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**PROPOSED RESIDENTIAL DEVELOPMENT
GREENACRE STABLES
AKESMOOR LANE
BIDDULPH, ST8 6RT
FOR
SHAW'S & COMPANY**

JANUARY 2021

**PHASE 1 GEO-ENVIRONMENTAL DESK
STUDY REPORT**

21005/GEDS

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PHASE 1 GEO-ENVIRONMENTAL DESK STUDY REPORT

PROPOSED DEVELOPMENT, GREENACRE STABLES, AKESMOOR LANE, BIDDULPH

1.0 INTRODUCTION

1.1 Instructions

1.1.1 We are instructed by Shaw's & Company of 43 Liverpool Road, Kidsgrove, Stoke on Trent, ST7 1EA to carry out a detailed Phase I desk study at Greenacre Stables, Akesmoor lane, Biddulph to examine the geotechnical and geoenvironmental risks associated within the proposed development at the site off Akesmoor Lane.

1.2 Objectives

1.2.1 This environmental assessment has been carried out in accordance with the principal recommendations of BS10175: 2011 "Investigation of Potentially Contaminated Sites" with regard to the consideration of potential soil and groundwater contamination along with the generation and migration of toxic and explosive ground gases. It is intended that the report will be submitted to the local planning authority as a preliminary risk assessment in support of a planning application. This report has been prepared to document the following:-

- Review of readily available published data which could provide information on the current status, ground conditions and site history;
- Findings of a preliminary contaminated land risk assessment;
- Findings of a preliminary geo-technical risk assessment;

1.3 Sources of Information

1.3.1 This report has been prepared using information from the following sources:-

- Groundsure Enviro+Geo Insight report dated 18th January 2021;
- Groundsure historic Ordnance Survey maps;
- Environment Agency information.
- CON29M Coal Mining Report dated 28th December 2020.

1.4 Development Proposals

1.4.1 At the time of preparation of this report we have been provided with a proposed site/block plan (drawing number: 191103(SK)006) for the proposed redevelopment at the site off Akesmoor Lane. The proposed layout shows the demolition of stable buildings and redeveloped into a single residential property with associated road access, parking areas and garden.

1.4.2 It is acknowledged that the development proposals for this site are likely to be amended as a result of local planning requirements. It is however anticipated that the current proposals will be representative of the final development approval. However, if the final development proposals are radically different from the current proposals, then recommendations made within this report may become inappropriate.

1.5 Limitations of Report

- 1.5.1 This report is a desk study report which has been prepared using readily available information in accordance with the project stage requirements, budget and timescales. The opinions expressed in this report and the comments and recommendations given are based upon the information obtained from the desk assessment and an initial site reconnaissance. At this stage intrusive investigations have yet to be undertaken at site to establish actual ground and groundwater conditions and provide data for assessment of the environmental status of the site.
- 1.5.2 The information, views and conclusions drawn concerning the site are based in part on information supplied to Robert E Fry & Associates Ltd (REFA) by other parties. REFA has proceeded in good faith on the assumption that this information is accurate. REFA accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied to REFA from others.
- 1.5.3 The copyright of this report (including its electronic form) shall remain vested in (REFA) but the client shall have a license to copy and use the document for the purpose for which it was provided. REFA shall not be liable for the use by any persons of the document for any purpose other than that for which the same was provided by REFA. This document shall not be reproduced in whole or in part or relied upon by third parties for any use whatsoever without the express written authority of REFA.

2.0 THE SITE

2.1 Location

- 2.1.1 The site is irregular in shape and is located to the south east of Akesmoor Lane, Biddulph, approximately 0.5km west of Biddulph town centre. The site extends to an area of approximately 0.45 hectares and the centre of the site is situated at National Grid Reference 387721 357908 within a rural area. Its location is shown in figure 1.

