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Flood Risk Assessment and Drainage Strategy Report

Roslyn Avenue, Netherton

Harron Homes (Yorkshire) Ltd

QUALITY MANAGEMENT

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REVISION SCHEDULE

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY REPORT

ROSLYN AVENUE, NETHERTON

Rev	Date	Details	Prepared By	Approved By
A	18.02.2025	First Issue	S. Griffiths	S. Griffiths
B	22.07.2025	Site layout plan revised. Report amended to suit.	S. Griffiths	S. Griffiths

CONTRACT

The report describes work commissioned by Harron Homes (Yorkshire) Ltd as outlined within fee proposal dated 18th November 2024.

PURPOSE

This document has been prepared as a Flood Risk Assessment and Drainage Strategy Report for Harron Homes (Yorkshire) Ltd. Elston Engineering Ltd accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

Elston Engineering Ltd has no liability regarding the use of this report except to Harron Homes (Yorkshire) Ltd.

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1. EXECUTIVE SUMMARY

Site Name	Roslyn Avenue, Netherton
Location	Roslyn Avenue, Netherton
Client	Harron Homes (Yorkshire) Ltd
Grid Reference	411974, 413060
Area (ha)	3.499ha
Current Land Use	Undeveloped grassland
Environment Agency Flood Zone	Flood Zone 1
NPPF Development Classification	More Vulnerable
History of Flooding	No history of flooding
Flood Defences	N/A
Summary of Risks	The site is not at risk of flooding from any sources
Runoff Rate (l/s)	**5.0 l/s** for 1 in 100 year + 45% CC

2. INTRODUCTION

2.1 SCOPE OF ASSESSMENT

Elston Engineering Ltd have been commissioned by Harron Homes (Yorkshire) Ltd to prepare a Flood Risk Assessment Report to support the Planning application for the works and change of use of Roslyn Avenue, Netherton.

2.2 STUDY OBJECTIVES AND METHODOLOGY

The Report is a holistic risk-based approach to consider flood risk from all possible sources, so to satisfy the requirements of the National Planning Policy Framework (NPPF). The objectives of this report are as follows:

- Determine likely sources of flooding,
- Assess the proposals in the context of the National Planning Policy Guidance,
- Propose an appropriate drainage strategy, and
- Determine appropriate mitigation and/or protection measures.

The methodology followed in the preparation of this report include the following:

- An investigation of the flood risk within and external to the Site,
- Consideration of the pre-development and post-development surface water runoff and identification of a means of storm water disposal, and
- Consideration of storm events up to and including the 1 in 100 year return period storm event, plus Climate Change, and calculations of the required volume of onsite storage, where this is applicable.

The report deals with environmental issues that are associated with flooding, other impacts on the environment are not considered. Existing sources of flood risk have been formally assessed, this includes both ground water and urban drainage systems.

3. DEVELOPMENT SITE AND LOCATION

3.1 EXISTING SITE

The site is located off Roslyn Avenue, Netherton and is centred about Ordnance Survey Grid Reference 411974, 413060. The site is roughly rectangular in shape orientated in a North South direction. The site occupies an area of approximately 3.499ha. Figure 1, below, shows the site location and boundary.

Figure 1 – Site Location Plan

The site is currently undeveloped grassland which is accessible via a gated entrance of Rosyln Avenue located to the East of the site. The site bound to the North by mature woodland. The Southern and Eastern boundaries are defined by established fence lines over which are existing residential properties. The Western boundary is defined by dry stone wall with access to the land to the West. The land to the West is undeveloped grassland / agricultural land.

3.2 TOPOGRAPHY

A topographical survey has been conducted by Turnbull Surveying on behalf of Harron Homes (Yorkshire) Ltd. There is a significant fall across the site with levels generally falling from North West to South East. Levels on site range from 186.209m AOD to 201.527m AOD.

A copy of the site topographical survey drawings can be found in Appendix A.

3.3 GEOLOGY AND GROUNDWATER

A Phase 2 Ground Investigation report was carried out by Lithos in July 2024. The report made the following comments with regards the conditions on site.

Made Ground

Encountered in one pit (TP06) beneath the topsoil to a depth of 2.4m; comprised of Cobbles and Boulders of Sandstone with gravelly Sand (Reworked Natural material), believed to be a localised borrow pit or small-scale quarry, further occurrences of which (yet to be identified) may be present.

The cobbles of sandstone were not uniform and were of different colours and shapes; the excavation was also very unstable and no 'structure' could be seen in the sidewall, as would be expected in weathered bedrock. Trial pits TP25 to 27 were excavated to delineate the made ground, however, all three found shallow sandstone bedrock at c. 1m depth.

Possible Reworked Natural material was also encountered in WS03 & WS06 to depths of around 2m; comprising very loose sandy Gravel of sandstone.

Natural Ground

Topsoil (typically 300mm in thickness), over weathered bedrock comprising gravelly Sand, sandy Gravel and/or Cobbles with occasional boulders and a matrix of sand/gravel. Sandstone bedrock was encountered in all trial pits at depths varying between 1.0m and 2.5m (ave. of 1.5m).

Groundwater & Excavations

Groundwater was not encountered within any of the exploratory holes. Shallow excavations are unlikely to remain stable in the short term due to overbreak in the granular residual soils (namely the cobbles). Excavation greater than c. 1.5m is likely to prove difficult across most of the site.

A copy of the Phase 2 ground investigation report by Lithos can be found in Appendix B

3.4 HYDRAULIC FEATURES

The nearest major watercourse to the site is the River Holme which is located approximately 1.50km North East of the site. The River Holme flows in an Northernly directions ultimately discharging to the River Colne in Huddersfield.

The Dean Clough minor watercourse is located approximately 0.10km North of the site. The Dean Clough watercourse flows in an Easternly direction discharging to the River Holme.

3.5 CURRENT SITE DRAINAGE

Yorkshire Water are responsible for adopted drainage assets in Netherton. Sewer asset record plans for the site and surrounding area have been obtained which show there are no foul and surface water assets within the extents of the development.

The record plans show combined water assets are located in Rosyln Avenue to the East of the site. The sewer at the head of the run is a 225mm dia. and the upstream manhole has a cover level of 193.280m and an invert level of 191.480m. The combined water system flows down Rosyln Avenue before turning through 90 degrees and heading south down Henry Frederick Avenue.

A copy of the Yorkshire Waters sewer asset record plans can be found in Appendix C.

4. DEVELOPMENT PROPOSALS

The proposed development comprises the construction of 82no. residential properties with associated adopted highways. The development will comprise of 66 Open Market properties with a mixture of 1, 2, 3, 4 and 5 bedroom units. In addition, there are also 16 S106 Affordable Houses with a mix of 1, 2, 3 and 4 bedroom units.

The development will be accessed via a single access off Roslyn Avenue. A area of public open space and a playground are also proposed as part of the development and will be located near to the Southern boundary. A public footpath will also be provided on site to connect the estate to an existing ginnel located in the South East corner of the site which will provide a pedestrian link to Henry Frederik Avenue / Meltham Road.

A copy of the proposed site layout plan can be found in Appendix D.

5. POLICY AND GUIDANCE

The following planning policies and guidance are relevant to the Proposed Development with regards to flood risk and surface water management.

5.1 FLOOD AND WATER MANAGEMENT ACT, 2010

In combination with the Flood Risk Regulations 2009, (which enact the EU Floods Directive in England and Wales) the Act places significantly greater responsibility on Local Authorities to manage and lead on local flooding issues. The Act and the Regulations together raise the requirements and targets Local Authorities need to meet, including:

- To play an active role in leading Flood Risk Management in the local area;
- The development of the Surface Water Management Plans (SWMPs);
- To implement the requirements of Flood and Water Management legislation;
- The preparation of preliminary Flood Risk Assessments (FRAs) and Flood Risk Management Plans (FRMPs);
- The development and implementation of drainage and flooding management strategies; and
- The responsibility for first approval, then subsequent adoption, management and maintenance of Sustainable Urban Drainage Systems (SuDS).

The Flood and Water Management Act also clarifies three key areas that influence development:

1. Sustainable Drainage (SuDS) - the Act makes provision for a national standard to be prepared on SuDS, and that developers will be required to obtain local authority approval for SuDS in accordance with the standards, likely with conditions. Supporting this, the Act requires local authorities to adopt and maintain SuDS, removing any ongoing responsibility for developers to maintain SuDS if they are designed and constructed robustly.

2. Flood Risk Management Structures - the Act enables the EA and local authorities to designate structures such as flood defences or embankments owned by third parties for protection if they affect flooding or coastal erosion. A developer or landowner will not be able to alter, remove or replace a designated structure or feature without first obtaining consent.

3. Permitted flooding of Third-Party Land - The EA and local authorities have the power to carry out work which may cause flooding to third party land where the works are deemed to be in the interest of nature conservation, the preservation of cultural heritage or people's enjoyment of the environment or of cultural heritage.

5.2 NATIONAL PLANNING POLICY FRAMEWORK (NPPF), 2018

The NPPF, originally published in 2012, was part of a series of reforms to simplify and make more accessible all planning legislation that is applicable within England. This is supported by the National Planning Policy Guidance (NPPG), an online planning resource published in July 2018 supersedes all previous technical guidance.

Both the NPPF and NPPG must be taken into consideration in the development of local and neighbourhood plans and must be considered in determining all planning applications.

The NPPF and NPPG also recommends that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and to develop local policies to manage flood risk from all sources and take account of advice from the Environment Agency and other relevant flood risk management bodies such as Internal Drainage Boards (IDBs). Local Plans should apply a risk based, sequential approach to the proposed development site to avoid, where practicable, flood risk to people and property. As well as to manage any residual flood risk, and to consider the impact of Climate Change, by:

- The application of the Sequential Test;
- Applying the Exception Test, if required;
- Prevent development on land that is required for current and future flood management;
- Use the opportunity from new development to reduce the source and impact of flooding; and
- To seek opportunities to relocate development, including housing to more sustainable locations, should Climate Change increase flood risk to a current development and render it unsustainable in the long term.

5.3 THE SEQUENTIAL TEST AND EXCEPTION TEST

The purpose of the Sequential Test is to steer new development towards areas with the lowest probability of flooding (Flood Zone 1). Where there are no reasonably available sites within Flood Zone 1, local planning authorities in their decision making should consider the flood risk vulnerability of land uses and consider all reasonably available sites in Flood Zone 2 (areas with a medium probability of flooding), and only applying the Exception Test as required. Only when there are no reasonably available sites in either Flood Zone 1 or 2, should sites in Flood Zone 3 (areas with a high probability of flooding) be considered. With full reference made to the land use flood risk vulnerability and applying the Exception Test when necessary.

For the Exception Test to be passed:

- the development must demonstrate that it will provide wider sustainability benefits to the community that outweigh flood risk, and that is informed by a comprehensive Strategic Flood Risk Assessment, where one has been prepared; and
- a site-specific flood risk assessment must demonstrate that the development will be safe for its entire lifetime, that the vulnerability of its users is considered, that it will not increase flood risk elsewhere and it will aim to reduce the overall flood risk.

5.4 THE SUDS MANUAL (C753) 2015

The SuDS Manual provides best practice guidance on the planning, design, construction, operation, and maintenance of Sustainable Drainage Systems (SuDS) to facilitate their effective implementation within the planning process.

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The SuDS Manual has been referred to in the decision-making process of which SuDS features will be suitable for the site. Section details the methodology used, the SuDS features that have been selected, and the reasoning for the selection.

6. CLIMATE CHANGE

The National Planning Policy Framework states that Climate Change should be considered as part of the formal flood risk assessment process. The National Planning Policy Framework Climate Change Allowance online mapping confirms the percentage allowance based on catchment. A link to the National Planning Policy Framework Climate Change Allowance online mapping can be found below.

https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgtmcatid=3052

The development falls within the Aire and Calder Management catchment and as such the climate change allowance as outlined in Table 1 and Table 2 below.

Table 1 - 3.3% Annual Exceedance Rainfall Event

	Central Allowance	Upper End Allowance
2050s	20%	35%
2070s	25%	40%

Table 2 - 1% Annual Exceedance Rainfall Event

	Central Allowance	Upper End Allowance
2050s	25%	40%
2070s	30%	45%

7. SITE SPECIFIC FLOOD RISK

7.1 FLUVIAL FLOODING

The Environment Agency Risk of Flooding from Rivers or the Sea mapping has been reviewed to give guidance for the fluvial and tidal risk to the site. Figure 2, below, shows the current Risk of Flooding from Rivers or the Sea map for the site.

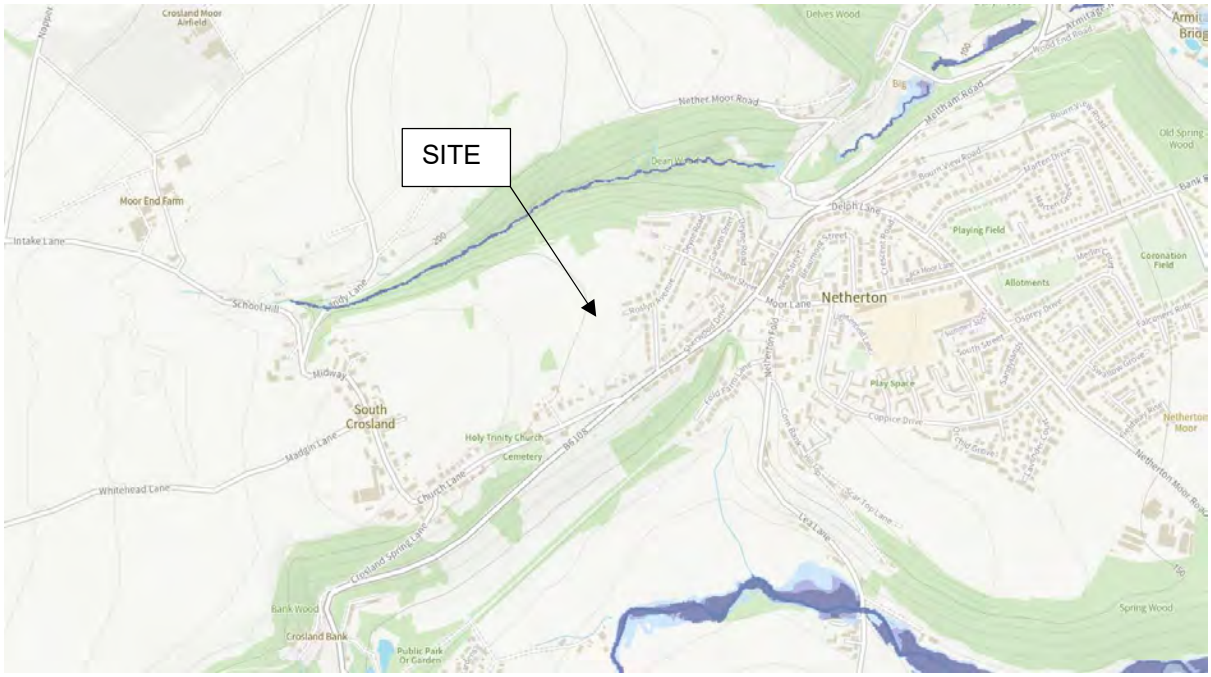


Figure 2 - Environment Agency Risk of Flooding from Rivers and Sea mapping for the site.

The Environment Agency flood mapping shows the site is not affected by flooding from fluvial sources.

The Environment Agency classifies the site as being location in Flood Zone 1 and is considered to be at Low Probability of Flooding. Flood Zone 1 is defined as land that has a “Low Probability” of flooding.

Table 3 - Flood Zone Classifications.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map - all land outside Zones 2 and 3).
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1000 annual probability of sea flooding. (Land shown in light blue on the Flood Map).
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map).
Zone 3b The Functional Floodplain	This zone comprises land where water must flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional flood plain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map).

The proposed development comprises the construction of 82no. residential properties with associated adopted highways. The development will comprise of 66 Open Market properties with a mixture of 1, 2, 3, 4 and 5 bedroom units. In addition, there are also 16 S106 Affordable Houses with a mix of 1, 2, 3 and 4 bedroom units.

Using Table 2: Flood Risk Vulnerability Classification of the National Planning Guidance, the development is classed as being 'More Vulnerable'.

More Vulnerable

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

7.2 PLUVIAL (SURFACE WATER) FLOODING

Pluvial, or surface water, flooding occurs when natural and manmade systems have insufficient capacity to cope with high volumes of rainfall. Pluvial flooding can occur in urban areas during extreme, high intensity, short duration summer rainfall events, which overwhelm the surface water drainage network. Or in rural areas following a medium intensity, long duration events, where the ground conditions are saturated and there is no additional storage capacity within the underlying soils. The flood water is then conveyed via overland flow routes that are in turn dictated by the local topography.

The Environment Agency Risk of Flooding from Surface Water mapping has been reviewed which shows no flooding from Pluvial Sources on site as shown in Figure 3, below.

Figure 3 - Environment Agency Flood Mapping - Flood Risk from Surface Flooding – Low Risk

From the Environment Agency mapping the development is therefore not considered to be at risk of flood from Pluvial Sources.

As part of the development levels on site are to be altered to suit the proposed layout. Overland flows are to be considered as part of the design and features such as filter drains incorporated to intercept overland flows from affecting properties or discharging off site.

7.3 TIDAL FLOODING

The site is remote from the sea and watercourse close to the site are not subject to tidal influence, as such the development is not considered to be at risk of Tidal Flooding.

7.4 FLOODING FROM ARTIFICIAL SOURCES

Flooding from artificial sources refers to all flooding generated by manmade sources. This includes reservoirs, canals, artificial lakes and from mining abstraction. Reservoir flooding is extremely unlikely to happen, and there are no recorded fatalities from a breach of a reservoir retaining dam in the UK since the 1920s. The Reservoir Act 1975, mandates that the Environment Agency is responsible for all reservoirs in England to be regularly inspected, and that essential maintenance works are carried out as and when required.

The Environment Agency Risk of Flooding mapping has been reviewed which shows the site not at risk of flooding from Artificial Sources, the development is therefore not considered to be at risk of flood from Artificial Sources.

7.5 GROUNDWATER FLOODING

Groundwater flooding occurs when water rises from an underlying aquifer or from water rising from abnormal springs. This usually occurs following long periods of sustained heavy rainfall, and the areas that are most susceptible are those that are low lying, and where there is a high-water table. Groundwater flooding is also known to occur in areas underlain by major aquifers, although increasingly it is associated with more localised floodplain sand and gravels.

Given the geology on site as identified within the Phase 2 Ground Investigation report prepared by Lithos the site is not considered to be at risk of flooding from groundwater.

7.6 FLOODING FROM DRAINAGE INFRASTRUCTURE

Flooding can also arise from the drainage network when it is either overwhelmed from high rainwater volume following an intense storm event, or when there is a blockage within the network. Blockages in the drainage system can lead to localised flooding where this occurs.

