

LCRM: Stage 1 Risk Assessment

**LONGFIELD HOUSE, THURGOLAND HALL FOLD,
THURGOLAND**

Project Ref: GUK-0826-03

For: Mr G. Eaton

CLIENT:

Mr G. Eaton

PROJECT:

Residential Development

SITE REFERENCE:

**Longfield House
Thurgoland Hall Fold
Thurgoland
South Yorkshire**

REPORT REFERENCE:

GUK-0826-03/Rp-002



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EXECUTIVE SUMMARY

This summary presents the salient points of the Report but should not be referred to in isolation of the body text. There will be other information contained within the Report which puts into context the findings of the Executive Summary. No reliance should therefore be placed on the Executive Summary until the Report has been read in full. The recommendations given are considered reasonable based on available information and the assessment of the Site as carried out by Groundsmiths (UK) Ltd at this time.

1 ENVIRONMENTAL CONSTRAINTS

Ground Investigation: A programme of intrusive ground investigation is required to establish the environmental condition of the underlying soils. Whilst the historic use of the Site indicates a generally low contamination potential, uncertainty remains regarding the possible presence and environmental quality of made ground, opencast backfill, and/or other disturbed materials beneath part of the Site.

Ground Gases: Potential sources of ground gas are associated principally with the Site's mining legacy, including recorded and potentially unrecorded shallow mine workings, former opencast activity, and associated disturbed and/or backfilled ground. The Site-specific ground gas regime should be established through a minimum of 6 No. bi-weekly monitoring visits. Allowance for protection measures consistent with BS8485 Characteristic Situation 2, or potentially greater protection, should be made until the Site-specific ground gas regime has been confirmed.

Radon: Available information indicates that the Site lies within an area where <1% of properties are estimated to exceed the UK radon Action Level. Radon protective measures are not indicated as being required in accordance with BRE Report BR 211. No further assessment is considered necessary, subject to confirmation of the applicable requirements by Building Control.

General Soil Contamination: No significant sources of contamination have been identified from the historic use of the Site and the overall preliminary contamination risk is considered to be Low. The principal uncertainty relates to the possible presence of made ground, opencast backfill, and/or other disturbed materials of presently unknown composition and environmental quality. Representative environmental testing should therefore be undertaken as part of the intrusive ground investigation.

Asbestos: No specific source of asbestos has been identified from the historic use of the Site and asbestos is not considered to represent a potential contaminant of concern. Asbestos screening is nevertheless routinely included within the standard soil analytical suite undertaken as part of ground investigation.

Remediation Requirements: Soil remediation is not presently anticipated but cannot be determined until the intrusive investigation and laboratory testing have been completed. Should unacceptable contamination risks be identified, remediation should be undertaken in accordance with LCRM, relevant YALPAG guidance, and any Site-specific requirements of the LPA.

Risk to Construction Workers: Appropriate health and safety assessments should be undertaken for the proposed construction works, having regard to the ground conditions and any contamination identified through investigation. Suitable precautions should be adopted to control exposure to soil, dust, vapours, gases, and other potential hazards as appropriate.

Controlled Waters Receptors: A very low risk is anticipated in relation to the potential for any mobile contaminants to enter controlled waters receptors, based on the Site's contaminative potential and underlying geology. No further assessment is considered necessary at this time.

Invasive Plant Species: Risk from invasive plant species has not been identified, although all specialist assessments should be completed as required.

2 GEOTECHNICAL & GENERAL DEVELOPMENT CONSTRAINTS

Ground Investigation: Intrusive geotechnical investigation is required to establish the presence, nature, thickness, and lateral extent of any made ground, opencast backfill and/or disturbed materials, together with the depth, nature, strength, and engineering characteristics of the underlying natural strata. Appropriate in-situ

and laboratory testing should be undertaken to provide the parameters required for subsequent foundation design.

Natural Ground Subsidence: Most natural ground subsidence hazards are indicated to be negligible to very low. A Moderate risk from compressible deposits is, however, identified across the northern part of the Site, and the potential for compressible and variable ground conditions should be investigated and taken into account during foundation design.

Buried Concrete: The Design Sulphate Class and Aggressive Chemical Environment for Concrete Classification should be established through representative laboratory testing, with the appropriate concrete specification subsequently determined in accordance with current guidance.

Anticipated Foundations & Ground Floor: Where investigation confirms suitable undisturbed natural ground beneath the proposed dwelling, with no mining-related instability, opencast backfill, or other geotechnical constraints that would preclude their use, reinforced spread foundations founded at appropriate shallow depth are anticipated to provide a suitable foundation solution. Where unsuitable or disturbed ground is present, alternative foundation and/or ground improvement measures may be required. A suspended ground floor construction is anticipated, with the final arrangement also incorporating any ground gas protection measures subsequently identified as necessary.

General Ground Stability: No significant landslide or general slope stability constraint is presently anticipated. Local excavation instability may nevertheless occur within made ground, opencast backfill, disturbed ground, and weathered natural strata, and appropriate temporary support and safe excavation practices should be adopted where required.

Heave Precautions: Where foundations are constructed within cohesive soils and within the influencing distance of existing, removed, or proposed trees, appropriate heave precautions should be determined having regard to the results of geotechnical testing and current guidance.

Excavation Obstructions: Below-ground obstructions associated with the existing outbuilding and hardstanding, former opencast activity, and/or shallow competent bedrock may be encountered. Appropriate excavation or breaking plant should be allowed for where necessary.

Potable Water Supplies: An existing potable water supply serves the current outbuilding; however, its age, specification, route, and suitability for continued use as part of the proposed residential development are not presently known. Its suitability for retention should be confirmed with the statutory water provider. Where new or replacement pipework is required, its specification should be determined having regard to the ground conditions and contaminant concentrations established, current UKWIR guidance, and the requirements of the statutory water provider.

Surface Water Drainage: The drainage solution is presently unknown and should be developed by a suitably competent drainage engineer. Where infiltration drainage is proposed, its feasibility should be established through appropriate investigation and, where required, infiltration testing undertaken in accordance with BRE365. The design should have regard to the ground conditions, groundwater regime, foundations, Site boundaries, adjacent watercourse, and any mining or opencast constraints identified.

Pavement: No specific pavement design assessment is considered necessary at this stage, having regard to the anticipated gravelled access and parking arrangements. Any areas requiring engineered construction should be designed having regard to the near-surface ground conditions established during investigation.

Archaeology: The potential for below-ground archaeology has not been identified within the remit of this assessment.

3 MINING LEGACY CONSTRAINTS

Mining legacy risks have been assessed separately within the accompanying Coal Mining Risk Assessment, which should be read in conjunction with this Report.

The Site is affected by recorded and potentially unrecorded shallow coal mine workings and former opencast activity. In particular, uncertainty remains regarding the presence and condition of shallow underground workings and the position, geometry, and influence of the former Birkfield OCCS margin, including the possible presence of opencast backfill and associated disturbed ground beneath part of the proposed development area.

Site-specific intrusive investigation is therefore required to establish the nature and significance of these features. Where investigation confirms mine workings, opencast backfill, disturbed ground, or other mining-related conditions that present an unacceptable ground stability risk, appropriate remedial treatment and/or specific engineering measures will be required.

Where treatment of mine workings is necessary, a standalone *Treatment of Mine Workings Specification* should be prepared and submitted to the LPA for consultation with the MRA and approval as part of the relevant planning process. A separate MRA permit would be required prior to commencement of treatment works. Following completion, a Validation Report would be required to demonstrate that the specified remedial objectives have been achieved and that the Site is suitable and stable for the proposed development from a mining legacy perspective.

1 INTRODUCTION

1.1 Appointment

Groundsmiths (UK) Ltd ('Groundsmiths') were commissioned by Mr G. Eaton (the 'Client') to provide professional services in relation to the preliminary geotechnical and geo-environmental assessment of land located at Longfield House, Thurgoland Hall Fold, Thurgoland, South Yorkshire (herein referred to as the 'Site').

Groundsmiths have prepared this report (the 'Report') for the sole use of the Client that commissioned it, in accordance with the agreement under which our services are performed. No other warranty, expressed or implied, is made as to the professional advice or commentary included in this Report. Any unauthorised third party relying upon or otherwise using the information presented does so entirely at their own risk and is excluded from any warranty, duty of care, or duty of skill.

No part of this Report shall be reproduced, adapted, or redistributed without the prior written consent of Groundsmiths. However, it may be issued by the Client or their Agent to Barnsley Metropolitan Borough Council (the 'LPA') in support of the proposed development and associated planning requirements under the Town and Country Planning Act 1990.

1.2 Report Context and Status

It is understood that the proposed development comprises the construction of a new residential dwelling within the north-western part of the wider Longfield House landholding, necessitating the replacement of an existing single-storey outbuilding. The proposed development area and associated access are shown on the appended location plan (Ref. GE/LH/LP/A4/01, October 2024).

This Report has been prepared to support a planning application for the proposed development and presents an LCRM: Stage 1 Risk Assessment based upon a review of currently available geological, hydrogeological, historic, and geo-environmental information. The assessment provides a preliminary appraisal of the geotechnical and geo-environmental conditions thought likely to be encountered beneath the Site, having regard to its historical development and surrounding land uses, the anticipated geological and hydrogeological conditions, and the potential implications of historical contamination for the proposed development. The assessment has been completed in accordance with the general requirements of BS10175 ^[1], BS5930 ^[2], and Land Contamination Risk Management ('LCRM') guidance ^[3].