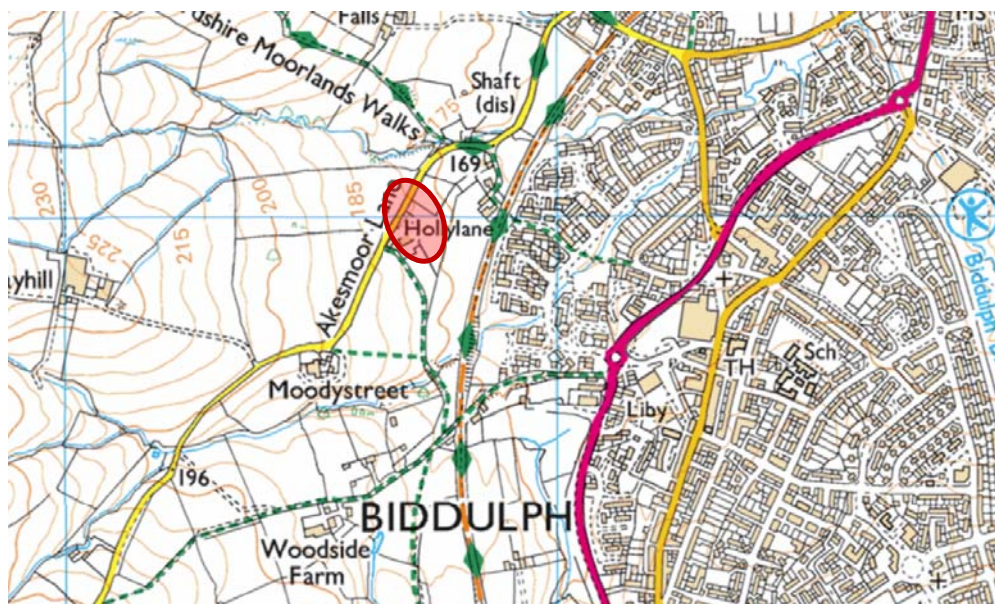


Figure 1 Site Location

2.2 Boundaries

- 2.2.1 *The eastern, western and southern boundaries are formed by agricultural farmland, whilst the northern boundary leads onto a small yard area with small outbuildings.*

2.3 Access

- 2.3.1 *The site can be accessed via a narrow lane directly off Akesmoor Lane towards the east. The proposed redevelopment of the site will not change the access point from its current location.*

2.4 Topography

- 2.4.1 *The general topography of the site is relatively flat and therefore, the topography of the site is not considered to pose a significant constraint on the proposed development.*

2.5 Trees

- 2.5.1 *Abundant vegetation is located along all boundaries with the menage becoming overgrown with vegetation. There will be the requirement for an arboriculturist report prior to any further works.*

3.0 DESK STUDY

- 3.0.1 *As part of our environmental desk studies we have commissioned an Enviro+Geo Insight report by Groundsure which gives details of all recorded environmental and geological features relating to the site and its immediately surrounding area. We have also obtained copies of all available old Ordnance Survey maps for the area and these also give historical guidance regarding the former usage of the site area and its immediate vicinity.*

3.1 Historical Industrial Sites

- 3.1.1 *The Enviro-Insight report has identified one hundred and seventy-seven (177 No.) records of potentially contaminative past land uses within 500m of the search boundary. The first six records are situated within the site and related to a former colliery and unspecified heaps. The former colliery may indicate the potential for colliery waste to be present below the site. An old coal shaft (28m north west) and unspecified shafts are recorded between 46m and 67m south west further indicating that the site is located in a coal mining area. Numerous refuse heaps and unspecified heaps are recorded within 250m of the site and therefore pose potential sources of ground gas.*
- 3.1.2 *The environmental report has identified one (1 No.) unspecified tank within 500m of the site boundary. The tank is located 233m east of the site, recorded on the 1899 map and is considered to be located at a sufficient distance from the site as to not pose a potential source of contamination.*
- 3.1.3 *The environmental report has identified eleven (11 No.) records of historical energy features, located within 500m of the site boundary, with all records relating to electricity substations. The closest of the substations is located 241m east of the site boundary, recorded as being present on the 1993 map. Due to the distance of the substation from the site, it is believed not to pose a potential source of PCB contamination to the study site.*

- 3.1.4 *The Enviro-Insight report has not identified any historical petrol or fuel sites within 500m of the study site.*
- 3.1.5 *The environmental report has identified three (3 No.) records of historical garages, located between 406m and 455m of the site. Due to the distances from site, the garages are not considered to pose offsite sources of contamination.*

3.2 Environmental Permits & Incidents

- 3.2.1 *The environmental report has not identified any licensed industrial activities (Part A (1)), within 500m of the site boundary.*
- 3.2.2 *The Enviro-Insight report has identified one (1 No.) record of licensed pollutant release, Part A (2)/B within 500m of the site boundary. The record is in relation to Sainsburys Petrol Station, located 403m east. Due to the distance of the Petrol Station from the site boundary, it is not anticipated to pose a potential contamination risk.*
- 3.2.3 *The environmental report has identified five (5 No.) pollution incidents within 500m of the site. The closest pollution incident was located 220m south east and involved oils and fuels as a pollutant on the 15th October 2001. There was a recorded minor impact to water and land and no impact to the air. The next two incidents are located 225m east, occurred on the 23rd September 2020 with an inert materials and waste pollutant. There was a category 2 significant impact to land and no impact to water and air. Due to the distance of all records from the site, they are not expected to pose a contamination risk.*

