THE SITE

2.1 Site Location

The site comprises land situated to the southwest of West Road in Pogmoor near Barnsley in South Yorkshire. The site is accessed from West Road and lies at National Grid Reference 433010E 406520N at a height of around 135maOD at its highest elevation and 125m at its lowest elevation.

The site is bounded to the north by industrial premises fronting onto West Road with housing beyond. To the east the site is bounded by open land. To the west the site is bounded by industrial premises and a recreation field housing and open land beyond. To the south the site is bounded by a railway line with industrial premises beyond.

The site is occupied by open land formerly used as a clay pit, brickworks, waste refuse destructor site and transport yard.

A site location plan is presented as Drg No TSDL 2620/1 and a site plan is presented as Drg No TSDL 2620/2.

2.2 Site Description

The site lies as open ground with rough grassland. Floor slabs and disused derelict buildings are present in the central northern area of the site and retain the land to the north which fronts onto West Road and is at a higher elevation. Access to the site is off West Road in the northwest corner of the site as a sloping roadway leading to the main site which lies at a lower elevation than West Road. The eastern part of the northern boundary is formed by a steep banking covered in shrubbery. The eastern boundary is open to fields beyond. The southern boundary is covered in shrubbery with a fence dividing the site from railway land. The western boundary is formed by a broken fence between the site and recreation land and the northern area of the site lies at a slightly lower elevation with mounds of topsoil.

3: REPORT OBJECTIVE AND REPORT SCOPE

3.1 Report Objective

The objective of the desk study is to determine the environmental nature of the site and to establish any environmental concerns and liabilities with particular reference to past contaminative uses of the site as far as is possible from historical and database review. Contaminative use is defined as "any use of land which may cause it to be contaminated by toxic substances" (Section 143 of the Environmental Protection Act 1990). The report undertaken is a Phase I Desk Study and Phase II Risk Assessment taking into account any potential contamination, the migration pathways and the presence of potentially sensitive receptors. Preliminary recommendations are also made for foundation design taking into account the geotechnical and mining situations to on the site.

3.2 Report Scope

The information for this report is from sources recommended by the Institute of Civil Engineers (ICE), the Association of Geotechnical and Geoenvironmental Specialists (AGS), Construction Industry Research and Information Association (CIRIA) and the Department of the Environment Transport and the Regions (DETR). The report has been compiled in accordance with the latest ICE, DETR, Department of Environment, Food and Rural Affairs (DEFRA) and British Standard Draft Documents and British Standards, particularly BS10175:2001.

The scope of the report was to undertake a desk study and to undertake soft ground boring and trial pitting to collect soil and groundwater samples for environmental and geotechnical testing and to present a geoenvironmental and geotechnical report with recommendations based on the drilling and testing undertaken and to make recommendations for investigation of mining beneath the site.

In addition the scope of the investigation has used the extensive knowledge and experience of the staff of Ashton Bennett Consultancy to assess the data and ground conditions and to interpret the data and ground conditions encountered.

4: SITE HISTORY

The maps and plans detailed in Table 1 were inspected to assess the history of the site and its environs. In summary the site has been occupied by a clay pit and brickworks, a refuse destructor and a transport yard and is now open ground.

TABLE 1
Historical Maps Inspected

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DATE	DRG. NO.	MAP & SCALE	DESCRIPTION
1850	TSDL 2620/3	Yorks 274 1:10,560	This map indicates the site to be occupied by open land with a footpath along the northern boundary and an area defined for a future railway line to the south. The south was surrounded by open fields.
1893	TSDL 2620/4	Yorks 274.7 1:2500	This map indicates the site to be occupied by an old clay pit occupying the southwestern area of the site and with a pond in the central southern area of the site. Buildings are shown in the southwestern corner. The site is surrounded by open fields. A railway line forms the southern boundary to the site. Slackhills Colliery lies to the northeast of the site and a clay pit and brickworks is shown to the south of the site, south of the railway. Pogmoor village lies to the northwest. Old shafts are shown to the south of the railway line.
1906	TSDL 2620/5	Yorks 274.7 1:2500	This map annotates the site as Summer Lane Brickworks. Two large buildings are shown in the centre of the site with sidings running into the southeast corner into the main rail line. A pond lies in the central southern area of the site. Buildings are shown in the southwest corner of the site.
1932	TSDL 2620/6	Yorks 274.7 1:2500	This map indicates the site to be occupied by Refuse Destructor (Barnsley Corporation) with one large building in the central western area of the site and with railway sidings to the main line. The annotation indicates the site has been filled in the south and eastern areas. A chimney is shown to the south of the main building with a line of possible houses in the southwest boundary of the site. A brickworks is shown to the north of the site, allotment gardens and open land lie to the east, a miners welfare recreation ground lies to the west and brickworks are shown to the south of the site. A Drift Mine annotated as Farm House Colliery is shown to the west of the site, west of the recreation ground.
1938	TSDL 2620/7	Yorks 274 NE 1:10,560	This map shows no change to the layout of the site or its immediate surroundings.
1948	TSDL 2620/8	Yorks 274 NE 1:10,560	This map shows no change to the layout of the site or its immediate surroundings.
1956	TSDL 2620/9	SE 30 NW 1:10,560	Farm House colliery is shown as disused. A large pond is shown in the clay pit to the south, and old brickworks, shafts and bedrock are shown to the south.
1961	TSDL 2620/10	SE 3206/3306 1:2500	This map indicates the site to comprise filled ground with one large building in the centre annotated as works. A chimney is still shown with works and brickyard cottages in the southwest corner.
1966	TSDL 2620/11	SE 30 NW 1:10,560	This map shows no change to the layout of the site or its immediate surroundings. A large pond lies to the north of the site in the old brickworks.
1973	TSDL 2620/12	SE 30 NW 1:10,000	This map shows no change to the layout of the site or its immediate surroundings.
1979	TSDL 2620/13	SE 3206 NE 1:1250	This map shows no change to the layout of the site or its immediate surroundings.
1991	TSDL 2620/14	SE 3306 SW 1:1250	This map only indicates a small portion of the site and indicates the presence of tanks.
1993	TSDL 2620/15	SE 30 NW 1:10,000	This map indicates one large building in the north of the site and open land over the remainder of the site.