A separate Coal Mining Risk Assessment has been prepared by Groundsmiths for the Site ^[4], to which reference should be made where required. That assessment considered the potential risks associated with historic mining legacy and identified the requirement for further mining-specific investigation. No further assessment of mining-related risk is therefore undertaken within the remit of this Report, although the findings of the Coal Mining Risk Assessment are referenced where relevant to the wider assessment of ground conditions and development constraints.

Notwithstanding the provision of discourse on any general construction matters that may apply, the assessment presented herein also considers potential sources of historic ground

contamination together with their anticipated impact upon sensitive receptors. A preliminary Conceptual Site Model ('CSM') has been developed to identify plausible source-pathway-receptor linkages, providing the basis for a qualitative assessment of potential risks and identifying where further risk assessment, intrusive investigation, or remedial works may be required to facilitate the proposed development. Given the proposed residential end use, the assessment of risks to human health has been undertaken within the framework of a generic residential with home-grown produce exposure scenario, as defined by the Environment Agency^[5].

The findings and recommendations presented in this Report are based upon the information available at the time of writing and are intended to inform the planning application process. Interpretation and recommendations should not be assumed valid for adjacent areas of land or alternative land uses. Should the proposed development change materially, or should significant additional information become available, the conclusions and recommendations presented herein may require reassessment in accordance with current guidance.

1.3 Objectives

The primary objectives of this Report are to:

- Obtain current information from published sources with respect to any environmental designations, SSSI, visual and cultural designations, and agricultural and/or habitat designations as may exist on Site or within the immediate area of development;
- Obtain current information from published sources about the likely soil and groundwater conditions within the area of development;
- Identify and assess the potential for any ground related environmental hazards, including the potential for where any adverse ground gas regime may represent constraints to the proposed development;
- Identify and assess the potential for any ground related geotechnical hazards;
- Define a preliminary CSM of plausible source-pathway-receptor linkages and undertake a qualitative assessment to evaluate the level of risk associated with each linkage in accordance with the proposed development end use scenario;
- Outline preliminary development recommendations, and
- Provide advice on any additional stages of LCRM assessment that may need to be completed to satisfy the concerns of the regulatory authorities, this including Stage 1 generic or detailed quantitative risk assessment with ground investigation, Stage 2 options appraisal^[6], and/or Stage 3 remedial actions^[7].

1.4 Scope of Works

Further to the Site walkover on the 20th August 2026, assessment undertaken within the context of this Report comprised a review of the following sources of publicly available data:

- British Geological Survey ('BGS') 1:50,000 and 1:10,000 scale series geological mapsheets ^[8,9]
- BGS Onshore GeoIndex records database ^[10]
- Groundsure - Enviro+GeoInsight Data Report (Appendix A) ^[11]
- Groundsure - Historical Ordnance Survey ('OS') Plans (Appendix B) ^[12]
- Zetica UXO ^[13]

1.5 Previous Reports

As indicated, a separate Coal Mining Risk Assessment accompanies this Report and should be referred to where required. Groundsmiths are not aware of any other ground-related studies having been completed for the Site.

1.6 Limitations of Study

This appraisal has been undertaken subject to the limitations detailed in Section 8 and any other limitations stated specifically in the Report. Where further works are identified, these shall be undertaken as required within the framework of LCRM and in accordance with other relevant current UK guidance, regulatory requirements, and legislation.

No intrusive ground investigation works have been completed as part of this assessment.

2 SITE SETTING

2.1 Details & Description

A general summary of the Site's setting is given in Table 2.1, below. This is based on current information and the Site walkover.

Table 2.1 - General Site Details

National Grid Reference	The National Grid Reference (NGR) for the Site is indicated to be 428678mE 401477mN.
Ground Elevations	Available information indicates that the Site lies at an elevation of approximately 245-246m AOD. These levels are approximate only, having been derived from available mapping and publicly available elevation data, and should not be relied upon for design purposes. Ground levels should be confirmed by an appropriate topographical survey prior to the commencement of detailed design.
Site Layout & Adjacent Development	The Site comprises an irregularly shaped parcel of land consisting of an existing access track leading to a single-storey outbuilding with associated gravel parking/hardstanding and an area of grass. The access track extends from Thurgoland Hall Fold towards the proposed development area, with Longfield House situated immediately to the south-east (Plate 1). The southern Site boundary is formed principally by drystone walling, beyond which is Yorkshire Water infrastructure and adjoining land (Plates 2 and 3). Open agricultural land adjoins the Site beyond drystone walling to the west (Plates 4 to 6) and north (Plates 7 and 8). The grassed area within the proposed development area has recently been enclosed by fencing to separate it from the remainder of the Client's wider landholding, which adjoins the Site to the east (Plates 9 to 11). The enclosed grassed area, which will form the garden area associated with the proposed dwelling, is shown in Plates 12 and 13. The existing single-storey outbuilding is of blockwork construction with a pitched roof, with adjoining gravel and hardstanding surfaces (Plates 14 and 15). At the time of inspection, the building was in use principally for domestic storage and ancillary purposes (Plates 16 to 19).
Invasive Species	Invasive plant species were not observed at the time of the walkover, although all other assessments in this regard should be completed as required.

2.2 Anticipated Geology & Hydrogeology

A summary of the salient geological data for the Site is given in Table 2.2, overleaf.

Table 2.2 - General Geological Conditions

Artificial Deposits

BGS geological mapping at both the 1:10,000 and 1:50,000 scales records the presence of artificial ground, classified as Infilled Ground (Artificial Deposit), within the northern part of the Site, forming part of a more extensive area extending beyond the Site boundary to the north.

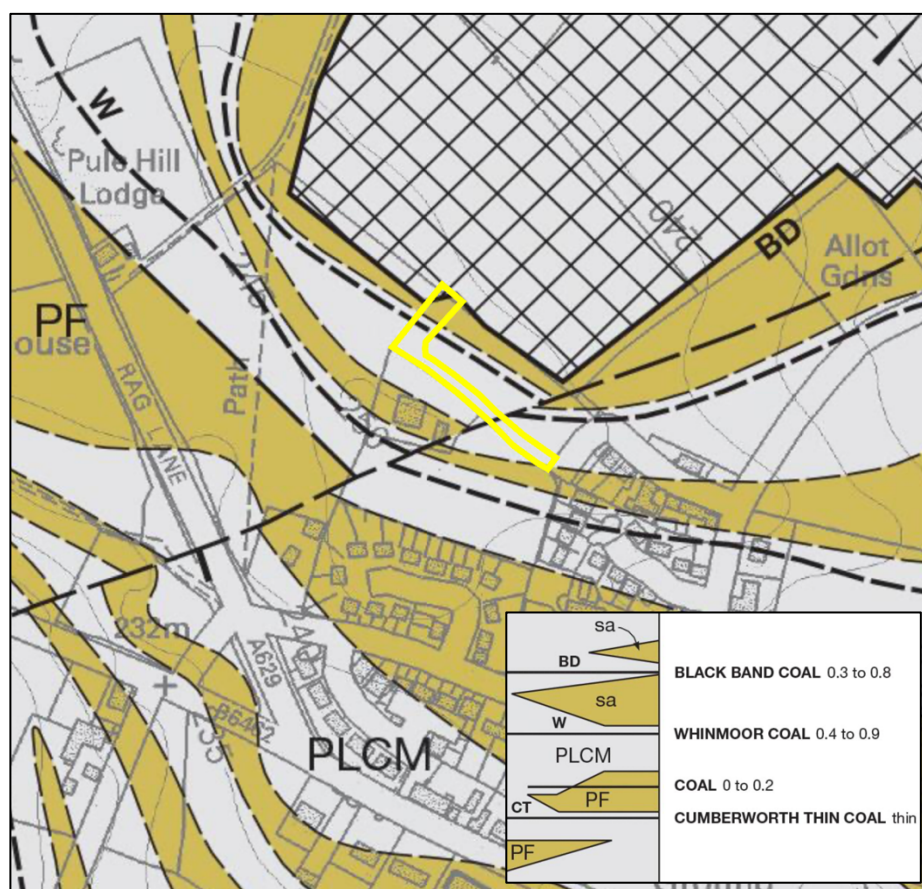
The nature, thickness, and age of these deposits are not defined by the published mapping. However, their distribution is consistent with the potential presence of disturbed and/or backfilled ground associated with former Birkfield opencast activity immediately to the north. As detailed within the accompanying Coal Mining Risk Assessment, the former opencast excavation, highwall/batter, and associated backfill may extend beneath part of the proposed development area.

Superficial Geology

No superficial deposits are indicated to be present beneath the Site.

Bedrock Geology

The bedrock geology is indicated to comprise deposits of the Pennine Lower Coal Measures Formation. This formation is typically characterised by a cyclical sequence of interbedded mudstone, siltstone, and sandstone, together with numerous coal seams and associated seatearth horizons. Available geological and mining records indicate that the Coal Measures strata in the vicinity of the Site dip broadly north-eastwards at approximately 5°. Local variation in the orientation and condition of the strata may nevertheless be present, particularly in areas affected by former opencast mining activity.