3.3 Landfill Sites

- 3.3.1 *The Enviro-Insight report has not identified any active or recent landfills within 500m of the site boundary. There are also no BGS recorded historical landfills or Local Authority recorded landfills within 500m of the site and therefore are no potential off-site sources of ground gases.*
- 3.3.2 *The report has identified two (2 No.) historical landfills (EA/NRW records) within 500m. These records are known historical but closed landfill sites and sites that existed before the waste licensing regime or has had the license revoked, ceased to exist or surrounding and a certification of completion has been issues. The first record is for Moody Street Farm, 198m south west. No further information has been provided with regards to waste type, first and last records and also the date of licence surrender. The second record is for a site near a dismantled railway, Biddulph, 236m south. Equally, no further information has been provided. Due to their distance from the development and the surrounding impermeable geology (glacial till) they are believed not to pose a risk of contamination or hazardous ground gas.*
- 3.3.3 *The environmental report has identified one (1 No.) waste exemption within 500m of the site. These sites include activities that involve the storage, treatment, use or disposal of waste that are exempt from needing a permit. The location of the waste exemption is 219m south west at Moody Street Farm, Akesmoor Lane for the disposing of waste, on a farm by burning in the open. Again, this record is not considered to pose a potential source of ground gas based upon its distance from the site and due to the surrounding impermeable geology.*

3.4 Current Land Uses

- 3.4.1 *The environmental report has identified two (2 No.) records of current potentially contaminative industrial sites within 250m of the site boundary. The first record relates to a depot, including the storage for transport, storage and delivery, located 223m south east. The second record is for an electricity substation, 2149m east. Due to the distance of both records from the site, they are not believed to be a source of contamination towards the development.*
- 3.4.2 *The report has not identified any petrol stations open, closed, under development or obsolete within 500m of the site boundary.*
- 3.4.3 *The Enviro-Insight report has not identified any National Grid high voltage transmission cables or National Grid high pressure gas transmission pipelines within 500m of the study site.*

3.5 Hydrogeology & Hydrology

- 3.5.1 *The Enviro-Insight report has identified that the underlying superficial deposits are designated as a Secondary Undifferentiated aquifer, where it is not possible to categorise A or B to the deposits. Generally, these layers have both minor and non-aquifer characteristics within different localities.*
- 3.5.2 *The underlying bedrock within the site is designated as Secondary A aquifer comprising permeable layers capable of supporting water supplies at a local scale, generally classified as a minor aquifer. The overlying impermeable aquifer provides protection to the underlying bedrock aquifer.*
- 3.5.3 *The environmental report has identified thirty-nine (39 No.) groundwater abstraction licences within 2,000m of the study site. The closest licence, located 842m west, is an historical licence for general use relating to Secondary Category (Medium Loss). No licence expiry date has been provided. It is considered that the development of the site is not considered to pose a risk to potential abstraction wells.*
- 3.5.4 *The environmental report has not identified any surface water abstraction licenses within 2,000m of the site.*
- 3.5.5 *The environmental report has confirmed that the site is not located within 500m of a source protection zone within confined aquifers.*
- 3.5.6 *The Enviro-Insight report has provided Environment Agency information on the groundwater vulnerability and soil leaching potential within the study site. This information classifies soil types within the site as having a low leaching class potential with a soil vulnerability category of low. These areas provide the greatest protection from pollution. They are likely to be characterised by low leaching with low permeability within the superficial deposits. The bedrock is classified as having a medium vulnerability with a flow mechanism of well connected fractures.*
- 3.5.7 *The environmental report has identified the presence of one (1 No.) Water Framework Directive (WFD) surface water body catchments on site. These lead to the protection of inland surface waters and groundwater through river basin-level management planning. The WFD is related to Biddulph Brook with an operation catching of Dane and management catchment relating to the Weaver Gow. The development of the site is not considered to pose a risk to these catchments.*

- 3.5.8 *The Enviro-Insight report has identified one (1 No.) WFD surface water body, located 122m south east relating to the Biddulph Brook. The brook has a good chemical rating and moderate ecological rating, thus giving the brook an overall moderate rating.*
- 3.5.9 *The environmental report has identified one (1 No.) WFD ground water body within the site, relating to the Manchester and Easter Cheshire Carboniferous Aquifers. The groundwater body has a good quantitative rating but poor chemical rating. The overall rating for the water body is poor.*

3.6 Flooding

- 3.6.1 *The Enviro-Insight report has confirmed that the site does not lie within an area at risk from flooding from rivers and seas or rivers and coastal flooding.*
- 3.6.2 *The Ambiantal Risk Analytics surface water FloodMap identifies areas likely to flood as a result of extreme rainfall events. The map shows the highest risk onsite and within 50m of the site to be negligible. BGS have identified that the site and within 50m of the site to be at low risk from groundwater flooding.*