5: POTENTIAL CONTAMINATION ON SITE

The site has been occupied by a clay pit, brickworks, railway sidings, refuse destructor and a transport depot and now lies as open ground.

The sources of potential contamination from the past and present uses of the site are those associated with these uses and may include:

1. Arsenic and sulphate in industrial/mine waste used for sidings
2. Hydrocarbons in fuel and oil for transport
3. Asbestos in pipe lagging, building materials and brake shoes
4. Unknown contamination in waste
5. Acids and alkalis
6. Methane and carbon dioxide from filled ground

This list does not imply that these potentially contaminating materials are present on the site and it is possible that other potentially contaminating materials not listed may be present. This list does not imply that these materials are on site in contaminating levels.

6: SITE GEOLOGY

6.1 Geology

The published British Geological Survey Map (BGS) shows the site to be underlain by mudstone, siltstones, sandstones and coal seams of the Carboniferous Pennine Middle Coal Measures Formation. Superficial deposits are not indicated to overlie the solid strata. The maps indicate the site to be immediately underlain by mudstone of the Coal Measures dipping to the northeast at shallow angles of 4 to 6 degrees to the horizontal.

The Kents Thin and Kents Thick Coal seam are shown to outcrop to the northeast of the site. The underlying Barnsley Rider Coal and Barnsley Coal are not shown to outcrop on the site but may underlie the site at shallow depth. Both the seams outcrop to the west of the site but have been downfaulted by a SW to NE trending geological fault immediately to the west of the site to lie at a greater depth beneath the site. A further geological fault trending NW to SE lies to the immediate south of the site. The extreme northern part of the site and northeastern boundary is annotated as a tip on the BGS maps and the railway to the south and land beyond is annotated as a colliery tip. Coal seams within this stratigraphic section of the Coal Measures are generally worked.

A borehole is shown on the BGS maps to lie to the east of the site at NGR 433245E 406500N. A mine shaft is shown to lie to the immediate west of the site at NGR 433000E 406550N.

A full discussion of the coal seams underlying the site, and mining history of the site is presented in Section 8.2.

6.2 Geological Faults

The BGS map indicates the presence of one geological fault crossing to the immediate west of the site in a SW-NE direction and the presence of one large fault trending in a mainly northwest to southeast direction to the south of the site. It is possible that smaller faults sub parallel to these may exist in the strata causing fissuring and fracturing to the rock. Due to the cessation of tectonic activity in the area, faulting is unlikely to detrimentally affect the site stability.

6.3 Engineering Geology

Any made ground present on the site is expected to be in a loose state of compaction. A comprehensive intrusive geotechnical ground investigation should be undertaken to assess suitable foundation strata before any new build construction is undertaken on the site.

It is possible that the made ground may be highly compressible and that the underlying clays may shrink and swell under varying moisture conditions and these possibilities need to be investigated before new construction.

7: SITE HYDROLOGY AND HYDROGEOLOGY

7.1 Hydrology

The rainfall over the area of the site will naturally drain in a southerly direction to the drain which flows west to east to the south of the site south of the railway line. There are no Environment Agency results for river quality in the drain.

The site is shown by the Environment Agency not to lie within a fluvial flood plain where there is a 1% chance of flooding each year. Properties within the indicative flood plain are at risk from flooding although the risk varies. The maps do not take account of local flood defences because they are built to varying standards. Further information can be sought at the Environment Agency Flood Line on 0845 988 1188.

7.2 Hydrogeology

Geological maps produced by the BGS at a scale of 1:10,560, indicate the site to be underlain by sandstones, mudstones and siltstones of the Carboniferous Coal Measures. Made up ground may be present and is a generally permeable stratum. The mudstone is relatively impermeable strata interbedded with more permeable sandstones, siltstones and coal seams.

The Environment Agency Groundwater Vulnerability map indicates the site to lie on an area of a minor aquifer. These are formations, which do not have a high primary permeability, and do not produce high quantities of water for abstraction, but are important for local supplies and base flows to rivers.

The minor aquifer is overlain by soils of intermediate to high leaching potential which readily transmit liquid discharges because they are shallow or susceptible to rapid flow directly to rock, gravel or groundwater, and are soils with little ability to attenuate diffuse source pollutants in which non absorbed diffuse source pollutants and liquid discharges have the potential to move rapidly to underlying strata or shallow groundwater. The minor aquifer comprises sandstone horizons within the Coal Measures strata. Care should be taken not to intrude into any aquifer and cause pollution to enter the aquifer.

Groundwater may be expected at shallow depths below ground level as perched water in any made up ground present beneath the site. Groundwater may also be encountered in the underlying sandstone bedrock. It is not expected that groundwater will be a concern to redevelopment of the site and it is anticipated that it could be dealt with by sump pumping during and after heavy rainfall.

The Environment Agency holds no details of any water abstraction within 250m of the site. Four abstractions lie within 700m to 1000m of the site as detailed in Table 2. Due to the distance it is unlikely that the site is detrimentally affecting these water abstractions, three of which are from surface spring water.

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TABLE 2
Water Abstractions

Grid Reference	Name	Licence No Permit start	Location	Abstraction Use	Source
433700E 406100N	Yorkshire Water Plc	2/27/08/058	Not given	Unclassified	Groundwater
433700E 406060N	Sheldale Developments Ltd	2/29/08/133	43a Shaw Lane, Barnsley	Food and Drink Water bottling	Groundwater from spring
433700E 406000N	Sheldale Developments Ltd	2/27/08/10	Shaw Lane	Food and Drink	Groundwater from spring
433700E 406000N	Sheldale Water Ltd	2/27/08/10	Shaw Lane	Water bottling	Groundwater from well/spring

As the local groundwater may be utilised for abstraction from old unlicensed wells, it is important that it is protected from pollution. It is an offence to pollute the groundwater, whether or not it is used for abstraction. The site is unlikely to be detrimentally affecting the quality of the drain as it is now culverted.