Source: BGS Mapsheet SE20SE. 1:10,000 scale (2005)

Bedrock Faults &
Linear Features

Review of the available BGS geological mapping indicates an inferred bedrock fault, of unknown displacement, crossing the access track within the south-eastern part of the Site. The fault is not mapped within the proposed development area. Further inferred faults are mapped within the surrounding area, reflecting the locally faulted nature of the Coal Measures succession.

Several coal seam outcrops are mapped within and adjacent to the Site, including the Black Band Coal, the mapped outcrop of which crosses the proposed development area. The disposition and potential significance of the coal seams and other mining-related geological features affecting the Site are considered within the accompanying Coal Mining Risk Assessment.

Hydrogeology

Aquifer within Superficial Deposits on Site: Not applicable.

Aquifer within Bedrock on Site: Secondary A (formerly minor aquifers given their potential to support water supplies at a generally local scale).

Source Protection Zones: There are no source protection zones within 500m.

Source Protection Zones within Confined Aquifers: There are no source protection zones within confined aquifers within 500m.

Groundwater Vulnerability Zones: The soil/surface leaching potential is classed as being low (<40% infiltration with 300-550mm/year dilution), whilst the vulnerability of the bedrock geology is indicated to be medium. Any groundwater flow through the bedrock would be via secondary porosity.

Groundwater Vulnerability – Soluble Rock Risk: No soluble rocks are identified as being present beneath the Site.

Hydrology

There are no recorded surface water features present on-Site.

The Site is indicated to lie within two Water Framework Directive Surface Water Body catchments, these being associated with:

- Rockley Dike from source to River Dove (Ref. GB104027057480);
- Dodworth Dike from source to River Dove (Ref. GB104027057520).

Furthermore, the Site is indicated to lie within a Water Framework Directive Groundwater Body Catchment. Data provided by the Environment Agency^[14] indicates that the groundwater body associated with the 'Don & Rother Millstone Grit & Coal Measures' achieved an overall classification of 'Poor' in 2019.

2.3 Designations

The Groundsure report provides details on property-specific environmental designations in addition to other potential actions associated with non-environmental search returns such as planning constraints. The following salient information is presented in Table 2.3, below and overleaf.

Table 2.3 - Published Designations & Other Potential Actions

SSSI

There are no statutory protection sites within at least 2km.

Ramsar

There are no records relating to conserved wetland areas under the Convention of Wetlands of International Importance within 2km.

SAC	There are no records of Special Areas of Conservation having been designated under the EC Habitats Directive within 2km.
SPA	There are no records of sites having been classified by the UK Government under the EC Birds Directive within 2km.
NNR	There are no records relating to important natural or semi-natural terrestrial ecosystems within 2km.
Nature Reserves	There are no records relating to local nature reserves within 2km.
Designated Woodland	There are recorded areas of ancient woodland from 436m to the south-west.
Green Belt	The Site lies within the South & West Yorkshire (Barnsley) Green Belt.
Nitrate Sensitivity	There are no records relating to nitrate sensitive areas within 2km.
Nitrate Vulnerability Zones	The Site lies within the River Dearne (surface water) NVZ (278).
Visual & Cultural Designations	There are no world heritage sites, areas of outstanding natural beauty, national parks, listed buildings, conservation areas, scheduled ancient monuments, or registered parks and gardens within at least 250m.
Habitat Networks	There are no priority habitat inventories, habitat networks, open mosaic habitats, or limestone pavement orders within at least 250m.
Archaeology	The potential for below-ground archaeology has not been identified within the remit of this assessment.
UXO	Information obtained from Zetica (https://zeticauxo.com) suggests that the Site lies within a low risk zone from unexploded ordnance. Further detailed risk assessment is unlikely to be required.

2.4 Environmental Records

A summary of salient published environmental data is presented in Table 2.4, below and overleaf.

Table 2.4 - Published Environmental Data

Landfill	Groundsure data indicates that there are no active, recent, or historical landfill sites within at least 500m.
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Flooding	Assessment of flood risk is outside the scope of this Preliminary Risk Assessment. Specialist flood risk advice should therefore be obtained where required, together with any Flood Risk Assessment or other supporting studies necessary to satisfy the requirements of the LPA and the Environment Agency. <u>River & Coastal Flooding:</u> The Site is not indicated to lie within either Flood Zone 2 or Flood Zone 3. <u>Surface Water & Groundwater Flooding:</u> The highest risk level from on-Site surface water flooding and groundwater flooding is indicated to be negligible.
Potable, Surface, and Groundwater Abstractions	There are no reported active groundwater or potable abstractions within 2km, and no surface water abstractions within at least 1km.
Public Register of Contaminated Land	There are no sites determined as being Contaminated Land under Part 2A of the Environmental Protection Act (1990).
Dangerous or Hazardous Sites	There are no COMAH recorded sites within at least 500m.
Radioactive Substances	There are no live radioactive substance authorisations within 500m.
Historical Fuel Sites	There are no records of any historic petrol stations within 500m.
Active Fuel Sites	There are no records of any active petrol stations within 500m.
Garages/Workshops	There are no records of any historic garages within 500m.
Historical Energy Features	There are no records of any historic energy features within 500m.
Mine Gases	Mine gas emission requiring action by the Mining Remediation Authority is not anticipated on the basis of their available records.
Hazardous Substance Storage/Use	There are no recorded consents for any site to hold hazardous substances at or above defined limits within at least 500m.
Pollutant Release to Surface Water	There are no recorded discharges within at least 500m.
List 1 Dangerous Substances	There are no recorded List 1 discharges within at least 500m.
Pollution Incidents	There are no (EA/NRW) recorded pollution incidents within at least 500m.

2.5 Site History

It is not the intention of this Report to reproduce or describe in detail all of the changes that may have occurred on, or within a radius of 250m to the Site, although a general review of available historical OS maps dating between 1854 and 2025 has been undertaken to identify

any potentially contaminative former land-uses that may significantly impact upon the proposed development.

It should be noted that defined boundary on some of the maps may not fully align with the Site's position. Furthermore, some of the OS map editions may not be fully complete. It is possible, therefore, that additional land uses to those presented on the plans could have occurred in the past. A general summary of the historical land use at the Site and within its surrounding area is presented in Table 2.5, below.

Table 2.5 - Principal Historical Ordnance Survey Features

Year	Principal On-Site Features	Principal Off-Site Features
1854-1931	The Site comprises undeveloped agricultural land, divided between established field parcels. No buildings or other developed land uses are shown on-Site.	The surrounding area is predominantly agricultural. California Colliery is shown to the north-west of the Site on the 1854 mapping, but is no longer shown by 1891. Thurgoland Hall and associated buildings are established to the south-east, with the settlement of Thurgoland further south.
1951-1965	The Site remains undeveloped agricultural land, with no buildings or other development shown.	Residential development expands within Thurgoland to the south and south-east. Comparison of the 1931 and 1960 large-scale mapping indicates changes to field boundaries within the surrounding agricultural land, together with a slight alteration to the alignment of the footpath to the north of the Site. By 1960, infrastructure associated with Yorkshire Water is shown immediately south of the Site.
1977-1993	The Site remains undeveloped agricultural land, with no buildings or other development shown.	Residential development continues to expand to the south and south-east, including around Thurgoland Hall Fold, whilst no significant change is evident to the agricultural land immediately to the north and west. Longfield House is first shown on the available 1993 mapping, immediately to the east of the Site, whilst the 1999 OS plan shows the Yorkshire Water infrastructure immediately south of the Site in its current configuration, having changed from that shown on earlier mapping.
2003-2025	The Site remains as open undeveloped land on the c.2003 OS plans. By 2010, a structure (outbuilding) is shown, which remains on subsequent mapping through to 2025.	Residential development to the south and south-east is broadly established in its present form, whilst agricultural land remains immediately to the north and west.

3 PRELIMINARY ENGINEERING APPRAISAL

3.1 Soils

Made Ground

BGS geological mapping records Infilled Ground (Artificial Deposit) within the northern part of the Site and extending further northwards. The origin, composition, thickness, and precise extent of these deposits are not defined by the published mapping.

As detailed within the accompanying Coal Mining Risk Assessment, the distribution of the mapped artificial ground is consistent with the potential presence of disturbed and/or backfilled ground associated with former opencast activity at the Birkfield OCCS. The precise position and geometry of the former opencast margin remain uncertain, however, and the associated excavation, highwall/batter, backfill, and disturbed ground may extend beneath part of the proposed development.

Accordingly, made ground and/or disturbed ground of potentially variable nature and thickness may be present, the extent and characteristics of which will require confirmation by intrusive investigation.

Natural Strata

No superficial deposits are indicated to be present on-Site or within the immediate vicinity. Where undisturbed natural ground is present, the Site is therefore anticipated to be directly underlain by strata of the Pennine Lower Coal Measures Formation, comprising predominantly mudstone and siltstone, with subordinate sandstone, coal seams, and associated seatearth horizons.

The near-surface natural strata are anticipated to comprise weathered mudstone and siltstone, potentially occurring initially as clayey and locally gravelly material, before grading into highly weathered and locally laminated mudstone and siltstone with depth. Less weathered and more competent mudstone is anticipated beneath the weathered zone, with sandstone and other lithologies potentially occurring locally within the Coal Measures succession.

The depth to rockhead, thickness of the weathered zone, and engineering characteristics of the natural strata are not presently known and should be confirmed by intrusive investigation to inform subsequent foundation design.