3.7 Environmentally Sensitive Sites

- 3.7.1 *The environmental report has identified that the site is located within an area of greenbelt land in association with the Staffordshire Moorlands and therefore the local authority should be consulted in relation to potential constraints associated with green belt land.*
- 3.7.2 *The report indicates that the site lies within nitrate vulnerable zones relating to the River Weaver (Dane to Frodsham) (Surface Water). The development of the site is considered to have a positive impact on the site and reduce the number of nitrates into the surrounding river networks.*
- 3.7.3 *The site is located within a SSSI Impact Risk Zone and therefore an initial assessment of the potential risks to the SSSI are needed relating to the development proposals. The zones around each SSSI reflect particular sensitivities of the features for which could have potentially adverse impacts.*
- 3.7.4 *The agricultural land classification is used to assess the quality of agricultural land taking into consideration multiple factors including climate, physical geography and soil properties. The site is classified as Grade 4, meaning the land is of poor quality with severe limitations, limiting the range of crops and level of yields.*

3.8 Geology

- 3.8.1 *The superficial deposits located within and surrounding the site are likely to compose of till deposits, comprising clay with minor sand and gravel units. These deposits are expected to have a low to high permeability with a mixed flow type.*
- 3.8.2 *The solid geology below the site comprises of the Pennine Lower Coal Measures Formation, consisting of alternative mudstone, siltstone, sandstone and coal. The underlying bedrock is considered to have a low to moderate permeability with a fracture flow type.*
- 3.8.3 *The geological report has identified thirty-six (36 No.) geological faults and linear features within 500m of the site boundary. An inferred fault is believed to run through the site, including an inferred coal seam. The Coal Authority believes there may be coal*

at or close to the surface and therefore investigation is required to fully understand its location and depth below the site as it may cause adverse effects on the development of the site if left untreated.

- 3.8.4 The geological report does not record the site to be underlain by artificial deposits but its anticipated that made ground deposits will be present across the site.*
- 3.8.5 The geological report identifies that the study area is not within a radon affected area as less than 1% of properties are above the action level. No radon protective measures are required.*
- 3.8.6 The geological report indicates that there is a 'very low' hazard rating for natural ground subsidence including shrink swell clays, running sands, collapsible deposits and landslides. Compressible deposits and ground dissolution of soluble rocks are recorded as being negligible within 50m of the site boundary.*

3.9 Ground Workings

- 3.9.1 The report has identified thirty (30 No.) British Pits within 500m of the site. These relate to active, closed surface and underground mineral workings, including details of major mineral handling sites such as wharfs and rail deposits. The closest record is 33m north west at Bradley Green Colliery, No. 9 pit. No. 10 Pit was located 61m south west and both consisted of wholly underground mining and access gained by a shaft, adit or drift.*
- 3.9.2 The geological report has identified seventy-five (75 No.) surface ground workings within 250m of the site boundary. The first seven records are within the site and relate to an old colliery and unspecified heaps. Unspecified ground workings and unspecified heaps make up the next six records, all within 1m north west of the site. The presence of such ground workings increase the risk of toxic ground gas production, however, the development of the site will not consist of closed buildings and structures and therefore the risk is reduced.*
- 3.9.3 The geological report has identified ninety-seven (97 No.) records of underground workings within 1,000m of the site boundary. Four record are within the site relating to a colliery and old colliery. An old mine shaft is located 28m north west with other unspecified shafts and collieries from this point. The presence of these records within the site may pose a risk to the development and therefore investigation into these areas is required with a risk of contaminated ground being present.*

3.10 Mining & Ground Stability

- 3.10.1 The site is located within a coal mining area as defined by the Coal Authority. REFA have already produced a Coal Mining Risk Assessment (report reference: MD/CMRA/21005). The assessment has identified a mine entry (reference: 387357-008) located within 20m of the site boundary and no further information could be provided in relation to its depth, dimensions and treatments. It is therefore plausible to assume that the mine entry has not undergone any remedial treatment. It is also considered likely that the site is underlain by the Magpie Coal and Holly Lane Coal and as such, the presence of shallow coal mine workings below the development area of the site is considered to represent a high risk and intrusive investigations are considered essential.*
- 3.10.2 Due to the potential presence of shallow coal mine workings its anticipated that they may pose a potential source of ground gasses.*

3.11 BGS Boreholes

3.11.1 The geological report has shown there to be one (1 No.) BGS borehole records within 250m of the study site boundary. The closest borehole with available data is located 127m south of the site and recorded the Magpie Coal Measures from ground level to 1.5m bgl. The Holly Lane Coal Measures was seen to be underlying to a depth of 14.6m bgl.