8: QUARRYING AND MINING

8.1 Quarrying and Stone Mining

The OS plans viewed indicate that clay extraction has taken place on the site. The British Geological Survey Mines and Quarries Survey 1998 does not indicate any existing quarries on or within 250m of the site. However this does not imply that local quarrying for stone has not taken place on or close to the site in the past. Excavation for clay for use in brickworks is known to have been undertaken on the site between 1893 (old clay pit) and possibly the 1930's.

8.2 Coal Mining

A Coal Mining Report obtained from The Coal Authority for the site, and based on their mine abandonment records since 1872 stated that the property is in the likely zone of influence from workings in six seams of coal at 30m to 370m depth and last worked in 1978. The property is not in the likely zone of influence of any present underground coal workings. The property is not within a geographical area for which a licence to extract coal by underground methods is awaiting determination by the Coal Authority or has been granted. The Coal Authority holds no record of any notice of the risk of the land being affected by subsidence given under S.46 of the Coal Mining Subsidence Act 1991.

The Coal Authority has knowledge of one mine entry within or within 20m of the property. There is no record of what steps, if any, have been taken to treat the mine entry. There may be further mine entries of which the Coal Authority has no knowledge.

The report states that the site does not lie within the geographical boundary of an opencast site from which coal has been extracted by opencast methods, and is not within 800m of a boundary of an opencast site for which a licence to extract coal by opencast methods is awaiting determination or has been granted. The property is in an area for which notices of entitlement to withdraw support were published in 1950, 1944, 1948, 1956 and 1944. The property is not in an area for which a notice has been given under Section 41 of the Coal Industry Act 1994 revoking the entitlement to withdraw support. The Coal Authority Report indicates that shallow mining has taken place beneath the site and is expected to be mining of the Barnsley Coal Seam. In addition there is one mine shafts which lies within 20m of the site.

The Coal Authority Report should be read in full and is reproduced in Appendix A.

It is recommended that the site is drilled to assess the depth and extent of shallow mining and it is recommended that the mine shaft is located and drilled to establish if it has been backfilled. It may not be backfilled to the Coal Authority requirements and following drilling, the shafts will require stabilisation and capping to Coal Authority requirements. Permission is required from the Coal Authority to drill the site and the mine shaft.

Further information obtained by reference to original mine abandonment plans for the Barnsley Coal seam of 1878 indicated the coal extraction to have been 2.60m in thickness and confirmed the location of the shaft to be immediately west of the site boundary.

TABLE 3
Mining Beneath Site

Coal seam or sandstone	Depth in mbgl	Coal worked beneath site (Coal Authority records)
Barnsley Rider Coal		
Barnsley Rock Sandstone		
Barnsley Coal	<30	YES
Dunsil Coal		
Gawber Coal		
Swallow Wood Coal		
Haigh Moor Sandstone		
Top Haigh Moor Coal	80	
Low Haigh Moor Coal		
Lidgett Coal		
Joan Coal		
Tankersley Coal		
Flockton Thick Coal	174	YES
Fenton Coal	196	YES
Parkgate Rock Sandstone		
Parkgate Coal	240	YES
Thorncliffe Coal		
Silkstone Four Foot		
Silkstone Rock Sandstone		
Claywood Ironstone		
Silkstone Coal	320	YES
Black Band Coal		
Whinmoor Coal	370	YES

9: SOURCES OF CONTAMINATION TO SITE

9.1 Waste Disposal, Waste Treatment and Waste Transfer

There are three registered landfill sites within 250m of the site for which licences are all cancelled or revoked.

There are seven historic landfills within 250m of the site as detailed in Table 4 and there are seven landfills recorded by Barnsley MBC within 250m of the site of unknown status.

The Environment Agency hold records of one licensed waste treatment and waste transfer site licensed by the Environment Agency under Part II of the Environmental Protection Act 1990 to treat keep or dispose of controlled waste within the site. This is licensed to D Lycett in

Haulage Yard off West Road, Pogmoor for household, commercial and industrial transfer station.

As the site is a landfill and a large number of former landfills lie within 250m of the site, monitoring was undertaken in six monitoring points on six occasions under varying atmospheric conditions following the site investigation and the results are presented in Section 11.5 and in Appendix D.

TABLE 4
Landfill Sites

Location	Licence Holder	Licence Reference	Location	Waste	Status
433200E 406500N	A F Budge (Contractors) Ltd	WD 20 B572 (WD2 B19)	West Road Pogmoor 83m east of site	Demolition rubble, excavation, rock, stone, concrete	Registered cancelled
433200E 406500N	Barnsley MBC	WD 2 B19	West Road Pogmoor 83m east of site	Demolition rubble, excavation, rock, stone, concrete	Registered cancelled
433300E 406500N	CRS Ltd Yorkshire Region	WD 20 B38	Summer Care Dairy Stocks Lane 183m east of site	Construction and demolition waste, excavated material, incinerator residues	Registered cancelled
4331394 406479N	A F Budge	EA HLD 04028	West Road Pogmoor 24m east of site	Inert and commercial waste	Historic
433037E 406434N	Polar Motors Pogmoor	EA HLD 04327 4400/(139)	North of Dodworth Road 34m south of site	Unknown	Historic
432858E 406500N	Not supplied	EA HLD 04325 4400/(34)	Recreation ground Pogmoor Road 44m west of site	Unknown	Historic
433154E 406525N	CRS Ltd Yorkshire Region	EA HLD 04329 4400/0459	Land west of Summer Lane Dairy 44m east of site	Industrial and commercial waste	Historic
433160E 406606N	Not supplied	EAHLD 04330 4400/B197	Allotment gardens Pogmoor 108m northeast of site	Unknown	Historic
432813E 406401N	Mr J Clayton	EAHLD 04324 6714400/(130	Quarry at Higher Spring Head Farm	Inert and commercial waste	Historic
432980E 406204N	Not supplied	EA HLD 04326 4400/(131)	Dodsworth Road 264m south of site	Unknown	Historic
433077E 406535N	Mr D Lycett	60564	Haulage Yard off West Road Pogmoor	Household, commercial and industrial transfer station	Issued April 1987
432926E 406515N	Barnsley MBC	134	On site	-	Recorded
433104E 406464N	Barnsley MBC	61	3m southeast of site	-	Recorded
433002E 406443N	Barnsley MBC	57	32m south of site	-	Recorded