Coal

As defined within the accompanying Coal Mining Risk Assessment, the Pennine Lower Coal Measures succession beneath the Site contains a number of coal seams. The Black Band Coal represents the shallowest identified seam affecting the proposed development area, with its mapped outcrop passing approximately through the western/central part of the proposed building footprint. The underlying Whinmoor Coal crops farther to the south-west and dips beneath the Site towards the north-east.

The depth and condition of these seams beneath the proposed development area are presently uncertain. In particular, the reported depth of the Whinmoor Coal does not readily reconcile with its mapped outcrop position, local ground elevations, and recorded dip. The disposition of the coal seams, together with the potential presence and significance of associated mine workings, is considered in detail within the Coal Mining Risk Assessment and is not reassessed herein.

Groundwater

On the basis of the available information, the Site's elevated topographical setting and the absence of superficial deposits, persistent shallow groundwater is not anticipated within areas of undisturbed natural ground. Groundwater may nevertheless be encountered locally within the weathered Coal Measures strata, particularly following periods of prolonged rainfall.

Where former opencast backfill or other disturbed ground is present, localised perched or transient groundwater may also occur, although significant groundwater accumulation is not presently anticipated given the Site's topographical setting.

The groundwater regime should be confirmed during intrusive investigation, particularly insofar as it may influence ground conditions, excavation stability, and subsequent foundation design.

3.2 Landslip (Mass Movement Deposits)

In providing a preliminary assessment of risk associated with potential landslip, consultation was made with the data presented by Groundsure at the 1:10,000 and 1:50,000 scales.

No landslip or mass movement deposits are identified on-Site or within 500m. The overall hazard rating for slope instability is reported as very low on-Site and within 50m, and no landslip permeability hazards are recorded within 50m. Slope instability problems are therefore considered unlikely to occur, although the potential for instability within adjacent areas to impact upon the Site should always be considered.

3.3 Foundations

Although the specific foundation design for the proposed development lies outside the remit of this assessment, it is considered at this stage that various factors will need to be taken into account and that detailed ground investigation is required to provide the information from which informed decisions can be made.

Made Ground

Made ground and/or disturbed ground of potentially variable nature and thickness may be present beneath part of the proposed development area, associated principally with the former Birkfield OCCS. Such materials should not presently be assumed suitable as a founding stratum, given the potential for variability in their composition, degree of compaction, and engineering characteristics.

The condition, thickness, and lateral extent of any such materials should therefore be established by intrusive investigation. Where present beneath the proposed structure, appropriate foundation and/or ground improvement measures will need to be developed having regard to the conditions encountered, with foundations ultimately designed to provide adequate and consistent support.

Pending confirmation by intrusive investigation, the preliminary engineering risk associated with made ground and former opencast disturbance is considered to be Moderate. This principally reflects the present uncertainty regarding the southern extent and condition of the former opencast backfill and associated disturbed ground beneath the proposed development area.

Natural Strata

Where undisturbed natural ground is present, the Site is anticipated to be underlain at relatively shallow depth by weathered strata of the Pennine Lower Coal Measures Formation, comprising predominantly mudstone and siltstone, with subordinate sandstone. The near-surface weathered profile may comprise clayey and locally gravelly materials, grading into highly weathered mudstone and siltstone and subsequently less weathered and more competent bedrock with increasing depth.

The ground conditions beneath the proposed building footprint will need to be established by intrusive investigation before an appropriate foundation solution can be determined. The presence and apparent performance of the existing outbuilding should not be regarded as demonstrating the suitability of the underlying ground for the proposed dwelling, which will likely impose materially greater structural loads. Depending upon the conditions encountered, a range of foundation solutions may therefore need to be considered, as outlined below.

Spread Foundations

Where competent undisturbed natural strata are present at suitable shallow depth, conventional spread foundations may provide an appropriate foundation solution. Such foundations should extend through all loose, weathered, disturbed, or otherwise unsuitable materials to bear within undisturbed natural strata demonstrated to possess adequate load-bearing capacity.

Alternative Foundation Solutions

Where opencast backfill, disturbed ground, unsuitable weathered materials, or other adverse ground conditions are present beneath the proposed dwelling, it may not be practicable or appropriate to achieve adequate and consistent support using conventional spread foundations. Depending upon the ground conditions established through intrusive investigation, alternative foundation solutions may therefore be required, potentially comprising a raft, piles, ground improvement techniques, or an appropriate combination of these measures. The suitability and detailed design of any such solution should be determined following completion of the ground investigation.

General Foundation Considerations

The intrusive investigation should provide sufficient information to establish the depth, nature, strength, and variability of the underlying strata and allow an appropriate foundation solution to be developed. The Designing Engineer should undertake appropriate assessment of allowable bearing capacity, structural loading, and anticipated total and differential settlement.

The foundation solution to be adopted should provide adequate and consistent support for the proposed structure and should be designed to accommodate the ground conditions encountered. Appropriate field and laboratory testing should be undertaken to provide the geotechnical parameters necessary for foundation design, with additional specialist testing undertaken where required by the foundation solution ultimately adopted.

The final foundation solution should be designed in accordance with current standards, statutory requirements, and recognised good practice, and should be agreed with Building Control and any relevant warranty provider prior to construction.

Mining

As detailed within the accompanying Coal Mining Risk Assessment, the Site is potentially affected by recorded and unrecorded shallow mine workings and former opencast activity, the nature and significance of which require confirmation through Site-specific investigation.

Where investigation confirms suitable undisturbed natural ground beneath the proposed dwelling, with no mining-related instability or opencast backfill requiring treatment, spread foundations founded at appropriate shallow depth are anticipated to provide a suitable foundation solution, subject to confirmation of the engineering characteristics of the founding strata and there being no other geotechnical constraints that would preclude their use. Given the Site's mining setting, such foundations should be suitably reinforced, with the final reinforcement requirements determined by the Designing Engineer.

Where mine workings, opencast backfill, or other mining-related disturbance are confirmed to present an unacceptable ground stability risk, appropriate remedial treatment and/or specific engineering measures will be required. The final foundation solution should subsequently be developed having regard to the ground conditions established and the nature and extent of any remedial works required.

3.4 Ground Floor Construction

The form of ground floor construction will be dependent upon the ground conditions established through intrusive investigation and the foundation solution ultimately adopted. Subject to detailed design, suspended floor construction is anticipated to provide the most appropriate solution for the proposed dwelling, particularly having regard to the anticipated near-surface clayey soils, potential influence from a nearby tree, and the possible presence of made ground and/or disturbed ground.

Where a raft or other integrated foundation and floor solution is subsequently considered appropriate, its suitability should be determined by the Designing Engineer having regard to

the ground conditions established and the anticipated structural loading and potential ground movement.

Allowance should also be made at the design stage for the potential incorporation of ground gas protection measures within the floor's construction. As discussed later in this Report, ground gas monitoring will be required to establish the Site-specific gas regime and determine the level of protection necessary. Depending upon the monitoring results, measures consistent with Characteristic Situation 2 of BS8485 ^[15], or potentially greater protection, may be required and the final floor construction should be designed to accommodate any such requirements.

3.5 Heave Precautions

The combination of shrinkable soils and trees, hedgerows, and shrubs represent a potential hazard to foundations and supported structures due to the effects of volume change and ground movement.

All foundations would need to be provided in accordance with current heave precautionary guidelines ^[16] if they lie within the zone of influence of removed, existing, or proposed planting when in cohesive soils (which includes mudstone and siltstone) or where seasonally desiccated soils are present at the time of construction. Information with respect to the plasticity indices and worst-case volume change potential of any proven or suspected cohesive soils will need to be obtained to assist with foundation design. If foundations are on granular material or intact sandstone, precautions would not be required.

The need for any precautions in construction and how these interact with the foundation solution should be discussed further with the Designing Engineer once ground investigation and all necessary testing and laboratory analytical works have been completed.

3.6 Slope Stability

No landslip or mass movement deposits are identified on-Site or within the surrounding area, and the available Groundsure data indicates a very low potential for slope instability. Accordingly, natural slope instability is not anticipated to represent a significant constraint to the proposed development.

Nevertheless, due consideration should be given to local topography, adjacent ground conditions, and any proposed changes in ground level during detailed design, particularly where excavation, retaining structures, or alterations to existing slopes are proposed.

3.7 Superstructure Precautions

The need for superstructure precautions (e.g. masonry reinforcement) is considered unlikely at this time, although this should be discussed further with the Designing Engineer once all ground investigation works and testing have been completed.

3.8 Excavation Stability

All excavation works should be carried out in accordance with current HSE guidance, *Structural Stability During Excavation* ^[17].

Made ground, opencast backfill, and/or other disturbed materials may be present beneath part of the proposed development area and, where encountered, should be assumed to be potentially unstable within unsupported excavations. The stability of such materials is likely to be dependent upon their composition, degree of compaction, moisture condition, and the depth and geometry of the excavation.

Within areas of undisturbed natural ground, the near-surface weathered Coal Measures strata may similarly be susceptible to local instability, particularly where excavations are deep, left unsupported for prolonged periods, subjected to heavy or prolonged rainfall, or where localised groundwater seepage is encountered. Excavation faces may consequently deteriorate or widen through sloughing or collapse of weathered materials.

The actual excavation characteristics of the underlying materials should be established during intrusive investigation. Temporary support, battering, staged excavation, or other appropriate measures may be required during development where unsupported faces cannot be safely maintained.