Yorkshire Water are responsible for adopted drainage assets in Netherton. No flooding incidents have been reported which are due to adopted drainage assets and as such the development is not considered to be at risk of flooding from drainage infrastructure.

8. SEQUENTIAL TEST

As stated in Section 5.2, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. All sources of flooding have been reviewed which have confirmed the site is located in Flood Zone 1.

The Sequential Test has been applied to the development site in accordance with the National Planning Policy Guidance. In accordance with the National Planning Policy Guidance the proposed development is considered suitable.

9. EXCEPTION TEST

The Exception Test is not required, in accordance with Table 3: Flood Risk Vulnerability and Flood Zone 'Compatibility' of the National Planning Policy Guidance. Table 4 below, shows the Flood Risk Vulnerability Classification from the NPPF.

Table 4 – NPPF - Flood Risk Vulnerability and Flood Zone 'Compatibility'.

Flood Zone	Flood Zone Classification				
	Essential infrastructure	**Highly vulnerable**	**More vulnerable**	**Less vulnerable**	**Water compatible**
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception test required	✓	✓	✓
Zone 3a †	Exception test required †	×	Exception test required	✓	✓
Zone 3b	Exception test required *	×	×	×	✓

Key:

✓ Development is appropriate.

× Development should not be permitted.

10. SURFACE WATER MANAGEMENT

10.1 REQUIREMENTS AND REGULATIONS

The means of draining surface water generated by a site are required to mirror the behaviour of the existing site run-off, so far as is practicable, to offset the off-site flood risk that might otherwise be created, or to bypass it entirely.

The following documents have been referred to as part of the development of the drainage strategy for the development to ensure current standards and industry best practice are adhered to:

- Buildings Regulations Part H - Drainage and Waste Disposal
- Code for Adoption, 2020.
- CIRIA Report 753 - The SuDS Manual, 2015
- BRE Digest 365 - Soakaway Design

In accordance with Building Regulations Part H - Drainage and Waste Disposal, surface water runoff generated by a site should look to discharge to one of the following listed in order of priority:

- An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,
- A watercourse; or where that is not reasonably practicable,
- A surface water sewer; or where that is not reasonably practicable,
- A combined water sewer.

10.2 SURFACE WATER DRAINAGE STRATEGY

In accordance with the surface water hierarchy outlined in Building Regulations Part H, surface water runoff should look to discharge to a soakaway and / or infiltration drainage system. A Phase 2 Ground Investigation report was carried out by Lithos in July 2024, the report confirmed a shallow layer of natural / made ground varying in thickness from 1.00m to 2.50m across the site over a limestone layer. Given the underlying geology infiltration drainage techniques are not considered suitable as the primary method of surface water discharge.

As infiltration drainage techniques are not suitable surface water runoff should look to discharge to watercourse. The nearest watercourse to the site is the Dean Clough minor watercourse which is located approximately 0.10km North of the site. The Dean Clough watercourse flows in an Easterly direction discharging to the River Holme. Due to the level of the watercourse and there being third party land between the site and the watercourse a discharge to the watercourse is not possible.

As a discharge to a watercourse is not possible surface water runoff shall discharge to a drainage system.

Yorkshire Water are responsible for adopted drainage assets in Netherton. The record plans show combined water assets are located in Rosyln Avenue to the East of the site. The sewer at the head of the run is a 225mm dia. and the upstream manhole has a cover level of 193.280m and an invert level of 191.480m. The combined water system flows down Rosyln Avenue before turning through 90 degrees and heading south down Henry Frederick Avenue.

Due to the topography on site surface water runoff cannot discharge to the manhole at the head of the run via gravity, however the system in Rosyln Avenue gets deeper up to the junction with Henry Frederick Avenue where it will be possible to make a connection into the combined water sewer via gravity.

A new gravity surface water drainage system shall be constructed on site which will accept surface water runoff from the residential properties, adopted highway and private impermeable surfaced areas. The surface water drainage system will run through the development and combined with the foul water drainage system before heading down Rosyln Avenue and connecting onto the existing Yorkshire Water combined water sewer.

As the site is currently undeveloped surface water runoff from the development will look to discharge to the Yorkshire Water sewer at a rate similar to the predevelopment site. Surface water discharge rates shall be discussed further in Section 10.3.

Individual SuDS features for the site have been reviewed based on the site characteristics, such as the underlying soil type and geology. As well as the design considerations from the development that may limit the feasibility of certain SuDS features from being implemented. Details of the specific SuDS features selected for the site can be found in Section 10.4.

Attenuation shall be provided to attenuate surface water flooding from storms, up to and including 1 in 100 years plus 45% Climate Change with a 10080-minute duration in accordance with Section 6 of this report. Onsite attenuation requirements shall be discussed further in Section 10.5.

An indicative foul and surface water drainage layout plan, drawing EE100008-100 can be found in Appendix E.

10.3 DRAINAGE DISCHARGE AND OUTFALLS

Surface water runoff from the site is proposed to discharge to the adopted Yorkshire Water combined water sewer in Roslyn Avenue. As the site is currently undeveloped surface water runoff from the development will discharge at a rate similar to the developed site..

Surface water runoff from the site shall be restricted to **5.0l/s** for all storm events up to and including 1 in 100 year + 45% Climate Change for a 10080-minute (7 days) duration. The rate will allow for a flow control device to be utilised with a suitably sized orifice to avoid blocking and potentially flooding of the surface water system.

10.4 USE OF SUDS

To ensure the quality of runoff leaving the site is treated to a suitable level, SuDS features have been assessed for their suitability within the proposed development. In accordance with CIRIA Report C753 - The SuDS Manual 2015 features have been considered and their suitability evaluated in relation to the development.

Table 5, below, details all the SuDS features that have been considered for this site and providing supporting evidence to why each SuDS features type have or have not been deemed suitable.

Table 5 - SuDS Selector Table

SuDS Selector Table		
Feature	**Suitable Y / N**	**Evidence**
Rainwater Harvesting	**Y**	Rainwater harvesting in the form of waterbutts could be used to store surface water runoff for reuse or external irrigation purposes.
Green Roofs	**N**	Green roofs are ideally suited to flat roofs, pitched roofs have been proposed within the development and as such are not considered to be suitable within the development.
Infiltration Systems	**N**	Due to the ground conditions infiltration systems are not considered suitable.
Proprietary Treatment Systems	**Y**	Trapped gullies are to be provided within the adopted highway to assist with the removal of sediment.
Filter Strips	**N**	Due to the ground conditions filter strips are not considered suitable.

Filter Drains	**N**	Due to the ground conditions filter strips are not considered suitable.
Swales	**N**	Due to limited space on site swales cannot be accommodated on site.
Bioretention Systems	**N**	Due to the depth of the drainage at the outfall a detention basin is not considered suitable due to health and safety concerns.
Trees / vegetation	**Y**	New planting will be incorporated into the development which will assist with the disposal of surface water runoff.
Pervious Pavements	**N**	Due to the ground conditions pervious pavements are not considered suitable.
Attenuation Storage Tanks	**Y**	An adopted tank shall be installed in the public open space area to provide surface water storage.
Detention Basins	**N**	Due to the levels on site a detention basin is not considered suitable.
Ponds and Wetlands	**N**	Due to the levels on site a pond and / or wetland is not considered suitable.

10.5 STORAGE

Surface water attenuation shall be provided for runoff from the residential properties, adopted highway and the hard surfaced external areas for all storm events up to and including 1 in 100 year + 45% Climate Change for a 10080-minute (7 days) duration.

Based on the current site layout plan the site has an impermeable area of approximately 1.428ha which includes the property roofs, roads, private parking courts and driveways.

Attenuation storage shall be provided within the piped drainage network and an adoptable attenuation tank. XP Solutions quick storage estimate calculations have been undertaken to confirm the surface water attenuation requirements.

The calculations confirm attenuation storage within the piped network and attenuation tank will need to be between 1612m^3 and 2387m^3 for all storms up to and including 1 in 100 year + 45% climate change events.

Copies of the input information and output results for the XP Solutions quick storage estimate calculations can be found in Appendix F.

10.6 OWNERSHIP AND MAINTENANCE

The surface / combined water drainage system and attenuation tank shall be put forward for adoption by Yorkshire Water under a Section 104 agreement and will be designed to Code for Adoption standards.

The connection into the adopted combined water Yorkshire Water sewer shall be made under a Section 106 agreement with Yorkshire Water.
The private surface water drainage around the residential properties to the adopted system shall be the responsibility of the individual property owners to maintain.

Future maintenance schedules for elements of the drainage system can be found in Appendix G.

11. FOUL WATER DRAINAGE PROPOSAL

11.1 REQUIREMENTS AND REGULATIONS

The following documents have been referred to as part of the development of the drainage strategy for the development to ensure current standards and industry best practices are adhered to:

- Buildings Regulations Part H - Drainage and Waste Disposal
- Code for Adoption, 2020.

In accordance with Building Regulations Part H - Drainage and Waste Disposal, foul effluent generated by a site should look to discharge to one of the following listed in order of priority:

- An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,
- A private sewer communicating with a public sewer; or where that is not reasonably practicable,
- Either a septic tank which has an appropriate form of secondary treatment or another wastewater treatment system; or where it is not reasonably practicable,
- A cesspool.

11.2 FOUL WATER DRAINAGE STRATEGY

Yorkshire Water are responsible for adopted drainage assets in Netherton. The record plans show combined water assets are located in Rosyln Avenue to the East of the site. The sewer at the head of the run is a 225mm dia. and the upstream manhole has a cover level of 193.280m and an invert level of 191.480m. The combined water system flows down Rosyln Avenue before turning through 90 degrees and heading south down Henry Frederick Avenue.

Due to the topography on site foul water runoff cannot discharge to the manhole at the head of the run via gravity, however the system in Rosyln Avenue gets deeper up to the junction with Henry Frederick Avenue where it will be possible to make a connection into the combined water sewer via gravity.

A new gravity foul water drainage system shall be constructed on site which will accept foul effluent from the residential properties. The foul water drainage system will run through the development and combined with the surface water drainage system before heading down Rosyln Avenue and connecting onto the existing Yorkshire Water combined water sewer.

A private foul water drainage system will be constructed to convey foul water effluent from the residential properties to the adopted drainage system.

An indicative foul and surface water drainage layout plan, drawing EE100008-100 can be found in Appendix E.

11.3 OPERATIONS AND MAINTENANCE

The foul / combined water drainage system shall be put forward for adoption by Yorkshire Water under a Section 104 agreement and will be designed to Code for Adoption standards.

The connection into the adopted combined water Yorkshire Water sewer shall be made under a Section 106 agreement with Yorkshire Water.

The private foul water drainage around the residential properties to the adopted system shall be the responsibility of the individual property owners to maintain.

12. CONCLUSIONS

12.1 FLOOD RISK

Based on the work carried out in the preparation of this report the following conclusions are made:

- The site is not at risk of flooding from fluvial, pluvial, tidal, sewer sources, groundwater sources and artificial bodies.
- The site is located in Flood Zone 1 – 'Low Probability'.
- The development is classified as being 'More Vulnerable'
- The development satisfies the requirements of the Sequential Test and as such is deemed appropriate.
- The Exception Test is not required as the site is deemed appropriate.

12.2 DRAINAGE SUMMARY - SURFACE WATER

The disposal of surface water runoff generated by the proposed development has been assessed in accordance with the guidance outlined by the Buildings Regulations Part H - Drainage and Waste Disposal.

Yorkshire Water are responsible for adopted drainage assets in Netherton. The record plans show combined water assets are located in Rosyln Avenue to the East of the site. The sewer at the head of the run is a 225mm dia. and the upstream manhole has a cover level of 193.280m and an invert level of 191.480m. The combined water system flows down Rosyln Avenue before turning through 90 degrees and heading south down Henry Frederick Avenue.

Due to the topography on site surface water runoff cannot discharge to the manhole at the head of the run via gravity, however the system in Rosyln Avenue gets deeper up to the junction with Henry Frederick Avenue where it will be possible to make a connection into the combined water sewer via gravity.

A new gravity surface water drainage system shall be constructed on site which will accept surface water runoff from the residential properties, adopted highway and private impermeable surfaced areas. The surface water drainage system will run through the development and combined with the foul water drainage system before heading down Rosyln Avenue and connecting onto the existing Yorkshire Water combined water sewer.

Surface water runoff from the site shall be restricted to **5.0l/s** for all storm events up to and including 1 in 100 year + 45% Climate Change for a 10080-minute (7 days) duration. The rate will allow for a flow

control device to be utilised with a suitably sized orifice to avoid blocking and potentially flooding of the surface water system.

Surface water attenuation shall be provided for runoff from the residential properties, adopted highway and the hard surfaced external areas for all storm events up to and including 1 in 100 year + 45% Climate Change for a 10080-minute (7 days) duration. Attenuation storage shall be provided within the piped drainage network and an adoptable attenuation tank.

The surface / combined water drainage system and attenuation tank shall be put forward for adoption by Yorkshire Water under a Section 104 agreement and will be designed to Code for Adoption standards.

The connection into the adopted combined water Yorkshire Water sewer shall be made under a Section 106 agreement with Yorkshire Water.
The private surface water drainage around the residential properties to the adopted system shall be the responsibility of the individual property owners to maintain.

12.3 DRAINAGE SUMMARY - FOUL WATER

The disposal of foul water effluent generated from the proposed development has been assessed in accordance with the guidance outlined by the Building Regulations Part H - Drainage and Waste Disposal.

Yorkshire Water are responsible for adopted drainage assets in Netherton. The record plans show combined water assets are located in Rosyln Avenue to the East of the site. The sewer at the head of the run is a 225mm dia. and the upstream manhole has a cover level of 193.280m and an invert level of 191.480m. The combined water system flows down Rosyln Avenue before turning through 90 degrees and heading south down Henry Frederick Avenue.

Due to the topography on site foul water runoff cannot discharge to the manhole at the head of the run via gravity, however the system in Rosyln Avenue gets deeper up to the junction with Henry Frederick Avenue where it will be possible to make a connection into the combined water sewer via gravity.

A new gravity foul water drainage system shall be constructed on site which will accept foul effluent from the residential properties. The foul water drainage system will run through the development and combined with the surface water drainage system before heading down Rosyln Avenue and connecting onto the existing Yorkshire Water combined water sewer.

A private foul water drainage system will be constructed to convey foul water effluent from the residential properties to the adopted drainage system.

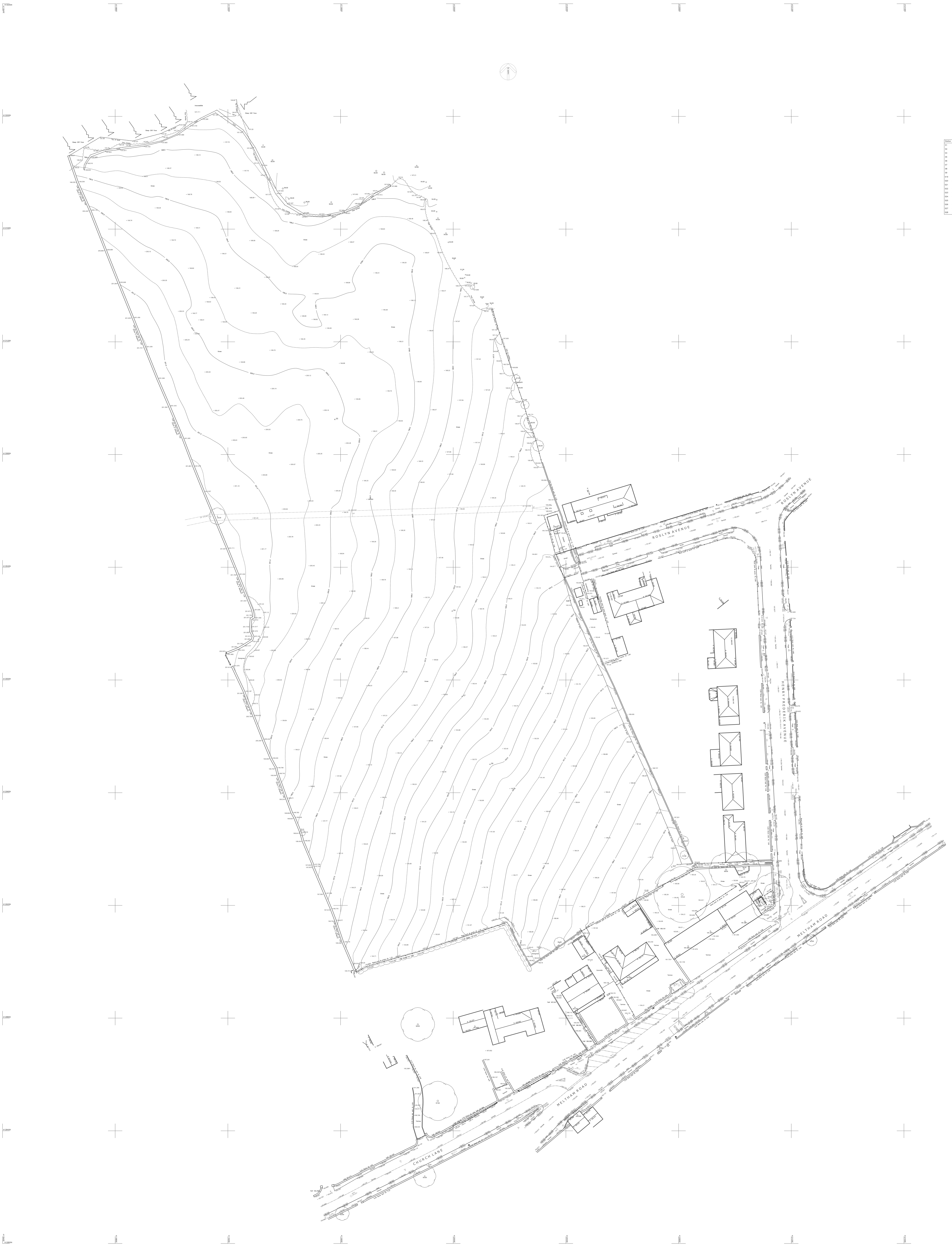
The foul / combined water drainage system shall be put forward for adoption by Yorkshire Water under a Section 104 agreement and will be designed to Code for Adoption standards.

The connection into the adopted combined water Yorkshire Water sewer shall be made under a Section 106 agreement with Yorkshire Water.

The private foul water drainage around the residential properties to the adopted system shall be the responsibility of the individual property owners to maintain.