433100E 406575N	Barnsley MBC	44	44m northeast of site	-	Recorded
433200E 406500N	Barnsley MBC	139	83m east of site	-	Recorded
432853E 406401N	Barnsley MBC	130	89m southwest of site	-	Recorded
432997E 406219N	Barnsley MBC	131	250m south of site	-	Recorded
433200E 406500N	A F Budge	WD20 B572 (WD2 B19)	West Road Pogmoor 83m east of site	Clean demolition rubble, excavation spoil, subsoil, rock, stone and concrete	Registered but lapsed or cancelled
433200E 406500N	Barnsley MBC	WD2 B19	West Road Pogmoor 83m east of site	Clean demolition rubble, excavation spoil, subsoil, rock, stone and concrete	Registered but lapsed or cancelled
433300E 406500N	CRS Ltd Yorkshire Region	WD20 B38	Summer Lane Dairy Stokes Lane 183m east of site	Construction/demolition waste, excavated natural materials and incinerator residues	Registered but lapsed or cancelled
433100E 406450N	D Lycett	WD20 B554 MOD3	Haulage Yard off West Road	Commercial waste, construction and demolition waste, excavation waste, soil, subsoil, packaging, paper, solid industrial and non hazardous waste	Operational small 10,000 to 25,000 tonnes a year
433050E 407005N	Barnsley Health Authority	WD20 B943	Barnsley District Hospital Gawber Road 397m north of site	Clinical, domestic black bag waste	Surrendered

9.2 Statutory Authorisations

Barnsley Metropolitan Borough Council confirmed that the site is listed on the Local Authority Potentially Contaminated Land Register

There are no sites registered by the Environment Agency under the Radioactive Substances Act 1993 to keep or use radioactive materials on or within 250m of the site. There is a registered site at Barnsley Hospital 445m northeast of the site but this is unlikely to detrimentally affect the site.

9.3 Industrial Processes

There is one recorded site authorised by the Environment Agency under Part 1 of the EPA 1990 to carry out processes subjected to Integrated Pollution Prevention and Control (IPPC) within 250m of the site. This is for Royston Lead Ltd under Permit No PO12640 and is for non ferrous metals, producing lead and alloys greater than 23%, lead (with copper) or 2% lead (without). This is effective. There are five recorded Local Authority Pollution Prevention and Controls as detailed in Table 5.

TABLE 5
Local Authority Pollution Prevention and Controls

None	Location	Permit	Description

		Reference	
S J Autowelding	West Road Pogmoor 7m north of site	Ppc/B/09	Waste oil burners less than 0.4 MW net rated thermal input
Polar Motor Co Ltd	Dodworth Road Pogmoor 77m SE of site	Ppc/B/37	Respraying of road vehicles
Intake 1	Pogmoor Road Barnsley 99m NW of site	Ppc/B/65	Petrol filling station
Crows Garage	Pogmoor Road Barnsley 101m NW of site	Ppc/B/06	Waste oil burners less than 0.4 MW net rated thermal input
Shell	Barnsley Motorway 246m SW of site	Epa/Petrol/21	Petrol filling station

9.4 Hazardous Substances

There are no records of sites regulated by the Health and Safety Executive (HSE) under the Control of Major Accident Hazards (COMAH) Regulations 1999 on or within 250m of the site.

There are no sites on or within 250m of the site which are subject to hazardous substances consents granted by the relevant Local Authority under the Planning (Hazardous Substances) Act 1990, or which are regulated by the Health and Safety Executive for storing specific dangerous substances under the NIHHS Regulation 1982.

9.5 Contraventions

The Environment Agency holds three records of pollution incidents to controlled waters within 250m of the site comprising de-icing chemicals polluting Old Slough Culvert as a minor incident, gas oil from textile industries to the rear of Polar Motors as a minor incident, and oils at road bridge with A628 for industrial premises.

These pollution incidents are not attributable to the site and are unlikely to have detrimentally affected the site.

9.6 Discharge Consents

The Environment Agency holds records of one authorisation issued by the Environment Agency to discharge to watercourses in accordance with the Water Resources Act 1991, within 250m of the site. This is for a discharge of sewage via a soakaway at 48 Farmhouse Lane, Pogmoor. This is unlikely to detrimentally affect the site.

9.7 Radon

Radon is a radioactive gas derived from naturally occurring uranium found in small quantities in soils and rock. The National Radiological Board recommends that where radon concentration exceeds the Action level of 200 Bqm^{-3} the householder should take measures to reduce it. According to the BGS the site within is in an area where basic radon protection measures are required in new buildings.

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9.8 Potentially Contaminative Uses

The site has been used for the potentially contaminating use of a railway sidings, clay pit, brickworks, waste site and transport yard. Local industry includes precision engineers, electrical engineers, garage services, car dealers, commercial vehicle dealers, exhaust and shock absorber centres, printers, within 100m of the site. The nearest petrol filling station is 99m northwest of the site in Pogmoor Road. It is unlikely that contamination from these local industries could have detrimentally affected the site.

10: PATHWAYS AND RECEPTORS

It is unlikely that surface water could transport contamination into Old Slough Beck as the surface water is culverted.

The groundwater is unlikely to be a pathway as it classifies as a minor aquifer and lies beneath a cover of relatively permeable clay according to the geological maps. The Environment Agency hold no details of any water abstractions within 250m of the site and those which lie within 1000m are from springs and therefore unlikely to be detrimentally affected by the site. The site is not at risk of a flood transporting contamination.

Made ground on the site could assist in the leaching of contamination into underlying strata but as this is relatively impermeable mudstone it affords protection to underlying aquifers.

The site may have a residential use in the future and therefore flora may be a pathway for contamination as edible plants and vegetables may be grown on the site. No animals in the food chain are present on the site or likely to be present in the future.

According to the Countryside Commission the site does not lie within a National Park or area of Outstanding National Beauty. According to English Nature the site does not lie within a Special Protection Area, National Nature Reserve and it is not a Site of Special Scientific Interest or within a Special Area of Conservation, or RAMSAR site.