Where excavation works have the potential to affect adjacent structures, services, Site boundaries, or neighbouring land, the potential implications should be assessed by a suitably competent person prior to commencement, with appropriate temporary or permanent support provided where required to maintain stability and safe working conditions.

3.9 Natural Ground Subsidence

Review of the available Groundsure data indicates that the Site is at negligible to very low risk from shrink–swell clay soils, negligible risk from running sands, very low risk from collapsible deposits and landslides, and negligible risk from dissolution of soluble rocks.

A moderate risk from compressible deposits is, however, identified across the northern part of the Site, with Groundsure indicating that compressibility and uneven settlement hazards are probably present and that the variability of the Site should be specifically considered. The remaining parts of the Site are indicated to be at negligible risk.

Accordingly, whilst most natural ground subsidence hazards are not considered likely to materially constrain the proposed development, the potential for compressible and variable ground conditions should be investigated as part of the intrusive ground investigation and taken into account during subsequent foundation design.

3.10 Obstructions in Excavation

The presence of significant below-ground obstructions within the proposed development area cannot be established from the available desk-based information. Where made ground, former opencast backfill, or other disturbed materials are present, buried obstructions or variable coarse materials may potentially be encountered. Within areas of undisturbed natural

ground, shallow weathered and locally more competent Coal Measures bedrock may also influence excavation conditions.

Such conditions could affect foundation excavations and the installation of below-ground services and drainage infrastructure. The nature and extent of potential obstructions should therefore be considered during the intrusive investigation, with appropriate excavation and breaking plant allowed for during construction where necessary.

3.11 Concrete

Protection may be required where buried concrete is to be placed in contact with soils exhibiting elevated sulphate concentrations. Accordingly, representative samples of the founding soils should be obtained during the intrusive investigation and subjected to appropriate laboratory testing. The Designing Engineer should then determine the appropriate Aggressive Chemical Environment for Concrete (ACEC) classification and corresponding Design Chemical Class in accordance with current guidance ^[18] and BS 8500-1 ^[19].

3.12 Stress Relief

On the basis of the available information and anticipated ground conditions, stress relief is not expected to represent a significant constraint to the proposed development.

3.13 Pavement

The proposed Site layout indicates that the existing access will be retained as a limestone chipping driveway, with associated parking and turning areas provided adjacent to the proposed dwelling.

No significant areas of conventional paved hardstanding are presently proposed. The suitability of the existing and proposed formation should nevertheless be confirmed during construction, with any soft, loose, disturbed, or otherwise unsuitable materials removed or improved as necessary to provide a stable formation for the proposed access, parking, and turning areas. Frost susceptibility to the subgrade should be expected.

3.14 Site Drainage

The drainage solution for the proposed development is not presently known and should be developed by a suitably competent drainage engineer, subject to the necessary statutory and regulatory approvals.

Where infiltration drainage is being considered, its suitability should be established having regard to the ground conditions, groundwater regime, and potential presence of made ground, former opencast backfill, disturbed ground, and mining legacy beneath and adjacent to the Site. Where required, infiltration testing should be undertaken in accordance with BRE365 ^[20].

The location and design of any soakaways or other infiltration features should be determined following confirmation of the ground conditions and should take appropriate account of the proposed structure, Site boundaries, buried services and infrastructure, and any potential implications for ground stability.

4 PRELIMINARY ENVIRONMENTAL APPRAISAL

4.1 Introduction

Current UK legislation on contaminated land is set out in Part 2A of the Environmental Protection Act 1990 ^[21], which was retrospectively inserted by Section 57 of the Environment Act 1995 ^[22]. The Contaminated Land Regulations 2000 ^[23] were amended in 2005. The Environmental Protection Act 1990: Part 2A Contaminated Land, Statutory Guidance, Edition 2 (2006) promulgates the revised statutory guidance with respect to the operation of the Contaminated Land Regime following the implementation of the Contaminated Land Regulations, 2005. The definition of contaminated land is central to the operation of Part 2A.

Legislation adopts the principle of a 'suitable for use' approach for the assessment of contaminated land, the rationale being reflected in the site-specific risk assessment and determination of remedial strategy; action is only required if unacceptable risks are posed to human health or to the environment, considering the site's land use and geo-environmental setting.

The legislation places a responsibility on the LPA to determine whether the land under its jurisdiction is contaminated by consideration of whether:

- The presence of substances (potential contaminants) are present at concentrations that are causing significant harm or have the significant possibility of causing significant harm;
- There are receptors which may be harmed (e.g. the water environment, human health, buildings, fauna and flora), and
- There is in existence a pathway between the identified sources and receptors.

To qualitatively assess the level of risk at the Site, the above rationale has been applied. This approach is consistent with the preliminary risk assessment procedure defined in LCRM. The following section summarises the preliminary CSM which has been produced following the review of available pertinent third party information. The CSM summarises Groundsmiths' current understanding of the surface and sub-surface features, potential sources of contamination, likely transport pathways, and the receptors, in order to support the identification and assessment of plausible potential contaminant linkages.

4.2 Potential Sources of Contamination

A potential source is defined as 'a contaminant which is in, or under the land and has the potential to cause harm to human health or to cause contamination of controlled waters receptors'.

Review of the Site's history indicates that the Site and immediate surrounding area have been subject to relatively limited and low-intensity land use, comprising predominantly open agricultural land, with the existing outbuilding and associated access/hardstanding representing the principal later development. On this basis, significant contamination associated with the historic use of the Site is not anticipated.

A degree of uncertainty does, however, relate to the potential presence of made ground, opencast backfill, and/or other disturbed materials beneath part of the Site. BGS geological

mapping records infilled ground across the northern part of the Site, whilst the available MRA information identifies various opencast boundaries/features extending across the Site. As discussed within the accompanying Coal Mining Risk Assessment, these datasets cannot presently be satisfactorily reconciled and the nature, extent, and significance of the mapped features remain uncertain. Accordingly, whilst there is no evidence from the historic land use to suggest a significant source of contamination, the composition and environmental quality of any made ground, opencast backfill, or other such disturbed materials that may be present are presently unknown. Furthermore, historic mining and the potential presence of associated disturbed and/or backfilled ground also represent a potential source of ground gas.

Available information indicates that the Site lies within an area where less than 1% of properties are estimated to exceed the UK radon Action Level. Radon protective measures are not indicated as being required on this basis, and no further assessment of this is therefore warranted.

Although no formal intrusive investigation has been undertaken within the remit of this assessment, the overall environmental risk associated with the Site is considered to be low. Nevertheless, in accordance with the LCRM framework, a limited number of potential contaminant sources have been identified for consideration within the preliminary CSM. These principally comprise made ground, opencast backfill, and/or other disturbed materials of presently unknown composition and environmental quality, together with the potential for ground gas associated with the Site's mining legacy. The resultant potential source-pathway-receptor linkages are summarised in Table 4.1, below.

Table 4.1 - Summary of Potential Sources and Contaminants

Potential Sources	Potential Contaminants (not limited to)
i - Made ground, opencast backfill, and/or other disturbed materials of presently unknown composition and environmental quality	Metals, metalloids, inorganic contaminants, sulphate, PAHs (e.g. benzo(a)pyrene), TPHCWG, BTEX, VOCs and SVOCs
ii - Any unforeseen contamination of the underlying natural strata	
iii - Historic mining legacy, including potential shallow mine workings and associated disturbed and/or backfilled opencast ground	Methane and carbon dioxide

4.3 Potential Migration Pathways

Migration pathways are routes by which contaminant sources may come into contact with receptors. Potential pathways for different types of contaminants vary depending on the properties of the contaminant, the mechanism of its release and the nature of the receptor. The principal potential contaminant pathways by which receptors might become exposed to potential contamination at the Site are summarised as follows in Table 4.2, overleaf.

Table 4.2 - Summary of Plausible Pathways

Potential Sources	Pathways
i - Made ground, opencast backfill, and/or other disturbed materials of presently unknown composition and environmental quality, and ii - Any unforeseen contamination of the underlying natural strata	Direct ingestion, dermal contact, dust, and/or vapour inhalation
	Direct ingestion and/or dermal contact with liquid contaminants
	Leaching and/or direct contact with potable water supply pipes
	Leaching and migration of contaminants via surface run-off and/or vertical and lateral migration through the ground
	Contact and chemical attack on buried concrete products
	Plant root uptake
iii - Historic mining legacy, including potential shallow mine workings and associated disturbed and/or backfilled opencast ground	Migration of ground gas through the ground and/or preferential pathways, with subsequent ingress and accumulation within the proposed dwelling

4.4 Potential Receptors

A receptor is the potential target of the source contaminant, to which either significant harm or deterioration in quality may be caused. The potential sensitive receptors with respect to the potential contamination hazards identified above are considered in Table 4.3, below.

Table 4.3 - Summary of Potential Receptors

Potential Receptor	Comment
Human Health	Site end-users in the residential with home-grown produce end use scenario Site operatives (during construction phase only) Future workers involved with any in-ground maintenance works
Buildings and Infrastructure	Buried concrete products Potable water supply pipes Foundations
Controlled Waters	'Secondary A' bedrock aquifer

4.5 Environmental Risk Assessment

Risk assessment and the procedure of identifying sources, pathways and receptors is recognised as an approach to determine the extent and significance of contamination either within the context of Part 2A (when assessing current site status or when considering the acquisition of an existing development) or the planning process (for the redevelopment of an existing site, or

when considering the acquisition of a site for redevelopment purposes). Either way, the 'suitable for use' approach is adopted when assessing risk and the source-pathway-receptor assessment defines the conceptual model for the site.