APPENDIX

APPENDIX A



Sheet 1 of 1	Surveyed by NT
Datum	Drawn by NT
GRID:- Related to Ordnance Survey using One Point Localisation on Station S1. Orientation at OS Grid North.	Date of Survey August 2017
	Scale 1/500 @ A0
LEVEL:- Related to Ordnance Survey by connection to the OS Active Network by G.P.S	Survey Job No. **S1200** August 2017 **S1710** February 2023

SITE SURVEY

LAND OFF ROSLYN AVE NETHERTON HUDDERSFIELD

LEGEND

TURNBULL SURVEYING
Land and Measured Building Surveying

Station	Easting	Northing	Level
S1	412044.913	413041.718	193.517
S2	412117.958	413060.276	189.856
S4	411999.645	413024.452	196.667
S5	411957.957	413092.457	200.108
S6	412013.048	412970.069	193.081
S7	412003.178	412994.198	195.517
S8	412110.355	413008.771	187.000
S9	412115.536	412913.651	179.660
S19	411991.479	412827.423	187.920
S20	412023.822	412844.660	184.937
S21	412049.059	412867.051	183.075
S22	412073.248	412868.991	182.148
S23	412089.473	412881.535	181.488
S24	412115.345	412913.781	179.733
S25	412115.061	412935.473	181.175
S26	412097.288	412934.524	184.566
S27	412077.570	412933.637	186.346
S28	412041.582	413028.134	193.350

APPENDIX B

Geoenvironmental Appraisal

Land at Roslyn Avenue, Netherton

For KCS Developments Ltd

Report no: 5080/1

Date: July 2024

Tel: 01937 545330 • info@lithos.co.uk • www.lithos.co.uk

SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	5080	**Site area/ha**	3.5
Client:	KCS Developments Ltd	**NGR:**	SE 119 130
Site:	Roslyn Avenue, Netherton	**Nearest postcode:**	HD4 7EW

The site is located off Roslyn Avenue, approximately 4.5 km south-west of Huddersfield town centre, and currently comprises a single parcel of land used for agriculture.

The site has remained undeveloped throughout history. A former sandstone quarry, later becoming a refuse tip, is present immediately beyond the north/north-eastern boundary. Numerous infilled quarries are also present to the east, south-west and west, within 250m. An electricity substation was erected immediately beyond the eastern boundary in around c. 1970.

Lithos were commissioned by KCS to provide a geoenvironmental appraisal of the site, which it is understood is to be redeveloped with housing. Lithos' investigation included a review of 3rd party reports, the site's history and environmental setting, and a ground investigation comprising 28 trial pits and 10 window sample boreholes.

A summary of salient geoenvironmental issues is provided in the table below.

Issue	Remarks
Made ground	Encountered in one pit (TP06) beneath the topsoil to a depth of 2.4m; comprised of Cobbles and Boulders of Sandstone with gravelly Sand (Reworked Natural material), believed to be a localised borrow pit or small-scale quarry, further occurrences of which (yet to be identified) may be present. The cobbles of sandstone were not uniform and were of different colours and shapes; the excavation was also very unstable and no 'structure' could be seen in the sidewall, as would be expected in weathered bedrock. Trial pits TP25 to 27 were excavated to delineate the made ground, however, all three found shallow sandstone bedrock at c. 1m depth. Possible Reworked Natural material was also encountered in WS03 & WS06 to depths of around 2m; comprising very loose sandy Gravel of sandstone.
Natural ground	Topsoil (typically 300mm in thickness), over weathered bedrock comprising gravelly Sand, sandy Gravel and/or Cobbles with occasional boulders and a matrix of sand/gravel. Sandstone bedrock was encountered in all trial pits at depths varying between 1.0m and 2.5m (ave. of 1.5m).
Contamination	No visual/olfactory evidence of hydrocarbon contamination was noted. Topsoil is suitable for re-use within the proposed residential end-use.
Mining & quarrying	The south of the site is located within a Coal Mining Development Low Risk Area (within the defined coalfield, but no known defined risks have been recorded by the Coal Authority; there may still be unrecorded issues). The north of the site is beyond the Coal Authority's defined coalfields. A sandstone quarry, later recorded as a refuse tip, is located immediately north/north-east. Numerous additional sandstone quarries recorded within 250m to the east, west and south-west; most notably c. 75-100m west/south-west and 100-150m east.
Hazardous gas	The site lies in an area where between 3-5% of homes are estimated to be above the radon action level. A former refuse tip is present immediately beyond the north/north-eastern boundary. Infilled quarries are also present within 250m to the east and west. Monitoring wells have been installed across the site and a Hazardous Gas Risk Assessment will be issued on completion of the monitoring.
Preparatory works	Stripping of topsoil, with stockpiling for subsequent re-use or disposal off-site.
Foundations	The vast majority of plots at the site will be founded on traditional strip foundations at a minimum depth of 600mm; founding stratum will be weathered bedrock (gravelly Sand, sandy Gravel or Cobbles of Sandstone). Locally, trench fill foundations (near TP06, WS03 & WS06) will be required where reworked natural material was encountered.
Groundwater & excavations	Groundwater was not encountered within any of the exploratory holes. Shallow excavations are unlikely to remain stable in the short term due to overbreak in the granular residual soils (namely the cobbles). Excavation greater than c. 1.5m is likely to prove difficult across most of the site.
Flooding & drainage	The site lies within Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. It is understood that surface water will be stored in an attenuation tank, to be disposed off-site.
Highways	Based on visual inspection of the shallow natural materials and published guidance, the Granular Residual Soils should provide a CBR value of at least 5%. This value should be verified prior to redevelopment.

SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	5080	**Site area/ha**	3.5
Client:	KCS Developments Ltd	**NGR:**	SE 119 130
Site:	Roslyn Avenue, Netherton	**Nearest postcode:**	HD4 7EW

Significant developer abnormals relating to geoenvironmental issues at the site are:

- **Overhead electrical utilities** will require either diversion of an easement.
- Excavation stability was generally **poor**, with overbreak due to cobbles.
- It would be prudent to allow for excavation of hard rock/breaking out for any deep excavations (c. > 1.0m) such as those required for drainage etc.

Some further work is required, most notably:

- Preparation of a Silt and Surface Water Management Plan.
- If deep infrastructure is proposed, rotary cored boreholes may be required to provide further information (spacing of bedding, fractures, strength etc).

CONTENTS

APPENDICES

Appendix A General notes

01	Environmental setting
02	Ground investigation fieldwork
03	Geotechnical testing
04	Contamination laboratory analysis & interpretation
05	Hazardous gas

Appendix B - Drawings

Drawing	Revision	Title
5080/1	-	Site Location Plan
5080/2	-	Proposed Layout
5080/3	-	Site Features
5080/3A	-	Site Features (Historical)
5080/4	-	Site Photographs
5080/5	-	Preliminary Conceptual Site Model
5080/6	-	Exploratory Hole Locations
5080/7	-	Revised Conceptual Site Model

Appendix C - Commission

Appendix D - Historical OS plans#

Appendix E - Search responses#

From	Date	Content
Landmark	24/05/2016	Environmental search data (3rd party)
Coal Authority	12/06/2024	Mining report
British Geological Survey	22/07/2024	Radon report

Appendix F to H - Exploratory records

Appendix F	TPs 01 to 28
Appendix G	WSs 01 to 10

Appendix H - Chemical test results

Appendix I - Contaminated land assessment for selection of water supply pipes

Appendix J - Geotechnical test results

Appendix K - Gas monitoring results

Some of this data is not included within the paper or PDF copies of this report but can be provided on request.

FOREWORD (GEOENVIRONMENTAL APPRAISAL REPORT)

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Lithos Consulting Limited (Lithos); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

This report has been reviewed by a Competent Person, as defined in the National Planning Policy Framework. We ensure that all projects are managed by individuals with necessary experience, relevant qualifications, and current membership of a relevant professional organisation. Records of engineers, project managers and reviewers involved in this project are maintained by us. Lithos QA/QC procedures for all our work forms an integral part of our ISO9001 accreditation and as such is regularly audited.

The report presents observations and factual data obtained during our site investigation and provides an assessment of geoenvironmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from Lithos prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. Lithos cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context. However, it should be noted that in order to keep the number of pages to a minimum, some information (e.g. full copy of the Landmark/Groundsure Report) is not included in the PDF; by request it can be provided.

The findings and opinions conveyed in this report (including review of any third-party reports) are based on information obtained from a variety of sources as detailed within this report, and which Lithos believes are reliable. Reasonable care and skill has been applied in examining the information obtained. Nevertheless, Lithos cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

Intrusive investigation can only investigate shallow ground beneath a small proportion of the total site area. It is possible therefore that the intrusive investigation undertaken by Lithos, whilst fully appropriate, may not have encountered all significant subsurface conditions. Consequently, no liability can be accepted for conditions not revealed by the exploratory holes. Any opinion expressed as to the possible configuration of strata between or below exploratory holes is for guidance only and no responsibility is accepted as to its accuracy.

It should be borne in mind that the timescale over which the investigation was undertaken may not allow the establishment of equilibrium groundwater levels. Particularly relevant in this context is that groundwater levels are susceptible to seasonal and other variations and may be higher during wetter periods than those encountered during this commission.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

Lithos cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remediation options.

The report represents the findings and opinions of experienced geoenvironmental consultants. Lithos does not provide legal advice and the advice of lawyers may also be required.

Lithos standard terms and conditions apply to the report, a copy of the terms and conditions is available on request or can be found with our proposal in Appendix C.

GEOENVIRONMENTAL APPRAISAL
of land at
ROSLYN AVENUE, NETHERTON

1 INTRODUCTION

1.1 The commission and brief

1.1.1 Lithos Consulting Limited were commissioned by KCS Developments Ltd to carry out a geoenvironmental appraisal of land at Roslyn Avenue, Netherton.

1.1.2 Correspondence regarding Lithos' appointment, including the brief for this investigation, is included in Appendix C. The agreed scope of works included:

- A review of third party reports
- A site walkover and inspection
- An assessment of the land use history
- Determination of the site's environmental setting
- A mining risk assessment in accordance with Coal Authority guidance
- An intrusive ground investigation comprising 28 trial pits and 10 window sample boreholes
- Assessment of the geotechnical properties of the near surface deposits to enable provision of foundation and highway recommendations
- A qualitative assessment of contamination risks
- Recommendations for the necessary site preparatory works

1.1.3 Primary aims of this investigation were to identify salient geoenvironmental issues affecting the site to support the submission of a planning application, and also to enable KCS to obtain budget costs for: foundations; gas protection measures; and site preparatory works.

1.2 The proposed development

1.2.1 It is understood that consideration is being given to redevelopment of the site with 82 traditional 2 to 3 storey domestic dwellings, associated gardens, POS, adoptable roads and sewers.

1.2.2 A site layout has been provided by KCS (Drawing reference 2246 PL 105B, dated November 2023) which is reproduced as Drawing 5080/2 in Appendix B to this report.

1.3 Report format and limitations

1.3.1 All standard definitions, procedures and guidance are contained within Appendix A, which includes background, generic information on:

- Assessment of the site's environmental setting
- Ground investigation fieldwork
- Geotechnical testing
- Contamination testing
- Hazardous gas

1.3.2 General notes and limitations relevant to all Lithos geoenvironmental investigations are described in the Foreword and should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site's location is shown on Drawing 5080/1 presented in Appendix B to this report. Site details are summarised in the table below.

Detail	Remarks
Location	4.5 km south-west of Huddersfield town centre
NGR	SE 411 413
Approximate area	3.5 ha (8.6 acres)
Known services	Underground and overhead electric

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on 14th June 2024.

2.2.2 Existing salient features, at the time of the walkover are presented on Drawing 5080/3 in Appendix B to this report and summarised in the table below.

Feature	Remarks
Current access	Off Roslyn Avenue
Topography	Topography slopes towards the west, with a steep drop/cliff along the northern boundary.
Approximate areas	3,500m² grass <10m² buildings (greenhouse)
Nature of boundaries	North – woodland East – woodland, hedgerows and garden fences South – trees and hedgerows with housing beyond West – hedgerows with sporadic trees and a dry-stone wall
Surrounding land uses	North – ancient woodland (Dean Wood) with former sandstone quarry/refuse tip East – housing and Roslyn Avenue (access road) South – housing and commercial properties (including a public house) with B6108 beyond West – open agricultural fields containing numerous former quarries (some infilled) and livestock

2.2.3 The site comprises a single agricultural field containing tall grass, accessed via Roslyn Avenue to the east.

2.2.4 In the far-east of the site, a small area of land containing a greenhouse and some general farming/gardening materials and equipment is present, segregated from the majority of the site by a dry-stone wall but still within the provided site boundary.

2.2.5 The site slopes gently towards the west; a steep drop/cliff is present immediately beyond the northern boundary.

2.2.6 The cliff face to the north resides within the area of mapped (historical OS maps) sandstone quarrying and comprises exposures of sandstone bedrock. This sandstone appears to have been quarried into the cliff face with some local depressions on the ground surface that have likely been infilled. Mounds of overburden and spoil from the quarrying process were noted in the woodland, adjacent to the cliff faces.

2.2.7 Most of the large quarry mapped immediately to the north-east now comprises woodland and a relatively flat, well-maintained, grassed playing field.

2.2.8 Evidence of two of the mapped historical quarries to the west (c. 100m and 250m west) was identified during the walkover. The remnants of these quarries comprised near-circular depressions that appear to have been partially infilled. Sandstone bedrock exposures were evident in both depressions; tall mature trees were also present, growing from the base. Run-down dry-stone walls partially surround the former quarries.

2.2.9 Electrical overheads cut across the site and BT telephone overheads are present adjacent to the site access (off-site).

2.2.10 In the far south, a well-trodden footpath is present. Numerous dog walkovers were noted during the site walkover.

2.2.11 Immediately east (off-site), an electrical substation is present.

2.2.12 A selection of site photographs is included on Drawing 5080/4; the locations of the former quarries are included on Drawing 5080/3A.

3 SITE HISTORY

3.1 Site centred extracts from Ordnance Survey (OS) plans dating back to 1854 have been examined. Some of these plans are presented in Appendix D to this report.

3.2 The table below provides a summary of the salient points relating to the history of the site. It is not the intention of this report to describe in detail all the changes that have occurred on or adjacent to the site. Significant former uses/operations are highlighted in **bold** text for ease of reference.

Date	Site	Surrounding land
1854	Site comprises open fields with a **footpath** in the far south.	Sandstone **quarry** immediately north/north-east, extending from boundary to c. 100m away. Sandstone **quarry** c. 150m east. Large area of woodland (Dean Wood) immediately north with a watercourse (Dean Clough) flowing north-east.
1892	No significant changes.	**Quarry** c. 100m west. Two '**old quarries**' 100-150m east. Unspecified **mound** (refuse heap/spoil?) c. 150m west. **Railway** c. 200 south/south-east. Graveyard c. 200m south-west.
1906		**Crane** recorded in quarry immediately north. Old quarry 100m east no longer shown; infilled? **Quarry** c. 100m west expanded to c. 75m west, now labelled 'New Warwick Quarries' with numerous cranes also noted. **Smithy's** c. 50m east and c. 150m west.
1932		Much of the quarry to west no longer recorded; infilled? Housing erected immediately south. New **quarry** c. 200m south-west.
1961-1963		**Quarry** immediately north/north-east now labelled as disused. Two quarries to west and south-west (75m and 200m) now labelled as disused. Two quarries to east (100-150m) now replaced by housing; infilled?
1971		**Quarry** immediately north/north-east now a **refuse tip.** **Electricity substation** immediately east.
1983-1985		**Railway** c. 200m south/south-east now dismantled.
1993		**Refuse tip** no longer recorded in north.
2000		No significant changes.
2006		
2016		

4 ENVIRONMENTAL SETTING

4.1 General

4.1.1 Notes describing how the site's environmental setting has been assessed are included in Appendix A to this report. Reference has been made to publicly available Government held digital data via QGIS (an Open Source Geographic Information System). Extracts from the 3rd party provided Landmark response, and the response from the Coal Authority are presented in Appendix E. These responses are summarised below, together with the findings of our own "desk study" investigation.

Issue	Data reviewed	Summary
Geology	1:50,000 BGS map (Sheet 77) 1:10,000 BGS map (Sheet SE11SW) BGS Memoir/Technical Report	Drift soils – None mapped. Solid (bedrock) – Rough Rock Flags (Sandstone). Shallowest coal seam – Upper Meltham Coal (thin) present at about 50m depth below the base of the Rough Rock Flags. Strata dip – c. 3-5m east. Faults – None recorded on site; closest is c. 600m west.
Mining	Coal Authority	The south of the site is located within a Coal Mining Development Low Risk Area (within the defined coalfield, but no known defined risks have been recorded by the Coal Authority; there may still be unrecorded issues). The north of the site is beyond the Coal Authority's defined coalfields. Past and present workings – None recorded. Opencast – None recorded within 500m. Mine entries – None recorded within 100m.
Quarrying	Historical OS plans	Sandstone quarry, later recorded as a refuse tip, located immediately north/north-east. Numerous additional sandstone quarries recorded within 250m to the east, west and south-west. Possible infilled quarries recorded c. 75-100m west/south-west and 100-150m east. Evidence of some former quarries is still present to the west (see Drawing's 5080/3A & 5080/4).
Landfills	Envirocheck Report	BGS Recorded Landfill site immediately northeast, present between c. 1971 and 1993 on OS maps. Quarries located to the west (c. 75-100m) and east (c. 100-150m) are recorded as potentially infilled
Radon	UK Health Security Agency	The site lies in an area where between 3-5% of homes are estimated to be above the action level. Further details in Section 14.
Hydrogeology	Environment Agency electronic open data via QGIS	Groundwater Source Protection Zone? No. Aquifer: Secondary A (Solid). Groundwater abstractions? Nearest is 217m south-east, recorded as a borehole abstraction for general farming and domestic use. Soil leaching potential–- High. Pollution incidents? None recorded within 1km.
Hydrology	Defra Catchment data explorer Envirocheck Report	The north of the site is within the Holme from New Mill Dike to R Colne Water Body and the south of the site is within the Mag Brook from Source to River Holme Water Body. Both water bodies are recorded as having a moderate ecological status and a failed chemical status (due to mercury, PBDE, benzo(g-h-i)perylene and cypermethrin). Nearest watercourse(s) – River c. 100m north (Dean Clough), flowing north-east.

Issue	Data reviewed	Summary
		Pollution incidents? Nearest incident is 223m south-east, relating to an agricultural contaminant (milk) polluting a stream in 1994; considered a major incident. Numerous other records within 1km; none of which are considered significant due to date (pre-2000s), severity (minor) and direction (downstream). Abstractions? Nearest is 392m south-east; abstraction from a stream for general industrial/commercial/public services use. Discharge consents? Nearest is 498m west; Yorkshire Water treated sewage disposed into stream/river. No other records of significance.
Flood risk	Environment Agency electronic open data via QGIS	The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. In accordance with Chapter 14 of the National Planning Policy Framework, a site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency).

4.2 Landfills

4.2.1 Known or suspected areas of landfill in the vicinity of the proposed development site are summarised below:

Location	NGR (proximity to site)	Remarks	Source of data
Netherton Tip, Chapel Street, Netherton	SE 412010 413134 (0m north) Positioned on northern boundary, extending off-site further north.	No information on waste type provided by landmark. OS plans suggest the refuse tip was operational between c. 1971 and 1993. Current land use: woodland and a flat-lying playing field. Former land use: sandstone quarry before becoming refuse tip.	Envirocheck Report OS plans

4.2.2 Much of the former quarry/refuse tip immediately north/north-east now comprises a flat-lying, well-maintained, grassed playing field. Other sections of this former quarry comprise woodland with near vertical exposures of sandstone bedrock and occasional mounds of quarry spoil (i.e. overburden). Much of the woodland area slopes steeply towards to north.