DEFRA records indicate that the site does not lie within a Nitrate Sensitive Area, or within an Environmentally Sensitive Area. The site lies within a Nitrite Vulnerable Zone. The site and the immediate area around are not classified as land which is a potentially sensitive receptor to contamination.

There is light industrial and residential use and schools within 500m of the site, and there is livestock in adjacent fields which are possible sensitive receptors to contamination. Workmen on the site and future users of the site will also be sensitive receptors.

11: RESULTS OF PHASE II GROUND INVESTIGATION

11.1 Fieldwork

A ground investigation was undertaken on the site between May 17th and May 25th 2007 and comprised the excavation of fourteen trial pits by mechanical excavator and numbered TP1 to TP14 and the drilling of six percussive boreholes numbered BH1 to BH6 by means of a Dando shell and auger rig. The trial pits were excavated to determine the depth of made ground and to assess the ground conditions and to collect soil samples for environmental testing. The boreholes were extended to depths of up to 7.50m bgl to assess ground conditions and to collect

soil samples for environmental and geotechnical testing. The soil samples were sent to NAMAS accredited laboratories for testing for environmental nature and geotechnical properties.

Six boreholes, BH1 to BH6 were fitted with standpipes following drilling to enable measurements of gas and groundwater. All trial pits were backfilled with arisings.

Borehole and Trial Pit logs are presented in Appendix A, Geotechnical Test Results are presented in Appendix B, Environmental Test Results are presented in Appendix C, Gas and Groundwater Monitoring Results in Appendix D and Photographs in Appendix E. Locations of Boreholes and Trial Pits are presented on Drg No TSDL 2620/16.

11.2 Ground Conditions

11.2.1 General

The ground conditions were fairly similar across the site of made ground underlain by Coal Measures mudstones weathered in their upper portion to firm clay.

11.2.2 Made Ground

Made ground was encountered to depths of 1.00m to 7.00m bgl but was generally 1.00m to 3.00mbgl. Trial pits TP1, TP2 and TP3 at the eastern end of the site did not encounter the base of the made ground due to unstable trial pit sides and ingress of water. Trial Pits TP12 and TP13 on the southern boundary and central area of the site did not encounter the base of the made ground due to water ingress causing collapse of the made ground. In the boreholes BH2 to BH5 the made ground was proven to a depth of 3.30m to 4.40m bgl and in BH6 in the north of the site the made ground extended to 0.50mbgl and in BH1 in the eastern end of the site the made ground was proven to 7.00mbgl.

The made ground generally comprised loose black ash and clinker with fragments of coal, gravel and cobbles of sandstone and reworked mudstone and often with brick fragments in the upper made ground. In BH1 and TP1 compacted paper was encountered between 2.00m to 4.00mbgl. In TP6, TP9, TP10 and TP11 masses of broken and whole red bricks were encountered.

Standard Penetration Tests in the made ground gave N values of 0 to 23 but were generally 0 to 13 indicating the material to be in a very loose to loose state of compaction and unsuitable in its present state of compaction to place foundations for development.

11.2.3 Clay (weathered bedrock)

In Trial Pits TP7, TP8, TP9, TP10, TP11 and TP14 and Boreholes BH1 and BH3 the bedrock was weathered to a firm to stiff yellow brown and grey silty clay often with lithorelics of mudstone. The clay was generally 0.20m to 0.90m in thickness and underlain by mudstone.

11.2.3 Bedrock

Bedrock comprised moderately to highly weathered weak mudstone of the Coal Measures. In the trial pits and boreholes bedrock was encountered at 1.00m to 7.20m bgl. Standard Penetration Tests in the mudstone gave N values of 20 to 29 and >50 indicating a weak bedrock.

TABLE 6
Ground Conditions

TP/BH No	MADE GROUND	BEDROCK	
	Concrete/clay/brick/ash	Bedrock weathered to Clay	Weak Weathered Mudstone
TP1	GL-4.00+		
TP2	GL-3.65+		
TP3	GL-1.20+		
TP4	GL-3.30		3.30-3.50
TP5	GL-3.00		3.00-3.30
TP6	GL-1.00		1.00-1.20
TP7	GL-1.20	1.20-2.10	
TP8	GL-2.70	2.70-3.00	
TP9	GL-1.60	1.60-1.80	
TP10	GL-1.80	1.80-2.20	
TP11	GL-1.60	1.60-1.80	
TP12	GL-3.20+		
TP13	GL-3.20+		
TP14	GL-1.50	1.50-2.00	
BH1	GL-7.00	7.00-7.20	7.20-7.50
BH2	GL-3.30		3.30-4.60
BH3	GL- 4.40	4.40-5.00	5.00-5.70
BH4	GL- 3.55		3.55-5.30
BH5	GL- 3.80		3.80-4.05
BH6	GL-3.55		5.00-5.00

TABLE 7
Standard Penetration Test N Values

Depth in mbgl	MADE GROUND	CLAY	MUDSTONE
GL-2.00	2,5, 9,10, 12, <50		
2.00-3.00	0,0,5,10,13,19		
3.00-4.00	1,2,4,10		20,29
4.00-5.00	23	27	24,>50,>50
5.00-6.00	5		>50,>50,>50
6.00-7.00	0		
7.00-8.00			>50

11.3 Groundwater Conditions

Five of the trial pits and one of the boreholes encountered groundwater at depths of 3.20m to 5.45mbgl. The site is generally dry to a depth of 3.00m bgl. During and after heavy rainfall small seepages may be encountered in the made ground where it overlies the less permeable mudstone.

It is not considered that special precautions will be required for groundwater control during construction at levels that cannot be dealt with by sump pumping. Water levels recorded in the standpipes varied from dry to 3.00m bgl and represents perched water within the made ground.

11.4 Geotechnical Testing

In situ shear strength tests were undertaken in selected boreholes to assess the engineering properties of the strata. Results indicated the made ground to be in a very loose to loose state of compaction, the clay to be of firm consistency and the bedrock to be weak to moderately strong.

Geotechnical testing was undertaken
RESULTS AWAITED ON WEDNESDAY

11.5 Gas Conditions

Six boreholes were fitted with standpipes following drilling to enable measurements of gas and groundwater. Boreholes were monitored on six occasions throughout May and June 2007 under varying atmospheric conditions. Results are presented in full in Appendix D.