3.12 Background Soil Chemistry

3.12.1 The Geo-Insight report includes and estimated geometric mean soil concentration for various elements. Assessment of this information suggests that all the determinants are at concentrations below the current tier 1 assessment criteria.

3.13 Railways and Tunnels

3.13.1 The Groundsure report has identified eighteen (18 No.) historical railways and tunnel features within 250m of the site boundary. Railways sidings are recorded within the site and 3m south west. All other record from 63m east relate to railway sidings also.

3.13.2 The Groundsure report has identified the presence of an historical abandoned railway located 86m to the east.

3.14 Site History

3.14.1 Table 1: Review of Historical Maps & Aerial Photographs

Date	Site	Adjoining Land
1878 - 1880	The majority of the site is greenfield area although its noted that a colliery encroaches into the site to the north.	A 'Old Shaft (Coal)' is located approximately 20m to the north. A railway runs along the western boundary on the site from the colliery to the Biddulph Valley Branch Railway. Further Collieries and shafts are present within the local area. The larger area is predominantly agricultural land with Moody Street Farm located 280m south west and Holly Lane located 250m north east.
1889	No significant changes.	No significant changes.
1897 - 1900	The colliery encroaching onto the site is now recorded as 'Old Colliery'.	The old shaft is no longer recorded on the maps and the railway along the western border has been dismantled.
1909	No significant changes.	No significant changes.
1911 - 1913	No significant changes.	No significant changes.
1922 - 1925	Groundworks associated with the colliery are still present just against the northern boundary although it is no longer noted as a colliery.	The shafts surrounding the site are no longer visible on the maps and have become areas of mixed woodland. The colliery (south east) is no longer recorded as a colliery but noted as rough ground.
1947	No significant changes.	No significant changes.
1950	No significant changes.	Increased residential development to the north east.
1953 - 1955	No significant changes.	A localised area of groundworks are shown approximately 20m north west in the location of the former shaft.
1967	No significant changes.	East Ballbrook Colliery is no longer labelled on the maps. Large expansion of Biddulph including schools, housing and industrial developments.

1974 - 1977	No significant changes.	Biddulph Valley Branch Railway has been dismantled.
1985 - 1989	No significant changes.	No significant changes.
1991 - 1993	No significant changes.	A building has been erected on the northern boundary of the site. All previous groundworks associated with the colliery are no longer shown.
2000	An access road has been constructed off Akesmoor Lane into the site and two small buildings constructed within the northern portion of the site.	Three buildings of varying sizes have been constructed within the land directly north of the site, including an area of hard standing. Access is gained of Akesmoor Lane.
2001 - 2003	No significant changes.	No significant changes.
2006	A menage is located within the northern area of the site.	No significant changes.
2010 - 2011	No significant changes	No significant changes.
2017 - 2018	The menage has become over grown.	No significant changes.
2021	No significant changes.	No significant changes.

3.14.2 Careful appraisal of all available historical information has shown that a colliery encroached onto the site and the groundworks remained up until the early 90's. A localised area of groundworks has been recorded in the locality of the former shaft which may indicate some kind of informal treatment of the shaft. The surrounding land included numerous shafts and a mineral railway running along the western boundary. The site was developed into a riding menage and stables during the early 90's and remained in similar configuration up to present day. The presence of coal mining and associated infrastructure within the site and in close proximity to the development area increases the possibility for ground contamination and hazardous ground gases.

4.0 **REVIEW OF GEO-ENVIRONMENTAL RISK**

4.1 **Introduction**

- 4.1.1 This element of the report is aimed at identifying possible risks, if any, arising from substances used or deposited on site or from other sources of land contamination. Both past and current potentially contaminative land uses have been considered.
- 4.1.2 The risk assessment utilises a source-pathway-receptor methodology for assessing whether a source of contamination could potentially lead to harmful consequences. This requires that there be a pollutant linkage from source to receptor for harm to be caused. The source-pathway-receptor methodology relationship allows an assessment of the environmental risk to be determined based upon the nature of the source, the degree of exposure of the receptor of the source and the sensitivity of the receptor.

Table 2: Statutory Receptors & Pathways

Target (Receptor)	Potential Source – Pathway Linkage
Site Users / Residents	Inhalation of soil gas, odours or dust. Ingestion of, and skin contact with, contaminated soil. Ingestion of contaminants in vegetables etc. or in soils adhering to vegetable etc.
Construction / Maintenance Workers	Inhalation of soil gas, odours or dust. Ingestion of, and skin contact with contaminated soil.
Plants	Adverse effects on growth caused by presence of contaminants in soil.
Buildings & Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion & fire hazards. Sulphate attack of foundations. Hydrocarbons penetration plastic water supply pipes.