4.2.3 There are numerous infilled sandstone quarries adjacent to the site (most notably located c. 75-100m west and c. 100–- 150m east), evident from Landmark and historical OS maps. The material used to backfill these quarries is unknown, however, given the age of the quarries (generally pre-1930s), any backfill material is expected to be largely inert, with limited gas generating potential.

4.3 Mineral safeguarded areas

4.3.1 The site is underlain by **Sandstone** and might therefore be considered by the Local Authority to lie within a Mineral Safeguarding Area (MSA).

4.3.2 Indeed, review of the Kirklees Council Mineral Safeguarding Areas map (dated 2015) suggests that due to the presence of sandstone, the site lies within a 'safeguarding area'. Further advice should be sought from a Minerals Surveyor.

4.3.3 MSAs are areas of known mineral resources that are of sufficient economic or conservation value to warrant protection for generations to come. The purpose of MSAs is not to preclude automatically other forms of development, but to make sure that mineral resources are adequately and effectively considered in land-use planning decisions.

4.3.4 Specialist guidance on Mineral Safeguarding "A Guide to Mineral Safeguarding in England" has been produced by The Coal Authority and the British Geological Survey.

4.3.5 Chapter 17 of the National Planning Policy Framework (NPPF) requires Local Authorities to facilitate the sustainable use of minerals, and planning policies should:

- Safeguard mineral resources by defining Mineral Safeguarding Areas and Mineral Consultation Areas; and adopt appropriate policies so that known locations of specific minerals resources of local and national importance are not sterilised by non-mineral development where this should be avoided (whilst not creating a presumption that the resources defined will be worked.
- Set out policies to encourage the prior extraction of minerals, where practicable and environmentally feasible, if it is necessary for non-mineral development to take place.

4.3.6 NPPF Chapter 17 notes that when determining planning applications, local planning authorities should give great weight to the benefits of the mineral extraction.

4.3.7 As a consequence of the NPPF, and the presence of sandstone beneath the site, the Local Authority may require KCS to consider the opportunity to recover (extract) the sandstone. Applicants submitting planning applications may need to demonstrate to the Local Authority that they will extract the sandstone, unless:

- It can be shown it is not economically viable to do so, or
- It is not environmentally acceptable to do so, or
- The need for the development outweighs the need to extract the sandstone, or
- The sandstone will not be sterilised by the development

4.3.8 Surface extraction of sandstone here is considered unlikely to be viable based on the relatively small size of the site, and its proximity to adjacent residential properties. Prior extraction of minerals would have the potential to cause unacceptable impacts on neighbouring properties and infrastructure, including noise, air quality, traffic impacts and land stability. However, it would be prudent to seek further advice from a Minerals Surveyor.

4.4 Agriculture

4.4.1 Historical plans show that the site has been occupied by arable farmland. Generally farming is not considered likely to have caused significant ground contamination. However, activities such as slurry spreading, the discharge of chemicals to ground, and unregulated burial are known to have occurred on farmland. Potential contaminants associated with farming activity could include any of the following.

Agricultural activity	Potential contaminant
Sewage farming, slurry spreading	Methane, metals, nitrates, oxygen depletion
Tracks (if built up with crushed demolition rubble etc)	Metals, asbestos, hydrocarbons
Carcase burial	Anthrax & other biohazards
Plant & animal protection	Pesticides & herbicides
Soil conditioners	Metals, sulphates, PAH
Field sports	Lead shot
Fuel storage	Hydrocarbons, methane, oxygen depletion
Equipment maintenance	Hydrocarbons, metals
Waste burial, land levelling, backfilling ponds/quarries	Methane, metals, PAH etc
Naturally occurring contaminants	Arsenic, metals

4.4.2 Whilst it is likely that pesticides have been applied during arable use of the land, these are not likely to include the persistent organochloride pesticides such as Dieldrin, Aldrin, DDT etc. Pesticides routinely used on arable crops the UK (Phenoxy Acetic acid herbicide or PAAH) rapidly degrade in soils or leach via rainwater infiltration to groundwater. It is highly unlikely these would be detected by soil sampling and therefore it is not proposed to undertake analysis of these.

4.4.3 The generation of ground gas in quantities with the potential to impact upon the proposed development would only occur with the presence of significant quantities of organic matter. Ground gas monitoring is not considered necessary unless significant quantities of organic matter are identified during the ground investigation.

5 PREVIOUS INVESTIGATION FINDINGS

5.1 General

5.1.1 KCS have provided Lithos with a copy of the following report: Desk Study Report for Roslyn Avenue, Netherton (Ref. 16RED116/DS), issued by Betts Geo Consulting Engineers in November 2023.

5.1.2 The report includes a review of data from a Landmark Envirocheck report, historical OS maps dating back to 1854, and a CON29M coal mining report. A site walkover was also undertaken on the 2nd June 2016. Sections 1 to 4 of this Lithos Report include similar content to the Betts Geo report, but with further detail.

6 PRELIMINARY CONCEPTUAL SITE MODEL

6.1 A preliminary conceptual site model, presented as Drawing 5080/5 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 4 inclusive of this report.

6.2 Potential contaminant linkages are shown on the preliminary conceptual site model.

6.3 Infilled quarries to the north, west, south-west and east are a potential source of contaminants and hazardous ground gas.

6.4 The conceptual model will likely be subject to modification in light of data arising from the proposed intrusive ground investigation; see Section 11.2.

7 GROUND INVESTIGATION DESIGN

7.1 Anticipated ground conditions & potential issues

7.1.1 Based on the data reviewed in Sections 4 (Environmental Setting) and 5 (Previous Investigation Findings), anticipated ground conditions are expected to comprise:

Anticipated condition	Remarks
Made ground	Not anticipated although may be present if unrecorded quarries are encountered.
Natural soils	Topsoil over residual soils (weathered Sandstone comprising gravelly Sand and/or Clay).
Bedrock	Sandstone bedrock anticipated at a shallow depth (no drift recorded).
Quarries	Sandstone quarries are abundant in the area; the presence of small-scale quarries on site cannot be discounted.
Groundwater	Possible at a shallow depth within the bedrock.

7.1.2 Based on the data above and that in Sections 2 (Site Description) and 3 (History), potential ground-related issues associated with this site are likely to include:

Type of issue	Specific issue	Remarks
Potential on-site contamination sources	1. Reworked topsoil (inorganics, organics) 2. Backfilled quarries (made ground and hazardous gas)	1. Associated with farming 2. Not recorded but possible on site
Potential off-site contamination sources	1. Former quarries/refuse tip 2. Electricity substation	1. Hazardous gas, organics & inorganics 2. PCBs

Type of issue	Specific issue	Remarks
Potential geotechnical hazards	1. Steep slopes	1. Beyond northern boundary
Other potential constraints	1. Underground and/or overhead utilities	1. Require decommissioning or diversion

7.2 Ground investigation design & strategy

7.2.1 The preliminary conceptual site model was used as a basis for design of an appropriate ground investigation, the scope of which is summarised below.

Exploratory holes	Purpose
Twenty-four trial pits	To determine the general nature of soils underlying the site, including the: • Nature, distribution and thickness of shallow soils, including any made ground • Suitability of the ground for founding structures and highways
One trial pit	Excavated adjacent to the electricity substation to schedule shallow soils for PCB chemical testing
Ten window sample boreholes	To confirm the strength (density) of natural in-situ granular soils via SPTs. To install monitoring wells across the site in order to: • Monitor for hazardous gas • Determine groundwater levels and assess flow direction

7.2.2 Proposed exploratory hole locations were selected to provide a representative view of the strata beneath the site and to target potential areas of interest (i.e. the electricity substation). A nominal 45m grid spacing was proposed. Additional exploratory locations might be scheduled by the site engineer in light of the ground conditions actually encountered.

7.2.3 The number of representative samples taken will be reflective of the geological complexity actually encountered. However, in general about 3 samples will be taken from most trial pits.

7.2.4 Review of the site's history (see Section 3) has confirmed the complete absence of any previous development or past potentially contaminative land uses (other than agriculture). Therefore, in accordance with the National Planning Policy Framework, this site is Greenfield rather than Brownfield.

7.2.5 The only potential on-site sources of contamination identified are metals & asbestos (associated with windblown/background or illegal deposits) and organics (associated with leakage from farming machinery). If these contaminants are present, they will be found within near-surface soils (topsoil), rather than at depth (in natural soils) and consequently, contaminant analysis will (at least initially) be restricted to recovered samples of topsoil.

7.2.6 If made ground, or elevated concentrations of contaminants within topsoil, are recorded during the ground investigation, testing of subsoil samples may be necessary.

8 FIELDWORK

8.1 Objectives

8.1.1 The original investigation strategy is outlined in Section 7.2 above.

8.1.2 The additional exploratory holes listed below were advanced in light of ground conditions actually encountered.

Exploratory holes	Purpose
TPs 25 to 27	To enable better delineation of the depth and lateral extent of the made ground identified in TP06

8.2 Exploratory hole location constraints

8.2.1 No access was available to parts of the centre of the site due to electrical overhead utilities.

8.2.2 Window sampling was carried out across the site to install gas and groundwater monitoring wells. It should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material). Furthermore, assessment of the strength of cohesive soils, via hand vane tests, is difficult due to disturbance caused by drilling.

8.3 Scope of works

8.3.1 Fieldwork was supervised by Lithos between 26th and 28th June 2024 and comprised the exploratory holes listed below.

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs 01 to 28	1.1m to 2.7m	All trial pits refused at less than 3m, where excavating became difficult with a JCB 3CX.
Window sample boreholes	WSs 01 to 10	1.0m to 1.9m	All boreholes refused at less than 2m in probable Sandstone bedrock. Gas and groundwater monitoring wells installed in all boreholes to depths of between1.0m and 1.9m.

8.3.2 Notes describing ground investigation techniques, in-situ testing and sampling are included in Appendix A to this report.

8.3.3 Exploratory hole logs are presented in Appendices F & G to this Report. These logs include details of the:

- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of the in-situ testing
- The monitoring wells installed

8.3.4 Exploratory hole locations are shown on Drawing 5080/6 presented in Appendix B; hole positions are based on data from a hand-held GPS (typically +/- 3m accuracy) and have not been surveyed in.

9 GROUND CONDITIONS

9.1 General

9.1.1 A complete record of strata encountered beneath the proposed development site is given on the various exploratory hole records, presented in Appendices F & G.

9.1.2 Typical ground conditions encountered at the site are described below in Sections 9.2 (made ground) and 9.3 (natural ground), with a summary provided in the table on page 13 and 14.

9.2 Made ground

9.2.1 Made ground was encountered in one trial pit (TP06) to a depth of 2.4m; this made ground comprised of:

- **Reworked Natural:** Cobbles and Boulders of Sandstone with a matrix of gravelly Sand. The cobbles of sandstone were not uniform and were of different colours and shapes; the excavation was also very unstable and no 'structure' could be seen in the sidewall, as would be expected in weathered bedrock.

9.2.2 Trial pits TP25 to TP27 were excavated adjacent to TP06 in attempt to delineate the made ground, however, all three found shallow bedrock at c. 1m depth.

9.2.3 It is possible that this made ground represents a localised area of small-scale quarrying or a borrow pit.

9.2.4 Possible Reworked Natural, comprising of very loose sandy Gravel of Sandstone, was also encountered in WS03 & WS06 to depths of 1.8m and 1.9m respectively.

9.2.5 Whilst not encountered during this investigation, the possibility of additional areas of small-scale quarrying, 'burial pits', and/or asbestos sheeting (used as shuttering) cannot be entirely discounted. Small-scale quarries are recorded to the north, east, south-west and west (within 250m) and therefore it is possible that additional unrecorded small scale quarries are present on and adjacent to the site.

9.3 Natural ground

9.3.1 Natural ground was encountered in all of the exploratory holes, and typically comprised:

- **Topsoil:** gravelly silty Sand was identified across the site to a typical depth of 300mm.
- **Granular Residual Soil:** encountered in all trial pits and the majority of window samples (excluding WS03 and WS06) to around 1.5m depth (min. of 1.0m; max. of 2.5m). Comprises of gravelly Sand, sandy Gravel and/or Cobbles with occasional boulders and a matrix of sand and gravel.
- **Rough Rock Flags – Sandstone:** encountered in all 28 trial pits from depths of between 1.0m and 2.5m (ave. encountered depth of 1.5m). Comprising of weak orangish brown medium grained Sandstone. Recovered predominantly as cobbles with occasional boulders, gravel and sand.

9.3.2 The in-situ relative density of granular deposits on site was established by carrying out Standard Penetration Tests (SPTs) during the drilling of the boreholes; see Section 13.5.

Summary of ground conditions

Hole ID	Final Depth	Depth to Base of Made Ground	Depth to Base (mbgl)				Depth to Bedrock (Sandstone)	Penetration (m) *	Remarks
			Topsoil	Made Ground	Natural Ground				
				Reworked Natural	Granular Residual Soil (gravelly Sand or sandy Gravel)	Granular Residual Soil (Cobbles with gravelly Sand)			
TP01	1.5	-	0.3	-	0.6	1.2	> 1.2	0.3	Pit unstable from 0.3m to 1.2m due to overbreak in granular residual soil.
TP02	1.9	-	0.35	-	-	1.1	> 1.1	0.8	Pit unstable from 0.35m to 1.1m due to overbreak in granular residual soil.
TP03	2.5	-	0.6	-	1.8	-	> 1.8	0.7	Pit unstable from 0.6m to 1.8m due to overbreak in granular residual soil.
TP04	2.0	-	0.4	-	1.65	-	> 1.65	0.35	Pit unstable from 0.4m to 1.65m due to overbreak in granular residual soil.
TP05	1.5	-	0.4	-	-	1.3	> 1.3	0.2	Pit unstable from 0.4m to 1.3m due to overbreak in granular residual soil.
TP06	2.7	2.4	0.5	2.4	-	-	> 2.4	0.3	Pit unstable from 0.5m to 2.4m due to overbreak in granular residual soil.
TP07	1.8	-	0.2	-	-	1.5	> 1.5	0.3	Pit unstable from 0.2m to 1.0m due to overbreak in granular residual soil.
TP08	1.5	-	0.3	-	-	1.3	> 1.3	0.2	Pit unstable from 0.3m to 1.3m due to overbreak in granular residual soil.
TP09	2.2	-	0.5	-	-	1.7	> 1.7	0.5	Pit unstable from 0.5m to 1.7m due to overbreak in granular residual soil.
TP10	1.2	-	0.3	-	-	1.1	> 1.1	0.1	-
TP11	2.0	-	0.5	-	1.3	1.7	> 1.7	0.3	Pit unstable from 0.5m to 1.7m due to overbreak in granular residual soil.
TP12	1.3	-	0.3	-	-	1.2	> 1.2	0.1	Pit unstable from 0.3m to 1.2m due to overbreak in granular residual soil.
TP13	1.8	-	0.3	-	-	1.4	> 1.4	0.4	Pit unstable from 0.3m to 1.4m due to overbreak in granular residual soil.
TP14	2.0	-	0.3	-	0.6	1.8	> 1.8	0.2	Pit unstable from 0.3m to 1.8m due to overbreak in granular residual soil.
TP15	2.5	-	0.3	-	0.7	1.9	> 1.9	0.6	Pit unstable from 0.3m to 1.8m due to overbreak in granular residual soil.
TP16	1.7	-	0.3	-	-	1.3	> 1.3	0.4	Pit unstable from 0.3m to 1.3m due to overbreak in granular residual soil.
TP17	1.75	-	0.3	-	-	1.5	> 1.5	0.25	Pit unstable from 0.3m to 1.5m due to overbreak in granular residual soil.
TP18	1.4	-	0.3	-	-	1.1	> 1.1	0.3	Pit unstable from 0.3m to 1.1m due to overbreak in granular residual soil.
TP19	1.6	-	0.3	-	-	1.4	> 1.4	0.2	Pit unstable from 0.3m to 1.4m due to overbreak in granular residual soil.
TP20	2.0	-	0.3	-	1.5	1.7	> 1.7	0.3	Pit unstable from 0.3m to 1.7m due to overbreak in granular residual soil.
TP21	1.6	-	0.3	-	0.6	1.3	> 1.3	0.3	Pit unstable from 0.0m to 2.5m due to overbreak in granular residual soil.
TP22	2.55	-	0.4	-	1.1 , 2.5	1.8	> 2.5	0.05	Pit unstable from 0.3m to 1.3m due to overbreak in granular residual soil.
TP23	2.5	-	0.3	-	1.1	2.1	> 2.1	0.4	-

Hole ID	Final Depth	Depth to Base of Made Ground	Depth to Base (mbgl)				Depth to Bedrock (Sandstone)	Penetration (m) *	Remarks
			Topsoil	Made Ground	Natural Ground				
				Reworked Natural	Granular Residual Soil (gravelly Sand or sandy Gravel)	Granular Residual Soil (Cobbles with gravelly Sand)			
TP24	2.5	-	0.5	-	-	2.3	> 2.3	0.2	-
TP25	1.1	-	0.3	-	-	1.0	> 1.0	0.1	Pit unstable from 0.3m to 1.0m due to overbreak in granular residual soil.
TP26	1.3	-	0.3	-	-	1.2	> 1.2	0.1	-
TP27	1.1	-	0.3	-	-	1.0	> 1.0	0.1	-
TP28	1.5	-	0.3	-	-	1.3	> 1.3	0.2	Pit unstable from 0.3m to 1.3m due to overbreak in granular residual soil.
WS01	1.0	-	0.3	-	1.0	-	-	-	Barrel refused at 1.0m.
WS02	1.3	-	0.2	-	1.3	-	-	-	Barrel refused at 1.3m.
WS03	1.8	1.8?	0.3	1.8?	-	-	-	-	Barrel refused at 1.8m. Possible re-worked natural between 0.3m and 1.8m depth.
WS04	1.4	-	0.3	-	1.4	-	-	-	Barrel refused at 1.4m.
WS05	1.2	-	0.3	-	1.2	-	-	-	Barrel refused at 1.2m.
WS06	1.9	1.9?	0.3	1.9?	1.9	-	-	-	Barrel refused at 1.9m. Possible re-worked natural between 0.3m and 1.9m depth.
WS07	1.4	-	0.4	-	1.4	-	-	-	Barrel refused at 1.4m.
WS08	1.4	-	0.3	-	1.4	-	-	-	Barrel refused at 1.4m.
WS09	1.0	-	0.3	-	1.0	-	-	-	Barrel refused at 1.0m.
WS10	1.4		0.3	-	1.4	-	-	-	Barrel refused at 1.4m.