FULL MONITORING NOT COMPLETE UNTIL NEXT WEEK

11.6 Mining Conditions

The Barnsley Coal seam has been mined at shallow depth beneath the site. If voids remain in the mined ground the voids could over the years migrate by successive roof collapse and reach the ground surface causing ground settlement and structural damage to overlying structures. If sufficient competent strata overlies the voids then they will become choked before they reach the ground surface.

It is recommended that the site is drilled on a grid pattern in the areas of known mining and other areas underlain by the Barnsley Coal at shallow (<30m) depth to ascertain the condition of the mined ground, presence and thickness of voids and thickness of overlying competent strata.

There is one mine shaft recorded within 20m of the boundary. It is recommended that this shaft is drilled to ascertain the condition of any backfill and to assess its future stability. This will not be necessary if development will not encroach within influencing distance of the shaft.

12: ENVIRONMENTAL TEST RESULTS

12.1 Standards

There are no definitive legal standards for contaminated land in the United Kingdom, although the Government Department of the Environment in the late 1970's published guidance on a restricted number of contaminants. Further guidance was published in March 2002 as the Contaminated Land Exposure Assessment (CLEA) by the Department of Environment, Food and Rural Affairs (DEFRA). This guidance is due to be revised in 2007.

12.2 Results of Environmental Tests on Soils

12.2.1 Soil Samples Tested

Thirteen soil samples were tested to date for the presence of contamination and assessed against the standards described. The soil samples were collected from window sampler boreholes at depths varying from ground level to 3.30m bgl. Thirteen soils were tested for the DETR screen to check for contamination, two were tested for Total Petroleum Hydrocarbons (TPH) and Polyaromatic Hydrocarbons (PAH) and six for asbestos.

12.2.2 Metals that are Phytotoxic

Contaminants that are phytotoxic are not normally hazardous to health, but restrict plant growth.

Boron

The soil samples tested fell within the DETR guidelines for all uses of the site with the exception of results from TP1 at 1.00m and 3.00m and TP2 at 3.00m.

Copper
The soil samples tested fell within DETR guidelines for all uses of the site, with the exception of the results from six samples which fell between 162.5 mg/kg to 709.1 mg/kg against the recommended 130 mg/kg.

Nickel
The soil samples tested fell within CLEA soil guideline values for residential use of the site with the exception of results from TP5 and TP10 which slightly exceeded the acceptable level.

Zinc
The soil samples tested were found to lie within guidelines with the exception of four results from TP1, TP2, TP5 and TP14 which fell above guidelines.

The samples tested for phytotoxic contamination generally fell below the threshold level for contamination according to DETR guidelines, and fell within CLEA soil guideline values. The exceptions were five results for boron, two of nickel, six of copper and four of zinc.

These contaminants are phytotoxic and do not present a hazard to health the results and indicate that they are of small concern to future use of the site for residential purpose and are unlikely at the levels detected to reduce plant growth. However where elevated levels are detected it may be prudent to provide clean uncontaminated topsoil.

12.2.3 Metals that are a Health Risk

All heavy metals, for which test results are presented below, can be detrimental to health and should be prevented from reaching the food and drinking water system.

Arsenic
The results of tests for arsenic fell within the CLEA soil guideline values for use of the site for residential with the exception of results from six samples which exceeded the acceptable 20mg/kg. Levels were generally 27 to 71mg/kg with one high level of 299.3mg/kg from TP10 at 0.20mbgl.

Cadmium
The soil samples tested generally fell within CLEA soil guideline values for residential use with the exception of results from TP2, TP5 and TP14.

Chromium
The soil samples tested all fell within CLEA soil guideline values for residential use.

Lead
The soil samples tested generally fell within CLEA soil guideline values for residential use. Three samples from TP2, TP5 and TP14 fell above acceptable levels for residential use.

Mercury
All the soil samples tested fell within CLEA soil guideline values for residential use.

Selenium

All of the soil samples tested fell within CLEA soil guideline values for residential use.

Cyanide
All the soil samples tested fell within the DETR Threshold for use of the site for gardens and/or parks playing fields and open space.

Thiocyanate
All the soil samples tested fell within DETR threshold for all uses of the site.

12.2.4 Other Inorganic Contaminants

Sulphide
The soil samples tested were all found to be within DETR threshold for sulphide.

Sulphate and pH
The levels of sulphate found in the soil samples tested indicated that the majority of results fall below DETR threshold levels and fall within the BRE Class 1 classification for design of underground concrete. However four results fell above 2000mg/kg from TP2 and TP5, TP12 and TP14 at levels of 4320 to 11,600mg/kg. These areas require special consideration for design of any underground concrete. pH levels in the soils were generally near neutral, varying from 7.60 to 8.90.

Sulphur
Two elevated levels of sulphur were detected in TP1 and TP12.

12.2.5 Organic Contaminants

Some organics may be particularly polluting in the environment, most notable of these are the polyaromatic hydrocarbons which can be carcinogenic. Organic pollutants produced from petroleum can pose environmental risk, the level of risk varying with particular pollutants. Organic pollutants cover a wide field and the testing undertaken on the site is intended to give indications only of any likely problem.

Phenol
Of the thirteen soil samples tested for phenol, all of the samples tested fell within the DETR threshold for residential use.

Polyaromatic Hydrocarbons (PAH)
Thirteen soil samples were tested for the presence of total PAH compounds. Four of the results fell within the Dutch Guidelines of 40mg/kg for PAHs with nine results falling above the guidelines at 99mg/kg to 1830mg/kg. All results fell within the DETR action level for PAHs for landscape use of the site.

Total Petroleum Hydrocarbons (TPH)
Two soil samples from TP4 at 1.00m and TP5 at 0.50m were tested for Total Petroleum Hydrocarbons and gave results of 1350mg/kg and 306mg/kg respectively. The level detected in TP5 lies within acceptable guidelines for residential use. The level in TP4 should be further tested and remediated if necessary.

12.2.6 Asbestos

Tests for the presence of asbestos were undertaken on six soil samples. All results gave no bulk fibres observed.