Groundwater	Migration of soluble contaminants into groundwater on/off site. Migration of oils into groundwater on/off site.
Surface water	Migration of soluble contaminants and/or direct run off of contaminants. Migration of oils into groundwater on/off site.

4.1.3 A conceptual model of plausible pollutant linkages has been formulated for the site in accordance with the risk assessment approach applied to contaminated land assessment.

4.2 Potential Sources of Contamination

4.2.1 The desk study information has indicated that the majority of site has remained as greenfield land although colliery works have encroached onto the site in the northern area of the site. The site was later redeveloped to contain two buildings of unknown usage and a menage. The current areal imagery shows the menage to have become disused. The surrounding land has also recorded mining activity and associated infrastructure within a predominantly agricultural setting.

4.2.2 The likelihood of widespread soil contamination is expected to be moderate. The site has undergone various phases of development and therefore increase the potential for made ground and potential contaminants.

4.2.3 Potential sources of contamination could be limited to the following:-

- Naturally occurring elevated concentrations of contaminants within the topsoil and natural strata;
- Potential contaminants associated with made ground deposits within the site;
- Potential contaminants associated with the former land usage as a colliery;
- Potential migrating ground gases generated from groundworks, shafts and shallow mine workings

4.3 Pathway for Migration

4.3.1 It is recognised that the migration pathways could change during the development of the site. These pathways are summarised below:-

- Migration of contamination (if present) via the un/saturated zones;
- Migration of contamination (if present) via buried services and foundations;
- Run-off from adjacent site areas;
- Migration of ground gas via soil pores;
- Direct contact with contaminated materials.

4.3.2 This list recognises that it is plausible that there are pathways associated with the presence of both on-site and off-site contamination. The above list recognises that the new development may not affect certain migration pathways such as migration in the saturated zone from an offsite source but could create new pathways such as the presence of services and foundations.

4.3.3 It is anticipated that, if a potential risk is identified, it can be reduced to an acceptable level by using a combination of mitigation measures during construction and in the building design. Site workers may be exposed to bare ground and existing building fabrics when clearing and redeveloping this site. Precautions should be taken to reduce the risks associated with these pathways including the adoption of personnel protective equipment (PPE), being rigorous in matters of personnel hygiene and adopting safe

practices for workers entering enclosed underground cavities. Environmental management practices should be implemented to prevent potential impact associated with dust generation and dispersion and surface water run-off for example.

4.4 Potential Receptors

4.4.1 The principal receptors are considered to be as follows:-

- Humans – future site users;
- Humans – construction and maintenance workers;
- Controlled waters;
- Building structures and services.

4.5 Assessment of Plausible Pollutant Linkages

4.5.1 The overall risk associated with future site users is considered to be moderate / low.

4.5.2 The risk of contamination is considered to be moderate / low at this site, though nevertheless site workers should adopt a precautionary approach in respect of potential land contamination. On the basis of the current assessment and recommendations the overall risk to site workers is considered to be low.

4.5.3 The overall risk associated with the water environment is considered to be low. The presence of layered drift deposits with a low permeability overlying a Secondary A aquifer suggests a low potential risk to groundwater.

4.5.4 Substances that may be involved in chemical attack upon building materials, structures and services may be present in the ground and there is the potential for ground gas to migrate through permeable deposits and accumulate in enclosed spaces. Currently the overall risk associated with this category of hazard is considered to be low. The proposed development will contain no enclosed spacing and therefore reducing the risk of toxic ground gases accumulating. The building's design and the materials used in its construction should be compliant with

4.5.5 Careful assessment of all currently available information has enabled a preliminary conceptual model to be prepared and this is detailed in table 3 below:

Table 3: Preliminary Conceptual Model

Potential Source	Potential Receptor	Possible Pathway	Probability	Consequence	Risk	Mitigation / Investigation
Contaminated Soils	Site personnel during construction	Direct contact of soils Inhalation or ingestion of soil / dust	Lw	Mi	Low	Soil sampling during intrusive investigations. Laboratory analysis of samples
	Future site users	Direct contact of soils Inhalation or ingestion of soil / dust	Lw	Md	Moderate/ Low	
	Surface water in the vicinity of the site	Leaching of contaminants through drainage system	UI	Md	Low	
	Ground water in aquifer	Leaching of contaminants to ground water	UI	Md	Low	
	Future site users	Vapour migration from soils	UI	Mr	Very Low	

Potential Source	Potential Receptor	Possible Pathway	Probability	Consequence	Risk	Mitigation / Investigation
	Proposed buildings and services	Direct contact with contaminated soils	UI	Mi	Very Low	
	Plants in gardens and soft landscaping	Direct contact	Lw	Mi	Low	
Contaminated ground water	Site personnel during construction	Water entering excavations	UI	Mi	Very Low	Sampling of ground water (where encountered)
	Future site Users	Retained surface water	UI	Mi	Very Low	
Toxic and explosive gasses	Proposed buildings and occupiers	Ground gas migration into buildings	Li	Md	Moderate	Program of ground gas monitoring required
Radon Gases	Proposed buildings and occupiers	Ground gas migration into buildings	UI	Md	Low	Site is located in an area where less than 1% of properties are affected by radon gas.
Key: Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor Hi = High, Li = Likely, Lw = Low Likelihood, UI = Unlikely						

4.5.6 In this qualitative risk assessment a low to moderate risk implies that remedial action may be required at the site, although until a full intrusive investigation is carried out, this cannot be positively confirmed.