Note: * Using a JCB 3CX

9.4 Visual & olfactory evidence of organic contamination

9.4.1 No visual or olfactory evidence of significant organic contamination was noted in any of the trial pits or window sample boreholes.

9.4.2 Samples of the Topsoil have been scheduled to confirm the suitability for re-use and analyse for the presence of pesticides; see Section 10.

9.4.3 A sample of the shallow natural material adjacent to the off-site electricity substation was also scheduled for PCB analysis.

9.5 Groundwater

9.5.1 No significant inflows or seepages of groundwater were encountered during the investigation.

9.5.2 Gas and groundwater monitoring wells have been installed in 10 window sample boreholes across the site, to a maximum depth of 1.9m.

9.5.3 Monitoring is ongoing and to date only one monitoring visit has been completed (15th July 2024); the groundwater levels recorded on this visit are summarised below.

Hole	Response zone (depth range & strata)	Groundwater body	Typical standing water level
			m bgl
WS01	0.5m – 1.0m (Granular Residual Soil)	Solid (Rough Rock Flags Sandstone)	ND
WS02	0.5m – 1.3m (Granular Residual Soil)		ND
WS03	0.8m – 1.8m (Granular Residual Soil)		ND
WS04	0.5m – 1.4m (Granular Residual Soil)		ND
WS05	0.5m – 1.2m (Granular Residual Soil)		ND
WS06	0.9m – 1.9m (Granular Residual Soil)		ND
WS07	0.5m – 1.4m (Granular Residual Soil)		ND
WS08	0.5m – 1.4m (Granular Residual Soil)		ND
WS09	0.5m – 1.0m (Granular Residual Soil)		ND
WS10	0.5m – 1.4m (Granular Residual Soil)		ND

ND: No groundwater detected.

9.6 Stability

9.6.1 Stability of excavations within the Granular Residual Soil was generally poor due to overbreak in the cobbles.

9.7 Revised conceptual ground model (ground conditions)

9.7.1 The Preliminary Conceptual Site Model has been revised in light of data obtained during the ground investigation, most notably with respect to:

- The nature and distribution of made ground
- The strength, nature and depth of underlying natural strata

9.7.2 Further refinement of the Conceptual Site Model is presented in Section 11.2, where the results of laboratory testing for contaminants have been considered.

10 CONTAMINATION (ANALYSIS)

10.1 General

10.1.1 The site has not been the subject of a past potentially contaminative industrial land use. However, historical mapping suggests arable farming has been carried out on the site. Sampling of the topsoil has been undertaken to confirm its suitability for re-use and analyse for the presence of pesticides.

10.1.2 A sample of the shallow natural material adjacent to the off-site electricity substation was also scheduled for PCB analysis.

10.1.3 An assessment of potential contaminants associated with the former uses has been undertaken; see Section 6.

10.1.4 In the context of risks to human health associated with residential redevelopment, the Tier 1 Soil Screening Values referenced in this report have been derived via the CLEA default conceptual site model (CSM) used for generating SGVs, but amended, where appropriate, to be more specific to redevelopment within the planning process.

10.1.5 Where available, Category 4 Screening Levels (C4SL) have also been referenced.

10.1.6 Generic Note 04 in Appendix A provides further details with respect to current guidance and the interpretation of analytical data.

10.2 Testing scheduled

10.2.1 Based on the above assessment, Lithos submitted a test schedule (summarised in the table below) to a UKAS accredited laboratory.

Type of sample	No. of samples	Determinands
Made ground (Reworked Natural)	1	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID Water soluble sulphate, chloride, nitrate and magnesium TOC, Speciated Polycyclic Aromatic Hydrocarbons (PAH), Banded Total Petroleum Hydrocarbons (TPH)
Topsoil	15	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID TOC, Speciated Polycyclic Aromatic Hydrocarbons (PAH)
	3	Clay/sand/silt content and visible contaminants, sharps (glass etc) to check compliance with BS3882:2015
	3	PAAH Pesticides
Natural soil (adjacent to substation)	1	Poly-Chlorinated Biphenyls (PCB)

10.3 Soil contamination results

10.3.1 The soil contamination test results are summarised in the tables on pages 17 to 19.

10.3.2 Laboratory test certificates as received from the laboratory are presented in Appendix I to this report.

Summary of degree of soils contamination (Topsoil)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Trigger Level Concentrations are shown in BLUE and assume a **residential with garden**s end-use.														
			pH	As ∞	B ~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg *	Ni	Se	Vn	Zn $	% TOC	PAH		Asbestos I.D.
																B(a)P ∞	Naphthalene	
				37	5	26	4000	100	200	199	109	434	584	200		5	10	
TP24	0.1	Topsoil	5.8	7.5	0.2	0.2	11	18	31	< 0.05	7	< 0.5	19	46	2.0	< 0.03	< 0.03	N.D.
TP22	0.1	Topsoil	5.1	15	0.2	0.3	14	26	46	0.08	12	< 0.5	25	56	4.1	0.05	< 0.03	N.D.
TP19	0.1	Topsoil	4.8	8.4	< 0.2	0.2	9.6	18	39	0.06	6.1	< 0.5	18	38	2.9	0.04	< 0.03	N.D.
TP17	0.1	Topsoil	5.1	8.8	< 0.2	0.2	12	18	40	0.12	7	< 0.5	20	43	2.7	< 0.03	< 0.03	N.D.
TP16	0.1	Topsoil	5.7	17	0.2	0.3	13	35	61	0.1	10	< 0.5	25	59	4.5	0.04	< 0.03	N.D.
TP15	0.1	Topsoil	5.2	12	0.2	0.2	12	28	63	0.08	9.6	< 0.5	21	58	4.3	0.04	< 0.03	N.D.
TP14	0.1	Topsoil	4.9	14	0.2	0.1	13	28	74	2	9.2	< 0.5	23	50	4.3	0.05	< 0.03	N.D.
TP12	0.1	Topsoil	5.5	14	0.3	0.3	12	35	59	0.15	8.7	< 0.5	22	60	3.9	0.08	< 0.03	N.D.
TP10	0.1	Topsoil	5.3	11	0.2	0.3	16	28	56	0.07	8.2	< 0.5	19	57	3.3	0.07	< 0.03	N.D.
TP09	0.1	Topsoil	6.0	13	0.2	0.2	15	27	63	0.2	10	< 0.5	25	66	3.0	0.04	< 0.03	N.D.
TP07	0.1	Topsoil	5.0	15	< 0.2	0.2	20	27	58	0.26	11	< 0.5	25	58	3.3	0.04	< 0.03	N.D.
TP06	0.1	Topsoil	6.7	7.9	0.3	0.2	9.3	16	41	0.07	6.4	< 0.5	15	48	2.1	< 0.03	< 0.03	N.D.
TP05	0.1	Topsoil	5.5	7.6	0.2	0.2	12	18	34	0.07	6.4	< 0.5	19	48	1.5	< 0.03	< 0.03	N.D.
TP03	0.1	Topsoil	6.1	16	0.4	0.3	13	27	70	0.14	10	< 0.5	24	67	4.0	< 0.03	< 0.03	N.D.
TP01	0.1	Topsoil	5.6	9.8	0.3	0.3	12	21	55	0.06	9	< 0.5	22	53	2.8	0.06	< 0.03	N.D.

Key on page 18.

Summary of degree of soils contamination in made ground (Reworked Natural)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Trigger Level Concentrations are shown in BLUE and assume a **residential with gardens** end-use.												PAH		Asbestos I.D.
			pH	As ∞	B ~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg *	Ni	Se	Vn	Zn $	% TOC	B(a)P ∞	Naphthalene	
				37	5	26	4000	100	200	199	109	434	584	200		5	6	
TP06	0.6	Reworked Natural	7.1	2.2	< 0.2	< 0.1	10	4.9	8.3	< 0.05	7.1	< 0.5	13	30	< 0.5	< 0.03	< 0.03	N.D.

Key		Source of guidance trigger level	
36	Parameter tested for and found to be in excess of Tier 1 value.	With the exception of those annotated with one of the symbols below (∞, $, ~), all Soil Screening Values in brackets above have been derived using CLEA v1.071. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
179	Parameter tested for and found to be > 5 x Tier 1 value.		
12	Parameter tested for but not found to be in excess of Tier 1 value.	∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).
-	Parameter not tested for.	$	MAFF. Code of Practice for Agricultural Practice for the Protection of Soil, 1998.
♣	Tier 1 Value is pH dependent.	~	Engineering judgement (Lithos). Boron is a phytotoxic, although most phytotoxic compounds can pose a risk to human health if sufficient concentrations are present. However, plants represent the most sensitive receptor, and a Tier 1 value which is protective of flora is therefore also protective of human health.
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI Tier 1 would be 21mg/kg.		
ND	No fibres detected (asbestos screen)		
		*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.

Summary of degree of soils contamination (organics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Trigger Level Concentrations are shown in BLUE and assume a **residential with gardens (and no cover)** end use						
			% TOC	PCB (total)	PAH		TPH-- C6 to C40		
					B(a)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				2	5	6	22	215	3299
TP06	0.6	Reworked Natural	< 0.5	-	< 0.03	< 0.03	< 0.1	< 30	< 30
TP15	0.4	Granular Residual Soil	-	< 0.01	-	-	-	-	-

Key		Source of guidance trigger level	
60	Parameter tested for and in excess of Tier 1 concentration.	All Soil Screening Values in brackets above have been derived using CLEA v1.071. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
0.3	Parameter tested for but not in excess of Tier 1 concentration.	~	Assumes all GRO is aromatic fraction C7 to C8.
-	Contaminant not tested for.	◊	Assumes all DRO is aliphatic fraction C10 to C12.
		∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).

Inorganic determinands

10.3.3 Of the 16 samples (15 of Topsoil and 1 of Reworked Natural) analysed for inorganic parameters, all 16 can be classified as uncontaminated.

10.3.4 These samples have been classified by comparison with Tier 1 Soil Screening Values for an end use including domestic gardens and any area where plants are to be grown (the most sensitive of proposed end-uses).

10.3.5 Current UK guidance regarding the statistical analysis of soil contamination data obtained during a site investigation is provided by CL:AIRE[1], and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?".

10.3.6 To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

10.3.7 The difference between the old and new approaches, including how Lithos apply the statistical assessment is detailed in Generic Note 04, included as Appendix A to this report.

10.3.8 Lithos can confirm that statistical assessment of the made ground (Reworked Natural) is not appropriate because:

- There are insufficient samples (only 1) from the Reworked Natural to allow representative statistical assessment to be undertaken.

10.3.9 Lithos can confirm that statistical assessment of the Topsoil is appropriate because:

- There is a well understood, robust CSM which identifies possible source areas
- Sampling locations are relatively evenly spread across the site and only random sample data has been included in the assessment
- Samples are considered by strata type
- A minimum of 10 samples (15 in total) have been taken from the Topsoil

10.3.10 Statistical analysis assumes that a given stratum is reasonably homogenous in terms of composition, the distribution of contaminants and the degree of contamination; the CSM indicates that this is a reasonable assumption at this site.

10.3.11 The Dot and Box Plots are presented in Appendix I and the results are summarised below.

Natural Ground - Topsoil

Contaminant	Critical concentration	Mean	Upper confidence level (95%)	Lower confidence level (5%)	Range of 'true' mean	Mean lies above critical concentration (Y/N)
Arsenic	37	11.80	13.63	10.13	10.13 – 13.63	N
Copper	100	24.67	28.08	21.55	21.55 – 28.08	N
Lead	200	50.99	58.35	44.27	44.27 – 58.35	N
Benzo(a)pyrene	5	0.04	0.05	0.04	0.04 – 0.05	N

All concentrations are in mg/kg.

[1] *CL:AIRE, 2020.Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.*

10.3.12 Statistical analysis indicates that the true mean for arsenic, copper, lead and benzo(a)pyrene in the Topsoil is not elevated compared with relevant Lithos tier 1 screening values.

Asbestos

10.3.13 No visual evidence of asbestos-containing materials (ACMs), such as broken fragments of asbestos-cement sheeting, was noted during the excavation of trial pits.

10.3.14 No asbestos fibres were identified in any of the 16 samples (15 of Topsoil and 1 of Reworked Natural) screened.

Organic determinands

10.3.15 This site is essentially greenfield and therefore for organic compounds, the Tier 1 Values used in this report have been derived with reference to a CSM that assumes a residential with gardens end use, with no clean soil cover will be placed in gardens/landscaped areas (Lithos Scenario A).

10.3.16 Lithos have used the CLEA model to derive risk-based screening values for hydrocarbons, in accordance with the methodology detailed by the TPHCWG, and reviewed by a UK workshop of experts with respect to UK adoption of the method.

10.3.17 However, these screening values assume a Soil Organic Matter (SOM) of 6% (equivalent to a TOC of 3.5%). Many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with lower screening values may be required.

10.3.18 In order to check the validity of Lithos' Tier 1 Soil Screening Values, the average TOC for each common fill type (beyond any areas of obvious hydrocarbon impact) have been determined.

Fill type	Typical TOC (%)	Comparison of soil results with revised screening value necessary?
Topsoil	c. 3%	Yes, but no significant organic contamination was recorded in these soil types. All determinands well below "6%" screening value; most below limit of detection.
Reworked Natural	< 0.5 %	

Hydrocarbons (TPH)

10.3.19 Given the absence of visual/olfactory evidence of any hydrocarbon contamination, only a simple banded TPH (cf full speciation) was initially scheduled on 1 sample of the made ground.

10.3.20 Assessment of TPH associated with a fuel/oil source would normally be undertaken in accordance with a 3-step approach, (outlined in Generic Note 04 in Appendix A) on fully speciated TPH results. However, although only banded TPH analysis has been scheduled here, none of the fractions exceed their respective Tier 1 criteria, even if it is conservatively assumed all of each fraction is either aliphatic or aromatic.

10.3.21 Consequently, no significant petroleum hydrocarbon concentrations have been identified, and there is no risk to human health from these hydrocarbons.

Polycyclic Aromatic Hydrocarbons (PAH)

10.3.22 There are numerous PAH compounds. The USEPA identified 16 PAHs that are considered to represent the most problematic in terms of toxicology, fate and behaviour. The UK have also focused on these 16 and these are included in the laboratory report where speciated PAH analysis has been scheduled.

10.3.23 Speciated PAH analysis has been undertaken in order to determine concentrations of the key "marker" compounds: benzo(a)pyrene (considered the most toxic of the PAHs); and naphthalene (the most mobile and volatile of the PAHs).

10.3.24 Speciated analysis has confirmed the absence of significant concentrations of both benzo(a)pyrene and naphthalene in the soils beneath this site.

Polychlorinated biphenyls (PCBs)

10.3.25 One sample (TP15, 0.4m) obtained from shallow soils adjacent to the off-site electricity substation (to the east) was scheduled to determine concentrations of PCB's. This sample yielded results for all tested PCB's that were below the laboratory limit of detection (0.01 mg/kg).

Pesticides (PAAH)

10.3.26 Two of the three topsoil samples (TP08, 0.1m & TP18, 0.1m) scheduled for PAAH pesticide analysis yielded results for the various determinands below the laboratory limit of detection (35 µg/kg).

10.3.27 One of the topsoil samples (TP02, 0.1m) scheduled for PAAH pesticides yielded results for the majority of derminands below the laboratory limit of detection (35 µg/kg). This sample did however return a value of 82 µg/kg for Picloram, a herbicide used to control weeds.

10.3.28 Based on the isolated nature of this marginally elevated exceedance, it is not considered to be significant and requires no further consideration. It is considered that this highly soluble pesticide will rapidly leach from the soil.

BS3882 Topsoil testing

10.3.29 The presence of visible contaminants, sharps (glass etc) was assessed by the Engineer in the field (inspection of initial trial pit arisings); none were identified. BS3882 considers visual contaminants to comprise 'undesirable potentially injurious foreign object(s) visible to the naked eye'.

10.3.30 The clay/sand/silt content of 3 topsoil samples have been determined to check compliance with BS3882[2] requirements.

10.3.31 It should be noted that this is a reduced suite of analysis, and no N-P-K etc. testing has been undertaken.

10.3.32 The results are summarised below:

Parameter	BS3882 Specification	TP03, 0.2m	TP09, 0.2m	TP16, 0.2m
Retained on 2mm sieve	< 30%	14	19	29
Retained on 20mm sieve	< 10%	3	**13**	**18**
Retained on 50mm sieve	0%	0	0	**9**
Clay content	5 to 35%	10	12	10
Silt content	0 to 65%	20	19	20
Sand content	0 to 90%	70	69	70
Visible contaminants	< 0.5%	< 0.5%	< 0.5%	< 0.5%

Note: Values in **bold** type fail the required specification for multipurpose topsoil

[2] *BS3882:2015. Specification for topsoil. Published by BSI Standards Limited.*

10.3.33 The above results suggest that the topsoil at this site does not fully comply with the standards set out in BS3882. In terms of textural classification, the topsoil falls into the 'sandy loam' class. However, within two of the three samples tested, the percentage of gravel exceeded the maximum permissible level. This is likely associated with the underlying natural granular soils, comprising sand, gravel and cobbles – from which the topsoil has likely been derived by weathering.

10.3.34 Further advice could be sought from an agricultural soils expert, but at this stage it seems likely that if existing topsoil is retained in proposed gardens, it may need to be screened to remove gravel.

11 CONTAMINATION (QUALITATIVE RISK ASSESSMENT)

11.1 Topsoil

11.1.1 Topsoil, typically 300mm thick underlies the entire site. Testing suggests this material is chemically suitable for re-use.

11.1.2 Given the nature of the topsoil present on this site it would be expected to be suitable to support plant growth.

11.2 Revised conceptual ground model (contamination)

11.2.1 No plausible contaminant linkages have been identified.

11.2.2 A revised Conceptual Site Model is presented as Drawing 5080/7 in Appendix B.

11.3 Waste classification

11.3.1 Some excess arisings (topsoil & subsoil) may be generated by excavations for foundations, sewers etc. If these are intended for retention and reuse on the site, they would be classed as clean naturally occurring soils and would not be considered waste, under the Waste Framework Directive.

11.3.2 Off-site disposal of surplus clean naturally occurring soils to landfill is not recommended. In accordance with the CL:AIRE Code of Practice[3] any excess natural soil arisings should be suitable for Direct Transfer to another development site, for use either as clean cover material, or bulk fill, without the need for waste legislation to be applied.

12 HAZARDOUS GAS

12.1 General

12.1.1 Consideration of the conceptual site model and potential linkages has enabled a preliminary qualitative assessment of risks associated with gas:

Sources	Receptors	Hazard	Pathway	Initial risk
Off-site infilled quarry/refuse tip immediately north/north-east **and** infilled quarries to east and west (<250m away)	Human health	Asphyxiation & explosion	Lateral migration, ingress & accumulation	**Low**: due to topography and likely backfill material
	Buildings	Explosion		
	Buildings	Explosion		

[3] *The Definition of Waste: Development Industry Code of Practice. CL:AIRE, 2011.*

12.1.2 Given the above gas monitoring wells have been installed in 10 boreholes across the site. Details of the installations are given on the window sample borehole logs presented in Appendix G to this the report.