The statutory guidance describes a risk assessment methodology in terms of 'significant contaminants' and 'contaminant linkages', using the 'source-pathway-receptor' scenarios for the site. Contaminant linkages are formed when there is a linkage between a contaminant source and a receptor by means of a pathway. The existence of a contaminant linkage is dependent on site use, as well as environmental conditions. If no contaminant linkages can be proven, then the risks may be discounted. However, it is not to say that remediation is required if contamination is proven. The identified potential contaminants and receptors have been considered in relation to the pathways that may link them. The risk classification has been estimated in accordance with those methods prescribed in CIRIA C552 ^[24]. Risk is regarded as a combination of the likelihood of an 'event' occurring and its severity: both elements must be considered when assessing risk. The method for risk assessment, or evaluation, is purely qualitative. As defined in CIRIA C552, the magnitude of the potential 'severity' of risk occurring may be assessed against:

- **Severe (acute):** short term risk to human health likely to result in significant harm as defined under Environmental Protection Act 1990, Part 2A. Short term risk of pollution to sensitive water receptor (may result in death).
- **Medium (chronic):** long term risk and significant harm to human health, contamination of sensitive water resource or significant change to an ecosystem or specific organism (may result in death).
- **Mild (chronic, but applicable to less sensitive receptors):** contamination of non-sensitive water resource but significant damage to crops, buildings, structures and services or the environment.
- **Minor (not significant):** harm, which may result in financial loss, or expenditure to resolve. Non-permanent effects to human health. Easily repairable effects of damage to buildings, structures, and services.

Similarly, the classification of the magnitude of the 'probability' of the risk occurring may be assessed against:

- **High Likelihood:** a contaminant linkage exists and an event appears very likely in the short term, or almost inevitable in the long term, or contamination is causing harm at the receptor. Urgent action is required.
- **Likely:** a contaminant linkage exists and it is probable that an event will occur. An event may not occur, but it is possible in the short term and likely over the long term.
- **Low Likelihood:** a contaminant linkage exists and it is possible that an event will occur. It is not certain that an event will occur over time, but it is less likely in the short term.
- **Unlikely:** a contaminant linkage exists but it is not possible to say if an event will occur even over a very long time.

Following completion of the severity and probability assessment, classifications can be compared to indicate the actual risk each contaminant linkage presents: this can only be undertaken where there is a possibility of there being an active linkage. The risk categories

which can be assigned are presented in Table 4.4, below, and range between ‘very high’ to ‘very low’ (NB – it is not possible to classify an identified risk as ‘no-risk’).

Table 4.4 - Risk Categorisation

		Consequence			
		Severe	Medium	Mild	Minor
Probability	Highly Likely	Very High	High	Moderate	Moderate / Low
	Likely	High	Moderate	Moderate / Low	Low
Probability	Low Likelihood	Moderate	Moderate / Low	Low	Very Low
	Unlikely	Moderate / Low	Low	Very Low	Very Low

Source: Table 6.5, C552 (2001).

- **Very High** – there is a high probability that severe harm could arise or that severe harm is occurring. Urgent investigation and remediation are likely to be required.
- **High** – harm is likely to occur, and that urgent investigation and remediation may be needed in the short term, but are likely over the longer term.
- **Moderate** – harm could occur. It is unlikely to be severe, most probably relatively mild. Investigation is normally required to clarify the risk with some remedial works being required in the longer term.
- **Low** – it is possible that harm could occur, but if it did, at worst it would be mild.
- **Very Low** – low possibility of harm arising, and that if it does it is not likely to be severe.

The identified potential contaminants and receptors have been considered in relation to the potential pathways that may link them. The resulting potentially active contaminant linkages are presented in Table 4.5, overleaf.

Table 4.5 - Summary of Environmental Risk (Current Site Condition without Mitigation)

Potential Sources	Potential Receptors	Plausible Pathways	Probability	Severity	Risk Rating	Comment
i - Made ground, opencast backfill, and/or other disturbed materials of presently unknown composition and environmental quality, and ii - Any unforeseen contamination of the underlying natural strata	Human Health	Direct ingestion, dermal contact, dust, and/or vapour inhalation (Site end user)	Low Likelihood	Mild	Low	An overall low risk is currently anticipated with respect to contamination within the underlying soils for Site end users and construction/other in-ground workers, having regard to the Site's history, potential contaminant sources, and environmental setting. The contaminant status of the underlying soils will require confirmation through intrusive investigation.
		Direct ingestion and/or dermal contact with liquid contaminants (Site end user)	Low Likelihood	Mild	Low	
		Direct ingestion, dermal contact, dust, and/or vapour inhalation (in-ground worker)	Low Likelihood	Mild	Low	
		Direct ingestion and/or dermal contact with liquid contaminants (in-ground worker)	Low Likelihood	Mild	Low	
	Potable Water Supply Pipes	Leaching and/or direct contact with potable water supply pipes (tainting)	Unlikely	Mild	Very Low	The suitability of potable water supply pipe materials should be confirmed having regard to the ground conditions and contaminant concentrations established, together with the requirements of the statutory water provider.
	Vegetation	Plant root uptake	Unlikely	Mild	Very Low	A very low risk is currently anticipated having regard to the Site's historic use.
	Foundations	Direct contact and chemical attack on buried concrete products and foundations	Low Likelihood	Mild	Low	Although considered to be a low risk, the requirement for sulphate precautions for buried concrete should be confirmed following laboratory testing of representative foundation soils.
	Controlled Waters	Vertical and/or lateral migration to bedrock aquifer	Unlikely	Mild	Very Low	No particular risk to controlled waters is anticipated having regard to the Site's historic use and the nature of the potential contaminant sources identified.

Potential Sources	Potential Receptors	Plausible Pathways	Probability	Severity	Risk Rating	Comment
iii - Historic mining legacy, including potential shallow mine workings and associated disturbed and/or backfilled opencast ground	Human Health	Migration of ground gas through the ground and/or preferential pathways, with subsequent ingress and accumulation within the proposed dwelling	Low Likelihood	Medium	Moderate / Low	The Site's ground gas regime has not been established and will require confirmation through monitoring. Allowance for protection measures consistent with BS8485 Characteristic Situation 2, or potentially greater protection, should be made at this stage until the Site-specific ground gas regime has been confirmed.

General Soil Contaminants

On the basis of the available information and the preliminary risk assessment presented herein, the overall risk associated with general soil contamination is considered to be low. The Site and immediate surrounding area have been subject predominantly to open agricultural use, with no significant potentially contaminative historic land uses identified within the Site boundary.

A degree of uncertainty does, however, relate to the potential presence of made ground, opencast backfill, and/or other disturbed materials of presently unknown composition and environmental quality. BGS mapping records infilled ground across the northern part of the Site, whilst the available MRA information identifies various opencast boundaries/features extending across the Site. The nature and extent of these features cannot presently be satisfactorily reconciled and, where artificial or disturbed materials are present, their contaminant status is unknown.

A representative assessment of the soils should therefore be undertaken as part of the intrusive ground investigation, including both any made ground, opencast backfill, and/or disturbed materials encountered and the underlying natural strata. Chemical testing should include the contaminants of concern identified within the preliminary CSM, with the results assessed against appropriate residential with home-grown produce GAC, including DEFRA's Category 4 Screening Levels ^[25], the LQM/CIEH Suitable for Use Levels ^[26] and/or other appropriate GAC derived by Groundsmiths ^[27].

Asbestos Containing Materials (ACM)

No specific source of asbestos has been identified from the historic use of the Site and asbestos is not therefore considered to represent a potential contaminant of concern. Nevertheless, although no specific asbestos-related investigation or assessment is considered warranted, asbestos screening is routinely included within the standard soil analytical suite undertaken as part of ground investigation.

Unforeseen Soil Contamination

As with any development site, there remains the potential for contamination to be encountered during construction that has not previously been identified. Allowance should therefore be made for appropriate assessment of any suspect or unexpected materials encountered during development. Where unforeseen contamination is identified, supplementary sampling, testing and risk assessment should be undertaken as appropriate, with remediation completed where required. Consultation with the LPA should be undertaken where necessary.

Ground Gases

The Site is affected by recorded and potentially unrecorded shallow mine workings, former opencast activity, and associated disturbed and/or backfilled ground. These features represent potential sources and/or migration pathways for ground gas, principally methane and carbon

dioxide. On the basis of the preliminary risk assessment, the potential risk to human health from ground gas is presently assessed as Moderate/Low.

The Site-specific ground gas regime has not been established and monitoring will therefore be required in accordance with BS8485. The monitoring programme should be sufficient to establish representative concentrations and flow rates and allow an appropriate Characteristic Situation to be determined. The requirement for ground gas protection measures within the proposed dwelling should subsequently be determined from the monitoring results and Site-specific risk assessment.

Allowance for protection measures consistent with BS8485 Characteristic Situation 2, or potentially greater protection, should be made at this stage until the Site-specific ground gas regime has been confirmed.