5.0 PRELIMINARY GEOTECHNICAL ASSESSMENT

5.1 Details of The Site

5.1.1 The site currently comprises of an access road off Akesmoor Lane, leading to a disused menage, outbuildings and a grazing field. It is anticipated that minor areas of made ground may be present overlying natural superficial deposits as a result of the various usages within the site. Deeper deposits of made ground may be present in the northern area of the site where the former colliery encroached onto the site.

5.1.2 It is likely that the development of the site will require the following stages:-

- Construction of permeable tarmac driveway;
- Construction of drainage;
- Preparation of hard standing areas;
- Assessment of coal mining features;

5.2 Geotechnical Hazards & Foundation Considerations

5.2.1 Based upon the information available to this desk study the anticipated ground conditions present within this site are outlined in table 4 below:-

Table 4: Anticipated Ground Conditions

Ground Material	Anticipated Condition
Made Ground	Anticipated to be present within the developed areas of the site and in the locality of the former colliery groundworks.
Till Deposits	Deposits comprising of firm to stiff clay with potential minor granular units
Bedrock	Pennine Lower Coal Measures Formation, comprising of mudstone sandstone, siltstone and coal units.
Groundwater	Natural groundwater is expected to lie at depth within the bedrock. Excavations and low lying areas are likely to be subject to surface water retention due to the possible low permeability of soils.

It will be essential for intrusive ground investigation works to be undertaken to confirm that the anticipated ground conditions are an accurate appraisal of the true ground conditions.

5.2.2 A summary of potential geo-technical hazards is detailed within table 5 below:-

Table 5: Summary of Potential Geotechnical Hazards

Hazard Category (excluding contamination issues)	Hazard Status	Engineering Considerations
Highly compressible / low bearing capacity soils (soft clays)	Unlikely	Till deposits comprising clays, silts, sands and gravels. Historical borehole records indicate firm to stiff clay deposits.
Ground subject to or at risk of landslides	Unlikely	Minor topography change
High ground water table	Unlikely	- Secondary undifferentiated aquifer in superficial deposits - Secondary A aquifer in bedrock
Surface water retention	Likely	Low permeability superficial deposits
Surface water run off	Likely	Low permeability superficial deposits
Mining	Likely	Coal Authority Report indicates a disused mine entry within 20m of the site boundary and shallow mine workings underlying the site. Intrusive investigation is required.
Volume change potential of soils	Possible	Cohesive superficial deposits
Adverse ground chemistry	Likely	Made ground deposits
Live services	Likely	Current infrastructure on site, comprising of four buildings.

5.2.3 It is anticipated that the ground conditions present within this site will consist of firm to stiff clays with varying gravel content and localised pockets of made ground.

5.3 Drainage

5.3.1 *The geological information relating to this site suggests that the superficial strata is likely to consist of low permeability till deposits. Based upon the currently available information it is considered that the ground conditions present within the site are not conducive to the adoption of ground infiltration method of surface water disposal.*

6.0 PROPOSED GROUND INVESTIGATIONS

6.1 Ground Investigation

6.1.1 *By undertaking an intrusive ground investigation an assessment of the ground and groundwater profiles may be carried out and the geo-technical and geo-environmental risks associated with this site identified. The investigation will allow a quantitative assessment as to whether any of the potential risks identified in this study are present and are of material concern to the proposed development. The works should be undertaken in accordance with the recommendations laid down in BS 10175 : 2011 "Investigation of Potentially Contaminated Sites".*

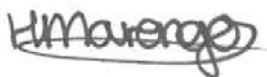
6.2 Proposed Scope of Ground Investigations

6.2.1 *On the basis of the currently available information regarding the geo-environmental setting of the site and to confirm the assumptions made, an intrusive ground investigation should be carried out. This should be utilised to confirm the geological succession and engineering properties of the sub surface materials. The scope of works for the ground investigation should comprise of the following:*