12.1.3 The generation potential of the gas source was initially considered to be Low, which has been confirmed by the monitoring undertaken to date. Consequently, in accordance with CIRIA Report C665[4], given the proposed residential end use, 9 visits have been scheduled over a 6-month period. A hazardous gas risk assessment will be issued on completion or monitoring.

12.2 Scope of works

12.2.1 To date, the wells have been monitored on 1 occasion (15th July 2024) for groundwater levels and soils-gases, and the results are presented in Appendix K.

12.2.2 A standard procedure was followed, in accordance with CIRIA guidance:

- Ambient oxygen concentration
- Atmospheric temperature & pressure
- Methane, oxygen and carbon dioxide concentrations and flow rates using a Gas Data GFM436 infra-red gas analyser
- Standing water level using a dipmeter
- Ambient oxygen concentration (check for instrument drift)

12.3 Monitoring results

12.3.1 The results of the monitoring completed to date are summarised below.

Well	Response zone	Range of methane concentrations (% v/v)	Range of carbon dioxide concentrations (% v/v)	Range of steady flow rates (litre/hour)
WS01	0.5m – 1.0m (Granular Residual Soil)	ND#	2.3	ND
WS02	0.5m – 1.3m (Granular Residual Soil)	ND	2.5	ND
WS03	0.8m – 1.8m (Granular Residual Soil)	ND	2.0	ND
WS04	0.5m – 1.4m (Granular Residual Soil)	ND	2.5	ND
WS05	0.5m – 1.2m (Granular Residual Soil)	ND	2.1	ND
WS06	0.9m – 1.9m (Granular Residual Soil)	ND	1.5	ND
WS07	0.5m – 1.4m (Granular Residual Soil)	ND	2.3	ND
WS08	0.5m – 1.4m (Granular Residual Soil)	ND	2.1	ND
WS09	0.5m – 1.0m (Granular Residual Soil)	ND	2.1	ND
WS10	0.5m – 1.4m (Granular Residual Soil)	ND	4.3	ND

ND: None detected.

12.4 Discussion (methane & carbon dioxide)

12.4.1 To date, no concentrations of methane and no significant concentrations of carbon dioxide or positive flow rates have been recorded.

12.4.2 Generic Note 05 in Appendix A outlines how monitoring results are interpreted.

[4] *CIRIA C665: Assessing risks posed by hazardous ground gases to buildings (2007).*

12.4.3 A hazardous gas risk assessment incorporating all of the results will be issued on completion of monitoring in January 2025.

12.5 Radon

12.5.1 Requirements with respect to radon measures are set out in Building Regulations Approved Document C. Probability bandings (based on the proportion of properties in a given area that exceed the Action Level; currently 200 $Bq.m^{-3}$) are used to determine whether a property requires no, basic or full measures.

12.5.2 At present Approved Document C advocates basic measures for the probability banding 3% to 10% (full measures if >10%). However, the UK Health Security Agency (HSA) would like to see all new build include basic measures.

12.5.3 In December 2022, the British Geological Survey (BGS), deployed a revised dataset which increased accuracy and also the number of properties falling within radon affected areas. This revised dataset is now referenced by maps on the HSA website.

12.5.4 The HSA website radon map indicates that the site is in an area where **3% to 5%** of homes are estimated to be above the action level, and **basic** radon protection measures are required in new dwellings.

12.5.5 Basic radon measures comprise a radon resistant barrier* (membrane) laid within the floor construction and across the wall cavity in accordance with BR211:2023[5]. The joints between the sheets that form the membrane and cross the cavity **must** be sealed, along with all service penetrations, to make the construction as airtight as possible. A separate cavity tray should be installed in the cavity one brick course above the radon membrane. In order to withstand the installation and follow on construction process membranes should be no less than 400 microns thick.[6]

12.5.6 BRE211:2023 highlights the importance of good practice and a high standard of workmanship to ensure radon membranes are installed to a high standard.

12.5.7 A building site is a harsh environment and barriers can easily become damaged during construction by operatives or equipment moving across or working over a completed section of barrier. As a consequence, where there is a risk of puncturing the membrane, it should be ensured that the membrane is well protected with sand or lean mix concrete before advancing construction.

12.5.8 The radon protection system should be subject to inspection and verification by a third party inspector that has a full understanding of all elements of the radon protection system.

12.5.9 Verification should be carried out at a minimum frequency of 1 in 10 plots where groundworkers carry out installation, and 1 in 20 plots where accredited installers are used. Plots selected for inspection should be located across the development and not clustered.

13 GEOTECHNICAL TESTING

13.1 General

13.1.1 A total of 12 samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.

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[5] *BRE Report BR211, 2023: "Radon: guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects"*

* *Confirmation of resistance to radon must be obtained from the manufacturer.*

[6] *BS8485:2015+A1:2019. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. January 2019.*

13.1.2 The geotechnical laboratory test results are presented in Appendix J to this report.

13.2 Atterberg limits

13.2.1 The plasticity indices of 12 samples of the Granular Residual soil have been determined; results are summarised below.

Soil type	No. samples tested	Moisture content range % (average)	Range of Plasticity Indices % *	Shrinkability
Granular Residual Soil	12	8-16 (12)	Non plastic to 8%	Non-shrinkable

* Modified where appropriate in accordance with Chapter 4.2 of the NHBC Standards

Note. The term Shrinkability is equivalent to the term Volume Change Potential used in Chapter 4.2.

13.2.2 For the purposes of foundation design, it is recommended that all granular soils be regarded as being **non-shrinkable**.

13.3 Particle size distribution

13.3.1 The grading of 6 samples of Granular Residual Soil has been determined by wet sieving and the results are summarised in the table below:

Sample & depth	Field description	% passing 37.5mm sieve	% passing 20mm sieve	% passing 2mm sieve	% fines	Material description (based on grading & plasticity)
TP03, 0.7m	Very gravelly SAND with low cobble content.	76	61	40	8	Very sandy clayey/silty GRAVEL.
TP11, 0.8m	Gravelly SAND.	93	74	58	9	Very gravelly clayey/silty SAND.
TP14, 0.6m	Gravelly SAND with medium cobble content.	70	57	42	11	Very sandy clayey/silty GRAVEL.
TP15, 0.6m	Very gravelly SAND.	74	62	54	13	Very sandy clayey/silty GRAVEL.
TP20, 0.6m	Very gravelly SAND with low cobble content.	82	61	49	18	Very sandy clayey/silty GRAVEL.
TP23, 0.7m	Sandy clayey GRAVEL.	82	59	48	19	Very sandy clayey/silty GRAVEL.

13.3.2 The results of the grading scheduled broadly confirm field descriptions.

13.3.3 NHBC Chapter 4.2 considers shrinkable soils to be those containing more than 35% fines and having a Modified Plasticity Index greater than 10%.

13.3.4 Fines (silt and clay) were found to comprise between 8% and 19% (average 13%) of the material sampled. Modified Plasticity Indices were less than 10% (see Section 13.2) Therefore, the Granular Residual soils encountered on this site can therefore be regarded as non-shrinkable.

13.4 Soluble sulphate and pH

13.4.1 In accordance with BRE SD1[7], this site has been classified as greenfield with a mobile groundwater regime.

[7] *BRE Special Digest 1 (2005) – Concrete in aggressive ground.*

13.4.2 It is envisaged foundations will extend to depths of about 2.0m through made ground and natural strata and samples taken from this depth range have been submitted for pH and water-soluble sulphate (2:1 soil/water extract).

13.4.3 The concentrations of sulphate in the aqueous natural soil extracts of 14 samples were determined. In addition, 1 sample of made ground was tested as part of the contamination suite. The pH value of each sample has also been determined.

13.4.4 The highest water-soluble sulphate concentration and the lowest pH value for each soil type analysed are shown in the table below.

Soil type	No. samples tested	Lowest pH values	Highest soluble sulphate concentration (mg/l)
Granular Residual Soil	14	5.6	<10
Reworked Natural	1	7.1	<10

13.4.5 pH values were all above 5.5, therefore concentrations of chloride and nitrate are considered insignificant.

13.4.6 One sample of the made ground (Reworked Natural) was tested for concentrations of magnesium, chloride and nitrate. The sample yielded magnesium, chloride and nitrate results of less than 10mg/l.

13.4.7 In accordance with Tables C1 and C2 of SD1, sub-surface concrete should be Design Sulphate Class **DS-1**, with the site allocated an ACEC Classification of **AC-1**.

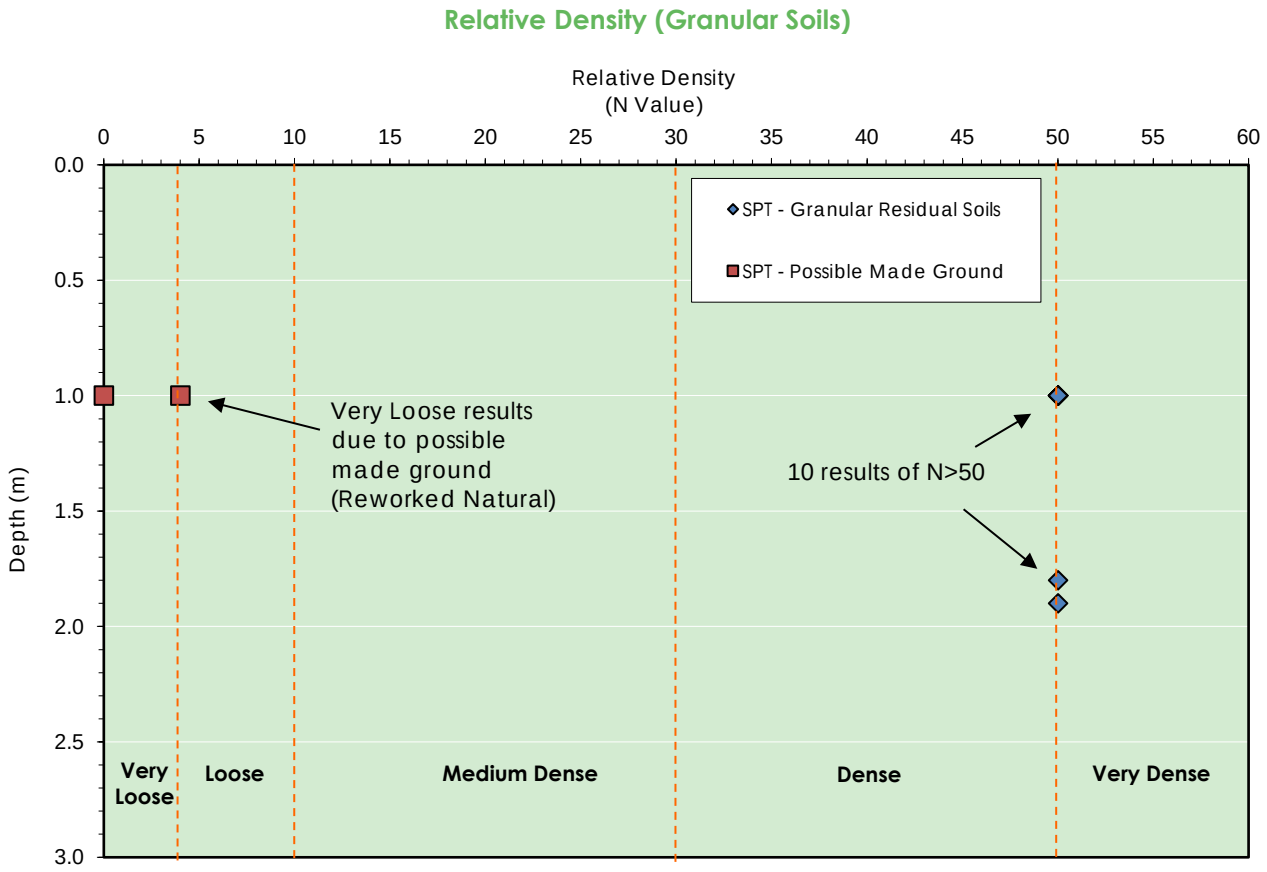
13.5 Standard penetration test (SPT)

13.5.1 The in-situ relative density of granular soils was established by carrying out Standard Penetration Tests (SPTs) during the drilling of window sample boreholes.

13.5.2 The SPT results are summarised in below:

Stratum	Ave. SPT 'N' value	Estimated strength or density	Remarks
Granular Residual Soils/Sandstone bedrock	50	Very dense	SPT tests likely started in Granular Residual Soil and refused in Sandstone bedrock
Possible Reworked Natural	2	Very loose	

13.5.3 The plot below presents a summary of SPT 'N' values.



13.5.4 All of the SPTs (excluding the two within the possible made ground) within the Granular Residual Soils returned N values of N>50. These values are likely unrepresentative of the granular soils and are likely more representative of the underlying Sandstone bedrock.

14 GEOTECHNICAL ISSUES

14.1 Conceptual site model

14.1.1 The Conceptual Site Model has been revised to reflect the presence of localised made ground and the nature and depth of natural soils across the site.

14.1.2 Shallow soils predominantly comprise Sand, Gravel and Cobbles of Sandstone (weathered bedrock) to depths of around 1.5m.

14.1.3 No groundwater was encountered in any of the boreholes or trial pits.

14.1.4 Trial pits and window sample boreholes indicate that competent Sandstone bedrock lies at depths of between 1.0m and 2.5m.

14.1.5 Made ground was encountered in 1no. trial pit (TP06), to a depth of 2.4m and comprised reworked natural material (gravel, cobbles and boulders of sandstone in a matrix of sand). This was a localised occurrence and may represent a backfilled borrow pit or very small-scale area of quarrying.

14.1.6 Possible Reworked Natural, comprising of very loose sandy Gravel of Sandstone, was also encountered in WS03 & WS06 to depths of 1.8m and 1.9m respectively.

14.1.7 Although not encountered elsewhere on site, the possibility of further small scale quarrying, yet to be identified cannot be ruled out.

14.2 Mining & quarrying

14.2.1 The south of the site is located within a Coal Mining Development Low Risk Area (within the defined coalfield, but no known defined risks have been recorded by the Coal Authority; there may still be unrecorded issues). The north of the site is beyond the Coal Authority's defined coalfields.

14.2.2 This site is underlain at depth by Sandstone bedrock and the shallowest coal seam lies at around 50m below the base of the Rough Rock Flags (sandstone). Whilst part of the site lies within a Coal Authority Low Risk area, no significant risks have been identified, and an intrusive mining investigation will not be required.

14.2.3 A former Sandstone quarry, later recorded as a refuse tip (OS maps), is present immediately north/north-east of the site. Additional former Sandstone quarries that were later infilled are also present to the east, west and south-west (within 250m). As such, monitoring wells have been installed across the site and a Hazardous Gas Risk Assessment will be issued on completion of the monitoring.

14.3 Site regrade

14.3.1 Given existing topography some site regrade is anticipated.

14.3.2 Careful consideration will need to be given to earthworks design, and implications for slope stability, retaining walls, foundations, highway gradients and drainage.

14.3.3 Wherever possible, Lithos recommend that excavated soils are retained on site. However, if this is not possible the comments in Section 11.3 should apply.

14.4 Foundation recommendations

General

14.4.1 It is understood that consideration is being given to redevelopment of the site with 2 to 3 storey domestic dwellings, associated gardens, POS, adoptable roads and sewers.

14.4.2 A site layout has been provided by KCS (Drawing reference 2246 PL 105B, dated November 2023) which is reproduced as Drawing 5080/2 in Appendix B to this report.

14.4.3 Foundation recommendations assume that development will be two or three storey construction and that line loads will not exceed 90kN/m run. If this is not the case significant alteration to these recommendations will be required.

14.4.4 We have assumed that final development levels will not differ significantly from ground levels existing at the time of investigation. Any digital terrain modelling undertaken, or commissioned, by KCS should consider implications for the foundation recommendations outlined below.

14.4.5 Made ground is not considered a suitable foundation material and foundations should therefore be taken through these materials into underlying natural strata of adequate bearing capacity.

14.4.6 Sub-surface concrete in contact with the made and natural ground should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-1.

Strip/trench fill footings

14.4.7 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for two or three storey houses constructed at the site. Footings will be founded in Granular Residual Soils (Sand, Gravel and/or Cobbles) or competent bedrock (Sandstone).

14.4.8 Reinforcement, as a precaution against differential settlement, is recommended only where foundation excavations encounter significant lateral and vertical variations in strata. One layer of B385 mesh placed 75mm above the base of the footing is likely to provide suitable reinforcement, but further advice should be sought from the Structural Engineer.

14.4.9 Foundations will be required to be placed below a line drawn up at 45° from the base of any service or similar excavation.

14.4.10 Deepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.3.

14.4.11 In order to minimise loosening of granular soils, it is recommended that footings are cast as soon as formation level is reached (or alternatively formation could be blinded using concrete with as low a water:cement ratio as possible).

14.4.12 In addition to the above, KCS should review proposed plot designs and layouts, since deeper excavations for trench fill are likely to be unstable where the centre-lines of parallel trenches are closer than about 2m (assuming 600mm widths). KCS should supervise their groundworker to ensure footings are excavated in a controlled and safe manner.

14.4.13 KCS or their groundworker should seek further advice from Lithos if unexpected ground conditions are encountered in foundation or sewer excavations, including any conflict between soft ground associated with a backfilled trial pit excavation and the line of a proposed footing.

14.4.14 Made ground was encountered in 1no. trial pit (TP06), to a depth of 2.4m. Possible Reworked Natural, comprising of very loose sandy Gravel of Sandstone, was also encountered in WS03 & WS06 to depths of 1.8m and 1.9m respectively.

14.4.15 Footings should be taken through this made ground/reworked natural into the Granular Residual Soils or Sandstone bedrock below.

Granular Residual Soils

14.4.16 The weathered in-situ sandstone (sand, gravel and cobbles) is assumed to have a relative density of at least medium dense (in accordance with BS5930).

14.4.17 A safe bearing capacity of at least 150kPa, allowing a maximum foundation line load of 90kN/m run, can be assumed if the following are true:

- A foundation length of 8m
- A foundation breadth of 0.6m
- A foundation thickness of 225mm
- A foundation depth of 0.6m depth
- An angle of shearing resistance of ϕ=32° for the granular deposits

14.4.18 Assuming the foundation geometry detailed above, minimal settlements would be anticipated. However, further advice should be sought from the Structural Engineer responsible for foundation design.

14.4.19 In accordance with NHBC Standards, a minimum founding depth of 450mm (due to potential frost susceptibility) is required in granular soils. This depth should be taken from finished ground level to the underside of the footing. If finished ground level is to be above existing ground level then the foundation excavation simply needs to ensure that there is sufficient depth of excavation to allow casting of the footing entirely within natural ground (not made ground or topsoil).

14.4.20 However, if the excavation is dug from original ground level in cold conditions when freezing is expected, then foundation depth should be taken from the existing, not finished, ground level.