12.3 Summary

The potential for contamination on the site is from the use of the site for a clay pit with sidings, infilled land and as a transport depot with fuel storage tanks.

The results of the Phase II environmental ground investigation indicated that the site, where tested, was generally free from gross contamination. The site was found to be uncontaminated where tested by chromium, mercury, selenium, cyanide, thiocyanate, sulphide, phenol and asbestos.

Some contamination was detected of phytotoxic metals particularly in the area of TP1, TP2, TP5 and TP14. These metals do not detrimentally affect humans but can reduce plant growth and although the levels are not of concern to redevelop the site for residential use with plant uptake and landscaping, it would be prudent to place clean uncontaminated topsoil in proposed garden areas.

Contamination by heavy metals included six elevated levels of arsenic, three of cadmium and three of lead in TP1, TP2, TP5, TP10, TP12 and TP14. These levels are a low risk if overlain by hard cover and need remediation/mitigating measures where they lie in areas of future landscaped ground or gardens.

Elevated levels of PAH were detected in nine samples and two elevated levels of sulphur were detected. Elevated hydrocarbons were detected in the central area of the site. It is recommended that these areas of contamination are remediated or that mitigating measures are used to prevent the contamination detrimentally affecting future residents or workmen on the site.

Four test results for sulphate fell above the DETR threshold and are not of concern as long as they lie under hard cover. These results indicate that cementitious materials for underground services, structures and foundations are classified as requiring special consideration for design and the appropriate mixes as described in BRE Special Digest 1 should be followed in accordance with the test results obtained.

13: ENVIRONMENTAL RISK ASSESSMENT

13.1 Introduction

Environmental risk considerations on the site have been assessed by adopting a site specific qualitative approach to identify the risk, if any, of environmental harm. In accordance with the DETR Draft Statutory Guidance on Contaminated Land the approach is by identifying a hazardous source and establishing possible links between the source via exposure pathways to a potential receptor.

The hazard is a contaminant or potentially polluting substance that is in, on or under the land and which has the potential to cause harm or to cause pollution to controlled waters. The receptor is a living organism or organisms, an ecological system or piece of property, which is being harmed, interfered with or polluted by the contaminant. The pollutant linkage is by means of the pathway which is one or more routes by or through which that receptor is being, or could be, exposed to, or affected by, that contaminant. Thus the presence of a hazard on a site

does not necessarily mean that there are risks unless pathways and receptors are present and are receptive to being affected by that specific hazard or contaminant.

SOURCE *release of pollutant* **PATHWAY** *route to receptor* **RECEPTOR**
eg. oil spills eg. permeable strata eg. River

It is proposed to develop the site for residential use and the environmental risks have been assessed for this future uses.

13.2 Sources of Contamination, Pathways and Receptors

13.2.1 Sources of Contamination

Sources of contamination were identified during the Phase II investigation and are associated with the past use of the site for railway sidings, a clay pit, brickworks and a waste site. This includes arsenic and sulphate in ash from the waste destructor and for construction of rail lines, hydrocarbons from transport, and unknown contaminants in the waste. The testing undertaken is only a preliminary investigation and further assessment within garden areas are recommended once the layout and use of the site is confirmed.

13.2.2 Pathways for Migration

The potential pathways for carrying the detected contamination in air, water or through the ground were identified as the following with the considered level of risk.

1. Ingestion of and/or skin contact with contamination in the soil.
   The development is for residential use and it is anticipated that a large part of the site will be hard covered by buildings, roads and hard cover preventing ingestion/soil contact to occur. Where landscaped ground or gardens are planned then consideration needs to be given to establishing the level of any contamination in these specific areas and sealing any contamination by the use of a clay seal and clean imported topsoil where required to reduce risk of harm to humans. Alternatively any hot spots of contamination detected could be remediated.

2. Ingestion of contaminated in and uptake of contamination in plants/vegetables/animals in food chain.
   T*he site is for residential use and the landscaped ground and gardens may require sealing and the importation of clean topsoil where contamination is detected to reduce risk of harm to humans. Alternatively any hot spots of contamination could be remediated. It is unlikely that animals in the food chain will be present on the site now or in the future eliminating this pathway to humans.*

3. Ingestion of contaminated drinking water through leaching of contamination into groundwater flowing to underground aquifers/groundwater.
   The site is not in a source protection zone for potable water and no water abstractions are present within 1000m of the site. It is not expected that any contamination detected will detrimentally affect groundwater as the aquifer is minor and protected by overlying mudstone.

4. Inhalation of vapours produced by landfill/radon/hydrocarbons/organics.
   The site contains filled ground. The site lies within 250m of a landfill site which may detrimentally affect the site. It is necessary to provide radon protection in future

development. Monitoring undertaken for toxic gases indicate that precautions will need to be incorporated in design for protection.

5. Inhalation of contaminated airborne dust.
Asbestos was not detected in the soil. During construction dust should be kept o a minimum.

13.2.3 Sensitive Receptors

The potential sensitive receptors on the site, once the site is developed, are expected to include workers, possibly residents and other site users. Sensitive receptors off the site include controlled waters, abstraction wells, land and adjacent residents or site users. The risk of these receptors being detrimentally affected by the site is summarised in Table 8.

TABLE 8
Risk Assessment for Industrial or Residential Use with plant uptake

Pathways	Receptors	Risk	Probability of Risk	Risk Reduction
Inhalation of vapours, methane and carbon dioxide and radon	Existing/future occupants of the site and workmen	Methane can be explosive in air. Carbon dioxide and other vapours can be asphyxiating Radon can damage health	Site was monitored for toxic gas Radon protection required	Use of appropriate protective membranes in development
Ingestion of and/or skin contact from contaminated soil	Existing/future occupants of the site and workmen	Health defects and skin burns/disorders	Low where site is hard covered Medium if gardens are provided	Risk can be reduced where hard covered and provided soil is handled with PPE. Gardens may need sealing against contamination or hot spots remediated
Ingestion of contaminated drinking water	Local abstraction wells/drinking water	Health defects	Low no water abstractions	No abstraction to be undertaken from groundwater on site, all water to be from town supply
Transportation by surface and/or groundwater	Aquifers Old Sough	Prosecution if controlled waters are polluted	Low Becks are culverted and aquifer is partly protected by clay	None
Ingestion and uptake of contamination in plants/animals/ vegetables	Existing/future occupants of site	Health defects	Low where hard covered Medium where gardens/landscape areas are planned	Hard cover of site sealing of gardens or remediation of hot spots of contamination, clean topsoil
Inhalation of airborne dust	Existing/future occupants of the site	Health defects in lungs	Low to medium	Use PPE during construction

The assessment of the likelihood of receptors being affected detrimentally is that it is unlikely that the site is detrimentally affecting surface water due to the distance to the nearest controlled surface waters. The risk of the site affecting groundwater and water abstractions may be reduced to low as there are no water abstractions within 1000m of the site and the mudstone encountered affords some protection to groundwater.