- *Program of ground investigations to identify the strata sequence and assess engineering properties;*
- *Sampling of the existing strata for chemical and civil engineering laboratory test purposes;*
- *Program of chemical analyses upon representative samples of the strata to determine their suitability for reuse within a commercial/industrial environment;*
- *Full program of ground gas monitoring due to infilled features, shafts and shallow mine workings;*
- *Reinstatement;*
- *Intrusive investigations to identify the presence of any shallow coal mining activities as recorded by the Coal Authority;*
- *Preparation of factual and interpretative report.*

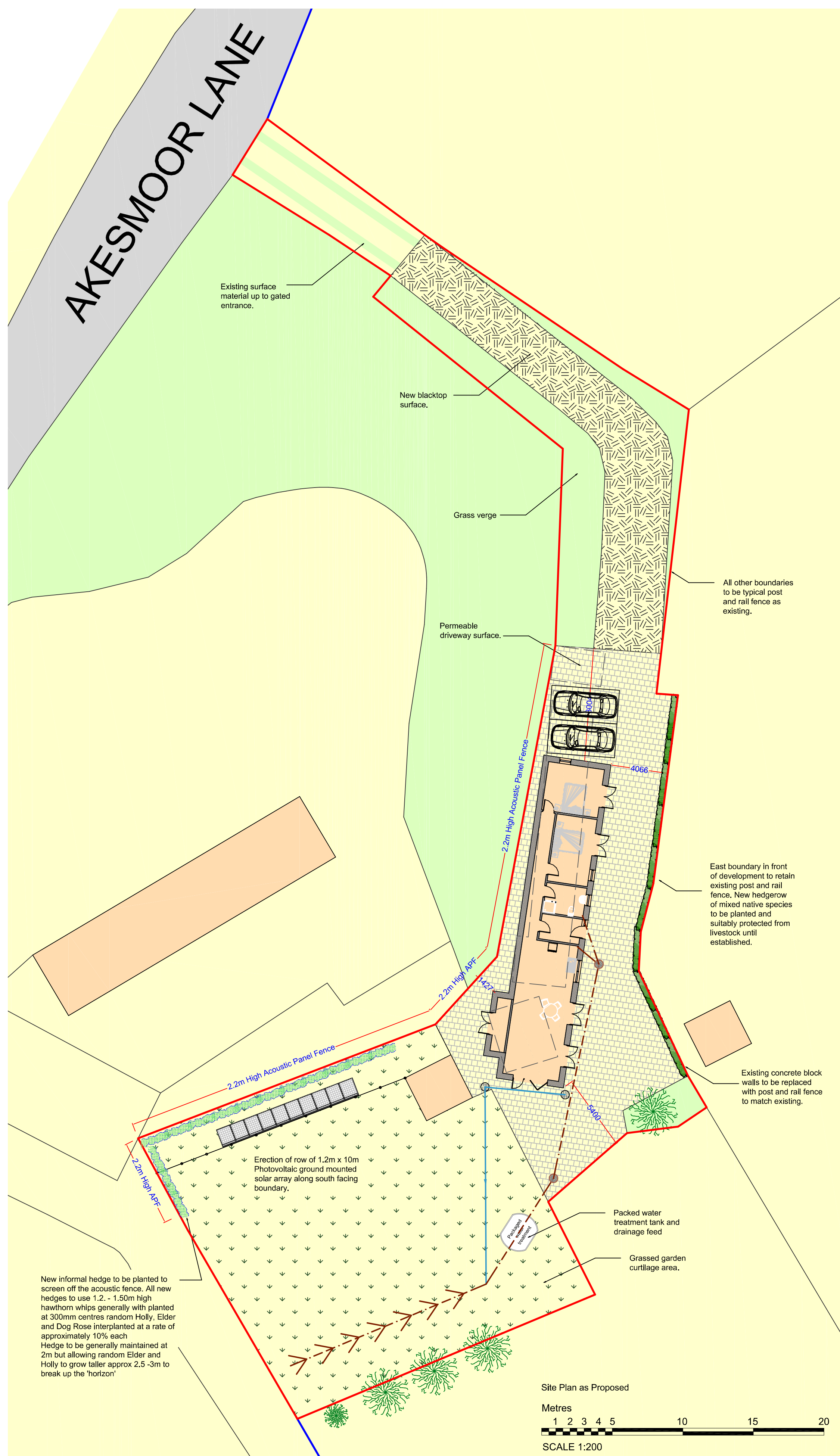
6.2.2 *These ground investigation proposals are intended to represent a preliminary assessment only and it is important that where unusual or suspicious ground conditions are identified, the design of the intrusive investigations should be amended to assess these areas.*

Signed for and on behalf of
R E FRY & ASSOCIATES LIMITED



Hollie Marengo B.Sc. (Hons), MSc
R E FRY & ASSOCIATES LTD

APPENDIX A



APPENDIX B