14.4.21 Where ground level is being raised, it would be prudent to proof roll the exposed granular soils after stripping topsoil (to mitigate any near-surface disturbance), and ideally fill should be placed prior to construction (otherwise the Developer will need to consider the potential for movement associated with placement of the fill).

14.4.22 It should also be noted that the footing may require deepening or stepping in order to allow plot drainage to exit the plot footprint (either over or under the footing).

14.4.23 It should be noted that founding at shallow depth (450mm), whilst desirable from an excavation stability viewpoint, may not provide sufficient bearing capacity due to the lesser depth of (resisting) overburden. Consequently, a minimum founding depth of **600mm** is recommended.

14.4.24 Where plots are underlain by granular soil and within the influence of existing trees, footings can be cast in the granular soil at a "standard" depth of 600mm, provided that all the following conditions are satisfied:

- Consistent ground across the plot
- The depth of granular soil is greater than ¾ of the depth which would be computed if founding in shrinkable clay
- The thickness of granular soil beneath the footing is equal to or greater than the foundation width (i.e. usually >600mm)

14.4.25 Good control/supervision of groundworks will be essential because there is a significant risk that over-excavation into granular soils (especially below the water table) will result in unstable trenches and collapse which may render the ground unsuitable and necessitate a piled solution.

Sandstone Bedrock

14.4.26 The Sandstone bedrock is generally considered to have a safe bearing capacity of at least 300kPa and minimal settlements would be anticipated.

14.4.27 Where rock is encountered at shallow depth foundations should be placed **entirely on rock** and not partially on rock and partially on soil. This may, depending on surface gradient, necessitate significant deepening of foundations.

Summary of foundation recommendations

14.4.28 In summary, the following foundation solutions are likely to be most appropriate (subject to KCS preferences regarding site preparatory works, final levels & costs associated with each foundation option).

Plot nos	Foundation solution(s)	Remarks (influencing factors)
Majority of plots	Strips at 0.6m	Where plots are directly underlain by Granular Residual Soils

Plot nos	Foundation solution(s)	Remarks (influencing factors)
34 to 35 & 42 to 44	Trenchfill at 2.0m to 2.5m	Where made ground or possible made ground (reworked natural material) is encountered beneath plots.

14.4.29 The foundation solutions outlined in the above table assume that ground levels will not change significantly from those existing at present. If this is not to be the case, further advice should be sought from Lithos.

14.5 Floor slabs

14.5.1 Suspended floor slabs should be utilised where the depth of made ground or engineered stone exceeds 600mm in accordance with NHBC Standards Chapter 5.1 (to negate potential settlement problems). The made ground on this site is non-shrinkable, therefore the slabs could be cast in-situ.

14.5.2 It is estimated that the thickness of made ground is likely to exceed 600mm beneath c. 5% of plots.

14.5.3 It is considered that the natural Granular Residual Soils are generally suitable for the use of ground bearing floors. However, ground bearing slabs should not be cast on topsoil. Where plots are elevated for design reasons, the depth of engineered stone below a ground bearing slab should not exceed 600mm, in accordance with NHBC guidance.

14.5.4 It should be noted that NHBC have suffered a significant number of claims resulting from the use of ground bearing floor slabs. Consequently, if ground bearing slabs are proposed, care should be taken to ensure correct and careful construction. For example, if fill to the internal face of the foundation excavation is not properly compacted, subsequent settlement can result in cracking of the slab.

14.5.5 Floor slab design should be finalised/take account of the results of the gas monitoring and protection measures required, which will be detailed in Lithos' gas risk assessment, to be issued on completion of monitoring in January 2025.

14.6 Designated concrete mixes

14.6.1 Designated mixes are considered in BRE SD1[8] and BS 8500[9]. However, in addition to soil chemistry (sulphate class), there are a number of other considerations relating to structural design that need to be taken into account when determining an appropriate concrete mix.

14.6.2 Consequently, KCS should seek advice from their appointed Structural Engineer.

14.7 Excavations

14.7.1 Based on the results of the investigation it is considered unlikely that major groundwater flows will be encountered in shallow excavations.

14.7.2 Where required, groundwater should be controlled in accordance with CIRIA Report R113[10].

14.7.3 The stability of even shallow excavations is likely to be poor due to overbreak within the granular soils (notably the cobbles) and therefore allowance should be made for shoring.

[8] *BRE Special Digest 1 (2005) – Concrete in aggressive ground.*

[9] *BS 8500-1&2:2015+A2:2019. Concrete. Complementary British Standard to BS EN 206. Method of specifying and guidance for the specifier (1) & Specification for constituent materials and concrete (2).*

[10] *CIRIA Report R113 (1986) - Control of Groundwater for Temporary Works.*

14.7.4 Bedrock was encountered in all of the trial pits, excavation greater than c. 1.5m is likely to prove difficult across most of the site. It would therefore be prudent to allow for excavation of hard rock in any deep excavations such as those that may be required for drainage etc.

14.8 Drainage

14.8.1 It is understood that KCS intend to store surface water within an attenuation tank, then connect to the existing drainage network, so no in-situ testing has been undertaken.

14.8.2 Based on observations made during the investigation (notably the topography), soakaways are unlikely to provide a suitable drainage solution for surface water run-off at the site.

14.8.3 Given topography it is considered possible that springs will appear down-gradient.

14.8.4 Whilst the site may not lend itself to the adoption of discrete soakaways, ground may have the capacity to absorb surface water run-off, and systems which spread infiltration over a wider area (e.g. swales and/or pervious paving) may provide an appropriate solution.

14.8.5 Alternative SuDS options (see CIRIA C753[11] for further details) include:

- Pervious Pavements – provide a surface suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate into subsurface storage, with subsequent infiltration or controlled discharge. Pavement could be porous (water able to infiltrate across entire surface material; e.g. reinforced grass), or permeable (water infiltrates via joints between concrete blocks).
- Swales – linear grassed features in which surface water can be stored or conveyed. Where suitable, swales can be designed to allow infiltration.

14.9 Highways

14.9.1 The natural soils present at shallow depth (anticipated formation) are predominantly granular. Based on visual inspection of the natural materials, published guidance[12] and tables[13] indicate that the Granular Residual Soils would be expected to provide a CBR value of at least 5%. This value should be verified prior to or during construction.

14.9.2 Whilst the CBRs estimated above should be achievable, significant deterioration during/after periods of significant rainfall and/or site trafficking is likely. Consequently, it would be prudent to consider flexibility in the groundworks programme to enable highway construction during prolonged dry/warm weather (typically between May and September) when formation will be least vulnerable to deterioration. Alternatively, a minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) could be placed along the line of proposed highways to protect formation during the construction phase.

14.9.3 Where made ground is present its full thickness (up to a maximum of 2m - from existing ground level or proposed highway formation, whichever is the lower) should be excavated and either:

- Replaced with suitable aggregate in accordance with Series 600 (Earthworks) of The Highways Agency (HA) "Specification for Highway Works" 1998; or
- screened, to allow selection of suitable material, before being replaced in engineered layers (in accordance with Series 600). Unsuitable materials include any soft or wet materials, biodegradables including topsoil, wood, scrap metal, frozen material and oversize.

[11] *CIRIA C753 (2015) – The SuDS Manual.*
[12] *CD225 Design for new pavement foundations Revision 1 (Design Manual for Roads and Bridges)*
[13] *The Structural Design of Bituminous Road, TRRL Laboratory Report 1132 (Table C1, page 36)*

14.9.4 Some refinement of the above advice might be possible after highways design (with consideration of the proposed formation level cf existing ground level), and via inspection (and usually CBR testing) of the proposed formation during site preparatory groundworks.

14.9.5 Any residual made ground materials in the base of the excavation should be inspected and (where necessary) any soft spots removed and replaced with suitable engineered fill.

14.9.6 Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.

14.10 External works

14.10.1 Any digital terrain modelling undertaken, or commissioned, by KCS should be made available to their Engineering Designer prior to issue of an External Works Drawing.

14.10.2 When designing retaining walls, consideration should be given to Clause 10.2.3 of NHBC standards which states that flexible retaining walls such as gabion and timber structures should not be used to provide support to homes, garages, roads, drives, car parking areas or drainage systems.

15 REDEVELOPMENT ISSUES

15.1 General

15.1.1 This report has presented options with respect to foundation solutions, re-use of topsoil etc that are considered technically feasible and in line with current good practice. Consequently, we would expect to obtain regulatory approval for whichever option is adopted, although this cannot be guaranteed. Copies of this report should be forwarded to the relevant regulatory authorities (Warranty Provider & Local Authority) for their comment/approval.

15.1.2 If unexpected ground is encountered during the construction phase, the Contractor should immediately seek further advice from the Engineer.

15.2 Preparatory works

15.2.1 Given the absence of any significant contamination, a remediation strategy is not considered necessary. Nonetheless, some preparatory works will be required, most notably:

- General site clearance of surface materials and vegetation
- Topsoil strip & stockpile
- Given existing topography some minor earthworks regrade may be required

15.2.2 A minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) could be placed along the line of proposed haul roads to provide a firm and stable running layer for the subsequent construction works.

15.3 Control of excavation arisings

15.3.1 The groundworker should appreciate the need for good materials management. Most notably the importance of not mixing different materials within a given stockpile; i.e. there should be separate stockpiles of: topsoil; made ground; natural soil arisings; general construction waste etc.

15.3.2 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed. See also comments in Section 12.9 regarding asbestos.

15.3.3 Made ground arisings could be:

- Placed in area deliberately left low on completion of the remediation works in order to accommodate construction arisings
- redistributed beneath concrete oversite, or areas of hardstanding,
- Exported from site to a suitably licensed landfill facility

15.4 Placement of topsoil

15.4.1 In order to manage surface water and silt it is recommended that a phased approach is taken to site clearance and construction; prior to construction, topsoil and vegetation form a natural barrier and limit surface water (and silt) run off.

15.4.2 NHBC Conditions require garden areas to be provided with topsoil to a thickness of not less than 100mm. Topsoil thicknesses in excess of 400mm should generally be avoided.

15.4.3 Prior to placement of topsoil, the underlying subsoil should be loosened by ripping or rotovating. Stones and other objects greater than 50mm should be removed from the prepared surface, and the loosened subsoil should be roughly levelled so that an even depth of topsoil can be achieved.

15.4.4 Subsequent trafficking over the loosened subsoil should be minimised.

15.4.5 Topsoil should not be placed during or immediately after heavy rain.

15.4.6 After spreading, any large compacted lumps should be broken down to produce a fine tilth suitable for planting, turfing and seeding (< 10mm maximum aggregate size).

15.5 Good practice guidance

15.5.1 The construction phase groundworker should follow good environmental practice to minimise the risks of spillage, leakage etc with reference, but not limited, to the following documents:

- CIRIA C741[14]
- EA Pollution Prevention Guidelines[15]:
  - PPG6 - Working at construction and demolition sites
  - PPG2 - Above ground oil storage tank
  - PPG7 – The safe operation of refuelling facilities
  - PPG21 – Incident Response Planning

15.5.2 Site preparatory works associated with this project are likely to involve the re-use of both natural and made ground soils on site. Therefore, the Contractor should prepare a Materials Management Plan (MMP) in accordance with the CL:AIRE Code of Practice (v2, March 2011) [16].

15.5.3 The MMP will document how all of the materials to be excavated during the proposed site preparatory and remediation earthworks are to be dealt with.

15.6 New utilities

15.6.1 It is strongly recommended that all statutory service bodies are consulted at an early stage with respect to the ground conditions within which they will lay services in order to enable them to assess at an early stage any potential abnormal costs.

[14] *CIRIA C741 (2015) - Environmental Good Practice on Site*
[15] *Whilst this has formally been withdrawn it can still be accessed via the EA archives and provides useful information on managing risks.*
[16] *The Definition of Waste: Development Industry Code of Practice. CL:AIRE, 2011.*

15.6.2 This site is greenfield, and no previous or current usage of the site or its immediate surroundings is likely to have resulted in ground contamination. Furthermore, no significant made ground was encountered in any of the exploratory holes during the ground investigation.

15.6.3 Consequently, the use of 'standard' polyethylene water supply pipes should be acceptable, although KCS should consult the adopting Water Authority at the earliest opportunity to confirm this.

15.6.4 This site investigation has enabled completion of a Contaminated Land Assessment Form[17], a copy of which is included in Appendix H.

15.7 Health & safety issues - construction workers

15.7.1 Access into excavations etc. must be controlled and undertaken in accordance with the CDM Regulations 2015, most notably Regulation 22, to mitigate risk of collapse or asphyxiation.

15.7.2 Before site operations are started, the necessary COSHH statements and Health & Safety Plan should be drafted in accordance with the CDM regulations.

15.7.3 Although no elevated concentrations of contaminants have been identified in the soils beneath this site, simple precautionary measures are recommended, i.e. good personal hygiene and basic personal protective equipment.

15.8 Potential development constraints

15.8.1 Topography may require some regrade earthworks.

15.8.2 Some deterioration of the surface is likely to be caused by trafficking, especially after topsoil has been stripped and during/after periods of significant rainfall. Consequently, it would be prudent to consider placement of a minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) along the line of proposed highways and any temporary haul roads to protect formation during the construction phase.

15.8.3 Consideration could also be given to flexibility in the groundworks programme to take advantage of any prolonged dry\warm weather (typically between May and September) to enable footings to be cast and blockwork brought up to DPC level well in advance of the build programme (i.e. so it is never necessary to dig deep footings in winter/early spring, when the groundwater table is likely to be higher).

15.8.4 The electrical overheads present a potential development constraint unless they can be relocated. Additional enquiries are required to ascertain the feasibility of such diversionary works and the particular easement required by each service undertaker if they remain in-situ.

15.8.5 A watercourse (Dean Clough) is present c. 100m north. Therefore, it is recommended that a silt and surface water management plan be developed prior to construction activities commencing.

[17] *Contaminated Land Assessment Guidance. Protocols published by agreement between Water UK and the Home Builders Federation. January 2014*

16 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

16.1 General

16.1.1 The site is located off Roslyn Avenue, approximately 4.5 km southwest of Huddersfield town centre, and currently comprises a single parcel of land used for agriculture.

16.1.2 It is understood that consideration is being given to redevelopment of the site with 82 traditional 2 to 3 storey domestic dwellings, associated gardens, POS, adoptable roads and sewers.

16.1.3 A site layout has been provided by KCS (Drawing reference 2246 PL 105B, dated November 2023) which is reproduced as Drawing 5080/2 in Appendix B to this report.

16.1.4 Shallow soils predominantly comprise Sand, Gravel and Cobbles of Sandstone (weathered bedrock) to depths of around 1.5m.

16.1.5 No groundwater was encountered in any of the boreholes or trial pits.

16.1.6 Trial pits and window sample boreholes indicate that competent Sandstone bedrock lies at depths of between 1.0m and 2.5m.

16.1.7 Made ground was encountered in 1no. trial pit (TP06), to a depth of 2.4m and comprised reworked natural material (gravel, cobbles and boulders of sandstone in a matrix of sand). This was a localised occurrence and may represent a backfilled borrow pit or very small-scale area of quarrying, further occurrences of which (yet to be identified) may be present.

16.1.8 Possible Reworked Natural, comprising of very loose sandy Gravel of Sandstone, was also encountered in WS03 & WS06 to depths of 1.8m and 1.9m respectively.

16.2 Mining

16.2.1 This south of the site is located within a Coal Mining Development Low Risk Area; the north lies beyond the CA's defined coalfields.

16.2.2 This site is underlain at depth by the Rough Rock Flags (sandstone), and the shallowest coal seams (Upper Meltham thin) lies at around 50m below the base is this geological unit. Whilst some of the site lies within a Coal Authority Low Risk area, no significant risks have been identified, and an intrusive mining investigation will not be required.

16.3 Hazardous gas

16.3.1 The site is in an area where **3% to 5%** of homes are estimated to be above the action level, and **basic** radon protection measures are required in new dwellings.

16.3.2 A former sandstone quarry (and refuse tip) is present immediately north/north-east. Additional infilled quarries are also preset <250m to the east, south-west and west, and as such, gas monitoring wells were installed in 10 boreholes across the site. Upon completion of the monitoring, a hazardous gas risk assessment will be issued.

16.4 Contamination & remediation

16.4.1 Topsoil (typically 300mm thick) underlies the entire site. Testing suggests that this material is chemically suitable for re-use.

16.5 Foundations

16.5.1 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for two or three storey houses constructed at the site.

16.5.2 Footings will be placed in Granular Residual Soils (Sand, Gravel and Cobbles) or Sandstone Bedrock at a minimum depth of 600mm; deepened where made ground is encountered.

16.5.3 Made ground is not considered a suitable founding stratum and footings should be taken through made ground and into underlying natural soils.

16.5.4 Where rock is encountered at shallow depth (anticipated from around 1m to 1.5m depth) foundations should be placed entirely on rock and not partially on rock and partially on soil. This may, depending on surface gradient, necessitate deepening of foundations.

16.6 Flooding

16.6.1 The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low.

16.6.2 Nonetheless, in accordance with Chapter 14 of the National Planning Policy Framework, a site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency).

16.7 Drainage

16.7.1 It is understood that KCS intend to store surface water within an attenuation tank, then connect to the existing drainage network, so no in-situ testing has been undertaken.

16.8 Highways

16.8.1 Based on visual inspection of the shallow natural materials and published guidance, the Granular Residual Soils should provide a CBR value of at least 5%. This value should be verified prior to or during construction.

16.8.2 Where made ground is present it should be excavated and either replaced with suitable aggregate, or screened, to allow selection of suitable material, before being replaced in engineered layers. Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.

16.9 Further works

16.9.1 If deep infrastructure is proposed (such as pump stations or wet wells), rotary cored boreholes may be required to provide further information (spacing of bedding, fractures, strength etc).

16.9.2 A watercourse (Dean Clough) is present c. 100m north. Therefore, it is recommended that a silt and surface water management plan be developed prior to construction activities commencing.

Appendix A

General Notes

01 - Environmental setting
Generic notes – geoenvironmental investigations

General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the "Search Responses" Appendix of this Geoenvironmental Report.

Geology, mining & quarrying

In order to establish the geological setting of a site, Lithos refer to BGS maps for the area, and the relevant geological memoir. Further information is sourced by reference to current and historical OS plans.

In July 2011, the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology. The CA, using its extensive records has prepared plans for all coalfield Local Planning Authorities, which effectively refines the defined coalfield areas into High Risk and Low Risk areas. **High Risk** areas are likely to be affected by a range of legacy issues that pose a risk to surface stability, including: mine entries; shallow coal workings; workable coal seam outcrops; mines gas; and previous surface mining sites. **Low Risk** areas comprise the remainder of the defined coalfield, and are areas where no known defined risks have been recorded; although there may still be unrecorded issues. Where a site lies within either a High or Low Risk area, a mining report is obtained from the CA.