Radon

Available information indicates that the Site lies within an area where <1% of properties are estimated to exceed the UK radon Action Level. On this basis, the Site is not considered to be significantly affected by radon and radon protective measures are not indicated as being required for the proposed development in accordance with BRE Report BR 211 ^[28]. No further assessment of radon is therefore considered necessary, subject to confirmation of the applicable requirements by Building Control as part of the detailed design process.

Controlled Waters Receptors

A very low risk is anticipated in relation to the potential for any mobile contaminants of concern to enter into controlled waters receptors on the basis of the Site's history, contaminative potential, and underlying geology. No further assessment is considered necessary at this time.

Potable Water

Water providers are required to ensure the safety of their staff, contractors, and customers and, accordingly, assess the suitability of buried potable water supply pipes where development is proposed on land that may be affected by contamination.

An existing potable water supply is understood to serve the current outbuilding. However, its age, specification, route, and suitability for continued use as part of the proposed residential development are not presently known. Its existing use should not therefore be regarded as confirmation that it meets the requirements applicable to the proposed dwelling, and its suitability for retention should be confirmed with the statutory water provider.

Where the existing supply cannot be retained, the specification of any new or replacement potable water pipework should be determined from the ground conditions and contaminant concentrations established through intrusive investigation and laboratory testing, with due regard to the current UK Water Industry Research guidance, *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (Ref. 10/WM/03/21) ^[29], and the requirements of the statutory water provider.

Soils Disposal (Waste Acceptance Criteria)

Where soil arisings are generated during redevelopment works and require off-Site disposal, they will need to be appropriately characterised and classified as waste prior to removal from Site. Technical Guidance WM3 ^[30] sets out the methodology for the classification of waste, including determination of whether material is hazardous or non-hazardous.

Where disposal to landfill is proposed, the requirements of the receiving facility will also need to be established. Waste Acceptance Criteria (WAC) testing may be required to determine whether the material meets the relevant acceptance criteria for the proposed class of landfill, but should not be regarded as a substitute for waste classification in accordance with WM3.

Any waste classification and, where required, WAC testing should be undertaken on representative samples of the materials intended for disposal (e.g. excavation arisings generated during development) prior to their removal from Site.

5 FURTHER WORKS

5.1 Introduction

The overall objective of this preliminary assessment was to contribute towards the understanding of the environmental, geological, hydrogeological, and geotechnical conditions underlying the proposed development at Longfield House, Thurgoland. Research into the history and evolution of the Site has been undertaken, allowing a proportionate assessment of the potential environmental risks and general geotechnical considerations to be made at this stage.

It is considered that the study has provided sufficient background information relating to the historic development of the Site and its surroundings, together with the local geology, hydrogeology, and potential sources of soil and ground gas contamination. The desk study has also identified a number of development constraints requiring further consideration, principally comprising the potential presence of made ground, opencast backfill and/or disturbed ground beneath part of the proposed development area, and the underlying Pennine Lower Coal Measures Formation. Mining legacy risks and the need for follow-on works were assessed in the accompanying Coal Mining Risk Assessment, which should be read in conjunction with this Report.

The preliminary assessment, when considered within the context of the proposed residential development, indicates that a number of potential source-pathway-receptor linkages require verification through intrusive ground investigation. That work should characterise the underlying ground conditions, establish the chemical quality and geotechnical properties of the soil matrices present, and assess the ground gas regime. The findings should then be used to refine the preliminary CSM presented herein and provide the Site-specific information required to inform the proposed development.

On this basis, it is considered that a programme of intrusive ground investigation should be undertaken prior to redevelopment, to verify the findings of this preliminary assessment and provide the information necessary for subsequent assessment and detailed design.

5.2 Objectives of Investigation

In relation to the proposed development, the primary objectives of the intrusive investigation and associated assessment works to be completed would be to:

- a. Investigate the presence, nature, thickness, and lateral extent of any made ground, opencast backfill, and/or other disturbed materials, together with the depth to, condition, and nature of the underlying undisturbed natural strata;
- b. Determine the geotechnical properties and strength profile of the underlying ground through appropriate in-situ testing and laboratory analysis, to provide information necessary for foundation design;
- c. Report the presence of any in-ground obstructions and/or other difficulties encountered during the works;

- d. Investigate the shallow-depth groundwater regime beneath the Site;
- e. *In accordance with the recommendations of the CMRA*, investigate the recorded and potentially unrecorded shallow coal mine workings beneath the proposed development and establish the presence, depth, condition, and significance of any coal seams, workings, voids, or mining-related disturbance encountered;
- f. Establish the position, nature, depth, and extent of former opencast excavation, backfill, and associated disturbed ground identified within the accompanying CMRA, insofar as these may affect the proposed development area;
- g. Determine the nature and concentration of any contamination within the soil matrices encountered across the Site, having regard to the potential contaminant sources identified within the preliminary CSM, including appropriate sulphate and other geochemical analysis relevant to buried concrete and services;
- h. Investigate the level of risk associated with ground gases; and
- i. Provide general advice in relation to any environmental, geotechnical, or mining-related issues identified and make recommendations necessary to facilitate the proposed development, including any further investigation, assessment, remediation, ground treatment, or other measures considered necessary.

5.3 Proposed Methods of Investigation

It is recommended that the works summarised in Table 5.1, below and overleaf, be completed. The final number, depth, and positioning of exploratory locations should be determined as part of the detailed investigation design, having regard to the proposed building footprint, the mining and opencast features identified within the accompanying Coal Mining Risk Assessment, Site access, and the presence of underground and overhead services.

Table 5.1 - Phase 2 Investigation Recommendations

	Anticipated Scope	Likely Investigation Method	Potential Contaminants of Concern
<i>Environmental Investigation</i>			
1	Determine the nature and environmental quality of made ground, opencast backfill, disturbed materials and underlying natural strata, including sulphate and other geochemical parameters relevant to buried concrete and services	Mechanical excavation and/or boring with representative sample recovery for environmental testing	Metals/metalloids, general inorganics, TPHCWG, BTEX, PAHs, VOCs, SVOCs and asbestos

Contd./

	Anticipated Scope	Likely Investigation Method	Potential Contaminants of Concern
2	Characterise the Site-specific ground gas regime	Mechanical boring with gas monitoring installation(s) and subsequent bi-weekly monitoring	CO ₂ , CH ₄
<i>Geotechnical Investigation</i>			
3	Establish the nature, thickness, variability and strength profile of made ground, opencast backfill/disturbed materials and underlying natural strata	Mechanical excavation and/or boring, with appropriate in-situ testing and sample recovery	-
4	Determine appropriate geotechnical parameters for foundation design, including the classification and engineering characteristics of cohesive/weathered materials	Geotechnical laboratory testing and appropriate in-situ testing	-
<i>Mining Investigation</i>			
5	Investigate the recorded and potentially unrecorded shallow coal mine workings and establish the presence, depth and condition of coal seams, workings, voids and/or mining-related disturbance beneath the proposed development	Rotary open-hole drilling undertaken in accordance with MRA permitting requirements	-
6	Investigate the extent and nature of former opencast excavation, backfill and associated disturbed ground potentially affecting the proposed development area	Targeted mechanical excavation/boring and/or rotary drilling, as appropriate to the anticipated depth and geometry of the former opencast margin	-

5.4 Testing

Geotechnical

The intrusive ground investigation should establish the nature, thickness, variability, and engineering characteristics of any made ground, opencast backfill and/or disturbed materials, together with the underlying weathered and less weathered natural Coal Measures strata beneath the proposed development area. Representative disturbed and, where appropriate, undisturbed samples should be recovered for geotechnical laboratory testing and supplemented by appropriate in-situ testing to establish the strength profile of the underlying ground and identify suitable founding strata.

The scope of laboratory and in-situ testing should be selected having regard to the materials encountered and the information required for subsequent foundation design. Testing would typically include appropriate classification, moisture content, plasticity and strength testing, together with any additional parameters necessary to assess allowable bearing capacity and anticipated total and differential settlement and facilitate selection of an appropriate foundation solution.

All works should be undertaken generally in accordance with BS 5930, BS 10175, BS EN 1997-1 (Eurocode 7: Part 1) ^[31] and BS EN 1997-2 (Eurocode 7: Part 2) ^[32]. Ground conditions should be logged on Site by a suitably qualified consulting engineer or geologist in accordance with BS EN ISO 14688-1 ^[33], BS EN ISO 14688-2 ^[34] and BS EN ISO 14689 ^[35].

Mining Legacy

As detailed within the accompanying Coal Mining Risk Assessment, the Site is affected by recorded and potentially unrecorded shallow coal mine workings and former opencast activity, the nature and significance of which require confirmation through Site-specific investigation.

The mining investigation should therefore be designed to establish the presence, depth, condition, and extent of any shallow coal seams and associated mine workings beneath the proposed development area, together with any voids, broken ground or other mining-related disturbance. Rotary open-hole drilling should be undertaken to an appropriate terminal depth sufficient to investigate the relevant coal-bearing succession, subject to the detailed investigation design and MRA permitting requirements.

The investigation should also seek to resolve the present uncertainty regarding the former Birkfield OCCS, including the position and geometry of the former opencast margin and the presence, depth, and extent of any associated excavation, backfill and disturbed ground beneath the proposed development area. The investigation method and location of exploratory positions should be specifically targeted towards resolving these uncertainties rather than relying solely upon a general Site-wide investigation pattern.

Where boreholes are located within 50m of occupied buildings, drilling should be undertaken using water flush techniques in accordance with current Health and Safety Executive guidance to minimise the potential for carbon monoxide displacement and any residual risk associated with spontaneous combustion.