It is considered unlikely that land adjacent to the site is being detrimentally affected by contamination on the site.

It is recommended that prior to any redevelopment of the site for residential use the level and extent of the identified contaminants are assessed to determine any areas for remediation of the ground prior to construction and to design mitigating measures such as sealing of any future gardens and gas protection.

With regard to human health, it is considered unlikely that humans outside the site are being detrimentally affected. Humans who will be working on the site, particularly in groundwork may be affected if they do not take the appropriate Health and Safety precautions. Future residents of any redevelopment for housing may be detrimentally affected by the contamination detected if garden areas are not sealed or hot spots of contamination remediated.

13.3 Risk Assessment

The risks have been assessed purely on the desk study and intrusive investigation undertaken and on the assumption that the site will in the future be for residential use with plant uptake.

The risk of humans being significantly harmed is due to the presence of gardens/vegetable plots and children who may eat plants/soil. This risk can however be reduced by the removal of any hot spots of contamination detected or by sealing contamination where detected and the use of clean topsoil.

The risks for future residential use of the site with gardens are as follows:-

1. Contamination affecting residents through soil contact or edible plant/vegetable/grass contact.
2. Contamination affecting residents through toxic gases arising from the filled ground into confined spaces.

Overall the risk to sensitive receptors is low provided the remediation and mitigating measures recommended are undertaken.

14: RECOMMENDATIONS

14.1 Environmental Recommendations

Contamination was identified through a Phase II Ground Investigation. The investigation confirmed the site to be generally free from gross contamination, with some contamination detected in the eastern and southeastern part of the site and in the central area of the site. Contamination was not detected over large areas of the site.

The site is to be developed for residential houses with gardens and the contamination detected should be removed or replaced beneath hard cover or sealed to prevent risk to future residents. A large area of the site is expected to be hard covered by roads, access roadways, pavements, driveways and house footprints and as the contamination detected is generally low risk remediation of contamination will not be required in these areas. Where contamination has been detected in proposed garden areas the soil requires sealing with a low permeability clay ($1x10^{-9}$ m/sec) and importation of uncontaminated tested topsoil. It is unlikely that remediation or mitigating measures will be required in the southwestern area of the site.

As the layout of the site is unknown specific recommendations cannot be made however these would form part of a Remediation Statement following design of the residential layout. Any remediation necessary will need to be validated by a chartered environmentalist to satisfy planners/future purchasers.

The ground was only tested in specific locations and undetected contamination could exist between investigative locations although it is considered low risk. It is recommended that personal protective equipment is worn by everyone undertaking excavation works within soil and/or groundwater on the site to safeguard health. Specialist advice should be sought if areas of unusual nature or odour are found on further excavation during the development of the site.

Special precautions are required for underground concrete foundations and services in accordance with the latest BRE Special Digest 1 recommendations and the levels of sulphate detected.

14.2 Geotechnical Recommendations

It is proposed to construct residential houses on the site. The made ground is in a very loose to loose state of compaction and is unsuitable material on which to place foundations in its present state of varying compaction without undue settlement and structural damage occurring to overlying properties. It is recommended that foundations therefore are extended below the made ground to found on the underlying mudstone where bearing pressures of 150kN/m2 can be accommodated with less than 25mm settlement. In the western and central areas of the site the made ground is generally less than 2.00m in thickness and conventional strip foundations placed 2.00m bgl on the mudstone may be used for foundations for low rise residential houses. In the eastern third of the site the made ground extends to generally 3.00m bgl and to 7.00m in the extreme eastern boundary and mini piles will be required founded in the mudstone.

Specialist Contractors will advise on the length and bearing capacity of piles depending on the size and design of their own piles. As a general rule piles should be sunk into the mudstone to a depth equal to five times the diameter of the pile. It is recommended that levels of sulphate detected are taken into account for design of concrete for piles. It is recommended that at least six piles are tested for integrity and bearing capacity.

Excavations for trenches are expected to remain stable in the short term over most of the site with the exception of the eastern and extreme southern areas of the site where the ash was very loosely compacted. Any excavations below 3.00mbgl are expected to encounter groundwater which may destabilise trench walls. All trenches below 1.20m will require support for entry by personnel.

Care should be taken not to allow rainwater to soften the clay/mudstone foundation strata before pouring concrete for foundations. Any softened material should be skimmed off before concrete foundations are constructed. It is not expected that groundwater will be encountered in

excavations to 2.00m bgl however during and after heavy rainfall it is expected that groundwater in shallow excavations could be dealt with by sump pumping.

14.3 Mining Recommendations

It is recommended that a ground investigation is undertaken to assess the possible presence of voids existing in mined ground at shallow depth beneath the site and to assess the likelihood of any voids migrating to the ground surface and causing damage to future development on the site.

15: GENERAL REMARKS

This report truly reflects the conditions found during the desk study and intrusive investigation. Whilst the desk study and intrusive investigation were undertaken in a professional manner taking due regard of additional information which became available as a result of ongoing research the results portrayed only pertain to the information attained and it is possible that other undetected information and undetected ground and gas conditions and undetected contamination and undetected mining may exist. The desk study and intrusive investigation was only undertaken within the site boundaries and should not be used for interpretation purposes elsewhere. These conclusions are only a brief summary of the report, and it is recommended that the report is read in full to ensure that all recommendations have been understood.

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