The findings should be used to determine whether the identified mining legacy presents an unacceptable ground stability risk and, where necessary, to inform the scope of any subsequent remedial treatment and/or specific engineering measures required to facilitate development.

Environmental

Environmental sampling should be undertaken in accordance with the recommendations of BS10175 and current LCRM guidance. Representative soil samples should be recovered from the principal soil matrices encountered, including made ground, opencast backfill and/or other

disturbed materials where present, together with the underlying natural strata, and submitted to an appropriately accredited laboratory^[36] for analysis.

The analytical suite should be developed from the preliminary CSM and potential contaminant sources identified herein and should include appropriate analysis for metals/metalloids, inorganic contaminants, sulphate, PAHs, TPHCWG, BTEX, VOCs and SVOCs. Asbestos screening should also be included within the standard analytical suite, notwithstanding that asbestos has not been identified as a specific contaminant of concern.

Appropriate geochemical testing should additionally be undertaken to determine the Design Sulphate Class (DSC) and Aggressive Chemical Environment for Concrete (ACEC) Classification, together with soil corrosivity parameters where required to inform the assessment of buried services and any new or replacement potable water supply pipework.

Where soil arisings are subsequently proposed for off-Site disposal, appropriate waste classification and, where required by the proposed disposal route or receiving facility, WAC testing should be undertaken on representative samples of the materials concerned.

Ground Gas

A programme of ground gas monitoring should be undertaken to establish the Site-specific ground gas regime, having regard to the recorded and potentially unrecorded shallow mine workings, former opencast activity, and potential associated disturbed and/or backfilled ground.

Monitoring should comprise a minimum of 6 No. bi-weekly monitoring visits and include measurement of methane, carbon dioxide, oxygen, atmospheric pressure, and flow rate. Monitoring should be undertaken under representative atmospheric conditions and in accordance with BS8485 and other current relevant guidance. The results should subsequently be used to complete a Site-specific ground gas risk assessment, determine the appropriate Characteristic Situation, and establish the requirement, if any, for ground gas protection measures within the proposed dwelling.

Allowance for protection measures consistent with BS8485 Characteristic Situation 2, or potentially greater protection, should be made until the Site-specific ground gas regime has been confirmed.

5.5 Outline Remediation Requirements

Soil

At this stage it is not possible to determine whether remedial measures relating to soil contamination will be required. The requirement for remediation will be established following completion of the intrusive ground investigation, laboratory testing, and subsequent risk assessment.

Should unacceptable risks to identified receptors be confirmed, remediation should be undertaken in accordance with the principles of the LCRM framework and the requirements

of the Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) guidance ^[37], together with any other Site-specific requirements of the LPA.

Where remediation is required, a standalone Remediation Strategy should be prepared setting out the proposed remedial measures, implementation methodology, verification requirements, and any post-remediation monitoring considered necessary. Following completion of the works, a Verification Report should be prepared to demonstrate that the agreed remedial objectives have been achieved.

Ground Gas

In the absence of Site-specific ground gas monitoring data, allowance should presently be made for protection measures consistent with BS8485 Characteristic Situation 2, or potentially greater protection, until the ground gas regime has been established. Potential sources of ground gas principally comprise the recorded and potentially unrecorded shallow mine workings, former opencast activity, and associated disturbed and/or backfilled ground.

The appropriate Characteristic Situation and corresponding gas protection requirements should be determined following completion of the ground gas monitoring programme and Site-specific risk assessment. The applicable Building Type should then be established in accordance with BS8485 to determine the minimum Gas Protection Score required for the proposed dwelling.

Should gas protection measures be required, a standalone Remediation Strategy should be prepared defining the proposed protection measures, installation requirements, quality assurance procedures, and verification methodology. The design, installation, and verification of the protection system should be undertaken in accordance with BS8485, relevant YALPAG guidance ^[38], the manufacturer's requirements, and any Site-specific requirements of the LPA.

Following installation, the protection measures should be independently verified in accordance with the requirements of the approved Remediation Strategy and relevant YALPAG guidance, with a Verification Report subsequently prepared to demonstrate that the specified protection measures have been satisfactorily installed and the remedial objectives achieved.

Coal Mining

The requirements for investigation and, where necessary, remediation of the identified mining legacy are detailed within the accompanying Coal Mining Risk Assessment.

Where intrusive investigation confirms mine workings, opencast backfill, disturbed ground, or other mining-related conditions that present an unacceptable ground stability risk to the proposed development, appropriate remedial treatment and/or specific engineering measures will be required. The nature and extent of such measures should be determined having regard to the conditions established through investigation.

Where treatment of mine workings is required, a standalone *Treatment of Mine Workings Specification* should be prepared defining the proposed treatment works, drilling methodology, grout design, quality assurance procedures, verification requirements, and

acceptance criteria. The Specification should be submitted to the LPA for consultation with the MRA and approval as part of the discharge of the relevant planning requirements. A separate permit application would also need to be made to the MRA prior to commencement of any treatment works, supported by the necessary technical information.

The remedial works should subsequently be undertaken in accordance with the agreed Specification, applicable MRA permitting requirements, and current UK guidance. Following completion, a Validation Report should be prepared to document and verify the works undertaken, demonstrate that the specified remedial objectives have been achieved, and confirm that the Site is suitable and stable for the proposed development from a mining legacy perspective.

6 REGULATORY APPROVAL

This Report has been prepared in accordance with current good practice guidance for the assessment and management of land potentially affected by contamination and geotechnical hazards. The opinions and recommendations presented are based upon the information available at the time of writing and should be considered within the context of the limitations of this assessment.

The conclusions and recommendations contained within this Report are considered appropriate for the proposed residential development and should be read in conjunction with the accompanying Coal Mining Risk Assessment and any subsequent intrusive ground investigation, risk assessment, remediation strategy, and/or verification documentation prepared for the Site.

Should additional information become available, or should ground conditions be encountered during subsequent investigation or construction that differ materially from those anticipated within this assessment, the findings, preliminary CSM, and recommendations should be reviewed and revised where necessary.

It remains the responsibility of the Client to ensure that the requirements of the LPA, MRA, Building Control, warranty provider, and any other relevant regulatory or statutory bodies are satisfied. Accordingly, this Report and subsequent reports prepared as part of the phased investigation, risk assessment, remediation, and verification process should be submitted to the relevant authorities, as appropriate, in support of the planning process and discharge of any associated conditions.

7 INFORMATION SOURCES

The following references have been cited in the production of this report:

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- 21 Environmental Protection Act 1990: Part 2A Contaminated Land, Statutory Guidance, Edition 2, 2006.
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 - 29 UKWIR (2011). Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites. Ref. 10/WM/03/21).
 - 30 Environment Agency (2018). Technical Guidance (WM3). Waste Classification, Guidance on the Classification and Assessment of Waste (1st Edition, Version 1.1).
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 - 32 BS EN 1997-2 (2007). Eurocode 7. Geotechnical Design. Ground Investigation and Testing.
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 - 37 Yorkshire and Lincolnshire Pollution Advisory Group (2021). Verification Requirements for Cover Systems. Technical Guidance for Developers, Landowners and Consultants. Version 4.1.
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8 REPORTING LIMITS

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The findings, opinions, and recommendations presented in this Report have been prepared in good faith and are subject to the limitations imposed by the scope of works undertaken, the information made available, and the methods of assessment adopted.

Information obtained from third-party sources has been used where appropriate. Whilst such information is believed to be reliable, Groundsmiths cannot independently verify its accuracy or completeness and accepts no responsibility for errors or omissions arising from information supplied by others. Professional judgement has been exercised throughout to reduce uncertainties to a level considered appropriate for the purpose of this assessment.

This Report comprises a qualitative LCRM Stage 1 Preliminary Risk Assessment based upon currently available information. No intrusive investigation has been undertaken as part of this assessment and actual ground conditions may differ from those anticipated herein. Such conditions can only be established through appropriate Site-specific investigation. The findings and recommendations are therefore applicable only to the Site, proposed development, and information available at the time of writing.

Should additional information become available, ground conditions differ materially from those anticipated, the proposed development change, or relevant legislation or technical guidance be revised, the Conceptual Site Model, findings, and recommendations contained within this Report may require review.

The conclusions and recommendations contained within this Report are limited to those that could reasonably be made on the basis of the available information. Any plans, boundaries, extents, or affected areas referred to within this Report should be regarded as approximate unless specifically stated otherwise.

This Report does not constitute an archaeological, ecological, arboricultural, invasive species, or unexploded ordnance (UXO) assessment. Any observations relating to these matters are provided for general information only, and specialist assessment should be undertaken where required.

Groundsmiths does not provide legal advice. Where legal advice is required, this should be obtained from an appropriately qualified legal professional.

Groundsmiths accepts no responsibility for the implementation, or otherwise, of the recommendations contained within this Report, nor for any additional investigations, remedial works, or other measures that may subsequently be required by the LPA, the MRA, Building Control, a warranty provider, or any other relevant regulatory or statutory body.

Reliance upon this Report is limited to the Client unless otherwise agreed in writing. Should a future purchaser or other third party require reliance upon the Report, this may be considered by Groundsmiths subject to agreement of the terms of reliance, payment of any applicable fee, and completion of an appropriate reliance or assignment agreement.