Landfills

Reference is made to publicly available Government held digital data via **QGIS** (an Open Source Geographic Information System), data from Landmark or Groundsure, and sometimes the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site.

Historical OS plans are also inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Radon

Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite), and can move though fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, Lithos refer to BRE Report BR211[1], and the UK Health Protection Agency (HPA) website. In December 2022, the British Geological Survey (BGS), deployed a revised dataset which increased accuracy and also the number of properties falling within radon affected areas. This revised dataset is now referenced by maps on the HSA website.

Advice on the limitation of exposure of the population to radon in buildings was originally published in 1990 by the National Radiological Protection Board (NRPB), which joined the HPA in 2005; the HPA updated NRPB advice in July 2010[2].

The HPA recommended that the NRPB radon Action Level for homes be retained, and a new Target Level for radon in homes be introduced. The values of the Action Level and Target Level, expressed as the annual average radon concentration in the home, are 200 Bqm^{-3} and 100 Bqm^{-3} respectively. The Target Level was to provide an objective for remedial action in existing homes and preventive action in new homes.

The term 'radon Affected Area' is defined as those parts of the country with >1% of homes estimated to be above the Action Levels. The level of protection needed is site-specific and can be determined by reference to this mapping on the Public Health England website, which indicates the highest radon potential within each 1km grid square. Each 1km grid square is classified on the basis of the percentage of existing homes within that grid square estimated to have radon concentrations above the Action Level. There are 6 'bands': <1%; 1 to 3%; 3 to 5%; 5 to 10%; 10 to 30%; and >30%.

The NRPB advised that action should be taken to reduce radon concentrations in existing homes if the radon concentration exceeded the Action Level of 200 Bqm^{-3} in room air averaged over a year; ten times the average UK domestic radon concentration. NRPB advice informed changes in the requirements for radon protection in new buildings.

- **Basic** preventive measures are required in new buildings, extensions, conversions and refurbishments if the probability of exceeding the Action Level is **>3%** in England and Wales, and >1% in Scotland and Northern Ireland.
- Provision for further preventive (**Full**) measures is required in new buildings if the probability of exceeding the Action Level is **>10%**.

At present Building Regulations Approved Document C advocates basic measures for the probability banding 3% to 10%, and full measures if >10%. However, HPA would like to see all new build include basic measures.

Action & Target Levels should also be applied to non-domestic buildings with public occupancy exceeding 2,000 hrs/yr and to all schools.

Hydrogeology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure with respect to:

- Groundwater quality
- Recorded pollution incidents
- Licensed groundwater abstractions

From April 2010 the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply), but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are split into two different types of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels
- Bedrock - solid permeable formations e.g. sandstone, chalk and limestone

The maps display the following aquifer designations:

Principal aquifers: These are layers of rock or superficial deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary aquifers: These include a wide range of rock layers or superficial deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into three types:

- **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
- **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers
- Secondary undifferentiated - In most cases, this is because the rock type in question has previously been designated as both a minor and non-aquifer in different locations due to the variable characteristics.

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1 BRE Report BR211, 2023: "Radon: guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects".

2 Limitation of Human Exposure to Radon, Documents of the Health Protection Agency - Radiation, Chemical and Environmental Hazards, RCE-15. July 2010.

Unproductive strata: These are rock layers or superficial deposits with low permeability that have negligible significance for water supply or river base flow.

The EA maps only display the principal and secondary aquifers as coloured areas. All uncoloured areas on the map will be unproductive strata. However, for uncoloured areas on the superficial (drift) designation map it is not possible to distinguish between areas of unproductive strata and areas where no superficial deposits are present; to do this, it is necessary to consult the published geological survey maps.

For the purposes of the EA's Groundwater Protection Policy the following default position applies, unless there is site specific information to the contrary:

- If no superficial (drift) aquifers are shown, the bedrock designation is adopted
- In areas where the bedrock designation shows unproductive strata (the uncoloured areas) the superficial designation is adopted
- In all other areas, the more sensitive of the two designations is used (e.g. If secondary superficial overlies principal bedrock, an overall designation of principal is assumed)

The EA have also designated groundwater Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone is a function of the aquifer, volume of groundwater abstracted and the effective rainfall, and may vary from tens to several thousand hectares.

Hydrology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure with respect to:

- Surface water quality
- Recorded pollution incidents
- Licensed abstractions (groundwater & surface waters)
- Licensed discharge consents
- Site susceptibility to flooding

The EA have set **water quality** targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality classification scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are 6 GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to **flooding** is assessed by reference to a Flood Map on the Environment Agency's website. These maps show natural floodplains - areas potentially at risk of flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas. There are two different kinds of area shown on the Flood Map:

1. Dark blue areas (Flood Zone 3) could be flooded by the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or by a river by a flood that has a 1% (1 in 100) or greater chance of happening each year
2. Light blue areas (Flood Zone 2) show the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Where there is no blue shading (Flood Zone 1), there is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

The maps also show all flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, or floods from the sea with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, older defences and defences which protect against smaller floods.

The Agency's assessment of the likelihood of flooding from rivers and the sea at any location is based on the presence and effect of all flood defences, predicted flood levels, and ground levels.

It should also be noted that as the floodplain shown is the 1 in 100 year, areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley, the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within a floodplain, it is recommended that a flood survey be undertaken by a specialist who can advise on appropriate mitigating measures; i.e. raising slab levels, provision of storage etc. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for: proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and any new development in Flood Zones 2 and 3.

COMAH & explosive sites

Lithos obtain information from Landmark or Groundsure with respect to Control of Major Accident Hazards (COMAH) or explosive sites within 1km of the proposed development site. Lithos' report refers to any that are present, and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise its emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH site may object to a proposed development (although it is the Local Authority who have final say, and they are likely to place more weight on advice from the HSE).

Preliminary conceptual site model

The site's environmental setting (and proposed end use) is used by Lithos to assess the significance of any contamination encountered during the subsequent ground investigation.

Assessment of contaminated land is based on an evaluation of pollutant linkages (source-pathway-receptor). Contaminants within the near surface strata represent a potential source of pollution. The environment (most notably groundwater), site workers and end users are potential receptors.

Potential pollutant linkages are shown on a preliminary conceptual site model (pCSM). A CSM is essentially a cross-section through a site that reflects both the surface topography and underlying geology, and shows surface features of interest. The most significant sources of contamination are then superimposed onto this cross-section together with potential receptors (human health & controlled waters), and plausible pathways between the two. In addition to environmental issues, the CSM should also highlight geotechnical issues.

A pCSM is prepared after consideration of all available "desk study" data, and before design of the ground investigation. Data reviewed should include historical plans (with superimposition on a current-day plan), previous SI reports, geological maps etc. The pCSM, in conjunction with knowledge of site constraints (buildings, services, slopes etc) is used to design the ground investigation.

The revised CSM takes account of data obtained during the ground investigation, including the distribution of made ground, the nature and distribution of contamination etc.

02 - Ground investigation fieldwork
Generic notes – geoenvironmental investigations

General

Lithos Ground Investigations are undertaken in accordance with current UK guidance including:

- BS5930:2015 "Code of practice for site investigation"
- Eurocode 7: BS EN 1997-1:2004. Geotechnical design - Part 1: General rules
- Eurocode 7: BS EN 1997-2:2007. Geotechnical design - Part 2: Ground investigation and testing
- BS10175:2013 "Code of practice for the identification of potentially contaminated sites"
- "Technical Aspects of Site Investigation" – EA R&D Technical Report P5-065/TR (2000)
- "Development of appropriate soil sampling strategies for land contamination" – EA R&D Technical Report P5-066/TR (2001)
- Contaminated Land Reports 1 to 6, most notably CLR Report No. 4 "Sampling strategies for contaminated land"
- "Guidance on the protection of housing on contaminated land" – NHBC & EA R&D Publication 66 (2000)
- AGS: 1996 "Guide to the selection of Geotechnical Soil Laboratory Testing"

Exploratory hole locations

Exploratory hole locations are selected by Lithos, prior to commencement of fieldwork, to provide a representative view of the strata beneath the site and to target potential contaminant sources identified during the preliminary investigation (desk study). Additional exploratory locations are often determined by the site engineer in light of the ground conditions actually encountered; this enables better delineation of the depth and lateral extent of organic contamination, poor ground, relict structures etc.

Investigation techniques

Ground conditions can be investigated by a number of techniques; the procedures used are in general accordance with BS5930: 2015 and BS1377: 1990. Techniques most commonly used by Lithos include:

- Machine excavated **trial pits**, usually equipped with a backactor and a 0.6m wide bucket. Allows a thorough inspection of the ground; especially the uppermost 1m or so (but able to reach depths of up to c. 4m), with the recovery of representative, disturbed samples. Also used to conduct soakaway testing.
- **Window or windowless** sampling boreholes (**dynamic sampling**). Constraints associated with existing buildings, operations and underground service runs can render some sites partly or wholly inaccessible to a mechanical excavator. In such circumstances, window sampling is often the most appropriate technique. A window sampling drilling rig can be manoeuvred in areas of restricted access and results in minimal disturbance of the ground (a 150mm diameter tarmac/concrete core can be lifted and put to one side). However, it should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material).
- **Cable percussive** (Shell & Auger) boreholes, typically using 150mm diameter tools and casing. Enables the recovery of soil samples and data from greater depth than is possible via trial pitting or a mini-percussive drill rig. Also enables the installation of better/deeper monitoring wells (cf use of a mini-percussive drill rig) due to the utilisation of temporary steel casing during drilling.
- **Rotary percussive** open-hole probeholes are typically drilled using a tri-cone rock roller or polycrystalline diamond compact (PDC) bit with air as the flushing medium. Probeholes are generally lined through made ground with temporary steel casing to prevent hole collapse. Often used to penetrate bedrock to investigate abandoned shallow mineworkings
- **Rotary cored** boreholes. A rock core is cut by a bit, passes up into the inner barrel and, at the end of the coring run, the core barrel assembly is lifted to the surface. Core drilling is relatively expensive, but essential if quality data is required to assess issues associated with deep excavation, rock slope stability etc.

Where installed, gas\groundwater monitoring **wells** typically comprise a lower slotted section, surrounded by a filter pack of 10 mm non-calcareous gravel and an upper plain section surrounded in part by a bentonite seal and in part by gravel or arisings. The top of the plain pipe is cut off below ground level and the monitoring well protected by a square, stopcock type manhole cover set in concrete, or the plain pipe is cut off just above ground level and the well protected by 100mm diameter steel borehole helmet set in concrete. Monitoring well details, including the location of the response zone and bentonite seal are presented on the relevant exploratory hole logs.

In-situ testing

Relative densities of granular materials given on the trial pit logs are based on visual inspection only, they do not relate to any specific bearing capacities.

The relative densities of granular materials encountered in cable percussive boreholes are based on Standard Penetration Test (SPT) results. SPTs are carried out boreholes, in accordance with BS 1377 1990, Part 9 Section 3.3. Where full penetration (600mm) is not possible, N values are calculated by linear extrapolation and are shown on the logs as N* = x. The strength of cohesive deposits is determined using a hand shear vane.

Shear strength test results (hand vane readings) reported on trial pit logs are considered to be more reliable than those reported on window sample logs. Significant sample disturbance occurs during window sampling and consequently shear strength results on disturbed window samples are generally lower than results obtained during trial pitting, in-situ or in large excavated blocks.

Sampling

Typically Lithos collect at least three soil samples from each exploratory hole, although in practice a greater number are often taken. The collection of a sufficient number of samples provides a sound basis upon which to schedule laboratory analysis, ensuring:

- A sufficient number of samples from each (common) site material are tested
- Horizontal and vertical coverage of the site is adequate, thereby providing a robust data set for use in the conceptual ground model
- Any localised, significant, but non-pervasive conditions are considered

Made ground and natural soils encountered in the field during a ground investigation often contain a significant proportion of coarse grained material (e.g. brick etc). Soil samples obtained during most investigations are often only truly representative of the in-situ soil mass where there is an absence of particles coarser than medium gravel; i.e the entire soil mass would pass a 20mm sieve.

Representative bulk samples of the **soil mass** are retrieved from coarse soils for specific geotechnical tests (most notably grading and compaction); this typically requires the collection of at least 10kg of soil, and occasionally >50kg. However, in the context of assessing land contamination, it is generally accepted that samples should be representative of the **soil matrix** of the stratum from which they are taken. Consequently, truly representative samples of coarse soils for subsequent contaminant analysis are not obtained - only the finer fraction is placed in sample containers. Coarse constituents not sampled would typically comprise any 'particles' with an average diameter greater than about 20mm (i.e. coarse gravel, cobble and boulder).

At present, neither ISO/IEC 17025 nor MCERTS specify sample pre-treatment with respect to stone removal. Unsurprisingly therefore UKAS accredited testing laboratories do not adopt the same approach to stones[1] – some crush and test the "as received" soil, whilst others sieve out stones and analyse only the residual soil (the sieve size used varies depending on the laboratory).

In essence, samples taken from coarser soils for contaminant analysis are "screened" by the geoenvironmental engineer in the field, and often sieved again by the laboratory during sample preparation. Geoenvironmental engineers do not typically re-calculate soil mass contaminant concentrations by taking account of the unsampled coarse fraction. Likewise, laboratories that remove stones typically report contaminant concentrations based on the dry weight of soil passing the sieve. In the context of land contamination and human health risk assessment, this is considered reasonable, because it is the soil matrix which is of greatest concern. Stones are unlikely to:

- Provide a significant source for plant uptake (consumption of vegetables)
- Remain on vegetables after washing (consumption of vegetables)
- Be eaten (accidentally by an adult, or deliberately by a child)
- Be whipped-up by the wind for dust generation (inhalation)
- Stick to the skin for any length of time (dermal contact)
- Yield toxic vapour (inhalation)

Consequently, Lithos instruct labs to remove all stones >10mm, and to report the results as dry-weight based on the mass of matrix tested. However, the laboratory are given site-specific instruction where coarse stones are coated in say oil, or impregnated with mobile contaminants such as diesel. Where the stones are predominantly natural, or inert (e.g. brick, concrete etc), removal will clearly result in higher reported concentrations, than if the stones were crushed and added to the matrix.

Where the stones include a significant proportion of contaminant-rich material (e.g. slag, fragments of galvanised metal etc) an argument could be made for crushing and analysing. However, provided the stones are stable (i.e. unlikely to disintegrate or degrade) they should not pose a significant risk to human health for the reasons stated above.

Sometimes it is necessary to obtain samples that are not representative of the wider soil matrix, for example when investigating localised, significant, but non-pervasive conditions. Any such unrepresentative samples are annotated with the suffix '*' (eg 2D*, or 4G*). Lithos' site engineer describes both the unrepresentative sample, and the soil mass from which it was been taken.

Sample Containers (for contaminant analysis). Samples of soil for contaminant testing are placed into appropriate containers (see below). Soil samples for organic analysis are stored in cool boxes, at a temperature of approximately 4ºC, until delivery to the selected laboratory.

Anticipated testing	Container(s)
Asbestos identification	1000ml plastic tub
pH & metals	1000ml plastic tub or 250ml glass jars
non-volatile organics	250ml glass jars
Speciated TPH	250ml & 50ml glass jars
VOCs (incl. naphthalene and\or GRO)	50ml glass jar

Sample Containers (for geotechnical analysis). The majority of samples are only scheduled for PI and sulphate testing, for which 500g of sample is required (a full 0.5-litre plastic tub). However, bulk bags are taken where scheduling of compaction or grading tests is proposed.

Groundwater

Where encountered during fieldwork, groundwater is recorded on exploratory hole logs. If monitoring wells are installed, groundwater levels are also recorded on one or more occasions after completion of the fieldwork. Long-term monitoring of standpipes or piezometers is always recommended if water levels are likely to have a significant effect on earthworks or foundation design.

It should be borne in mind that the rapid excavation rates used during a ground investigation may not allow the establishment of equilibrium water levels. Water levels are likely to fluctuate with season/rainfall and could be substantially higher at wetter times of the year than those found during this investigation.

Description of strata

Soils encountered during a Lithos investigation are described (logged) in general accordance with BS 5930:2015. The descriptions and depth of strata encountered are presented on the exploratory hole logs and summarised in the Ground Conditions section within the main body of text. The materials encountered in the trial pits are logged, samples taken, and tests performed on the in-situ materials in the excavation faces, to depths of up to 1.2m; below this depth these operations are conducted at the surface on disturbed samples recovered from the excavation.

[1] *Mark Perrin. Stoned – Sample Preparation for Soils Analysis. Ground Engineering, April 2007.*

03 – Geotechnical laboratory testing
Generic notes – geoenvironmental investigations

General

Soil samples are delivered to the laboratory for testing along with a schedule of testing drawn up by Lithos. All tests are carried out in accordance with BS 1377:1990. The following laboratory testing is routinely carried out on a selection of samples:

- Atterberg limits & moisture contents
- Soluble sulphate & pH

Where soft, cohesive soils are encountered, one-dimensional consolidation tests are scheduled in order to assess settlement characteristics, and unconsolidated undrained triaxial compression tests to assess shear strength.

The additional tests are typically only scheduled where significant earthworks regrade is anticipated:

- Grading
- Compaction tests
- Particle density

Test results are presented as received in an Appendix to the Geoenvironmental Report.

Atterberg limits & moisture content

The Liquid and Plastic Limits of samples of natural in-situ clay are determined using the cone penetrometer method and the rolling thread test. These tests enable determination of an average Plasticity Index (PI) for each "type" of clay, although judgement is applied where variable results are reported.

PI can be related to shrinkability (low, medium or high) and then to minimum founding depth. Lithos typically only consider a soil to be shrinkable if the proportion finer than 63µm is >35%. PI results are compared against guidance given in the NHBC Standards, Chapter 4.2 (revised April 2003), which advocates the use of modified Plasticity Index (I'p), defined as:

I'p = Ip * (%< 425µm/100)

i.e. if PI is 30%, but the soil contains 80% < 425µm, then: I'p = 30 * 80/100 = 24%.

It should be noted that in accordance with the requirements of BS 1377, the % passing the 425µm sieve is routinely reported by testing labs. Lithos apply engineering judgment where PI results are spread over a range of classifications. Consideration is given to:

- The average values for each particular soil type (ie differentiate between residual soil and alluvium)
- The number of results in each class and
- The actual values

Unless the judgment strongly indicates otherwise, Lithos typically adopts a conservative approach and recommends assumption of the higher classification.

Soluble sulphate and pH

Sulphates in soil and groundwater are the chemical agents most likely to attack sub-surface concrete, resulting in expansion and softening of the concrete to a mush. Another common cause of concrete deterioration is groundwater acidity.

The rate of chemical attack depends on the concentration of aggressive ions and their replenishment at the reaction surface. The rate of replenishment is related to the presence and mobility of groundwater.

Lithos refer to BRE Special Digest 1 (SD1) "Concrete in aggressive ground. Part 1: Assessing the aggressive chemical environment" (2005). SD 1 provides definitions of:

- The nature of the site (greenfield, brownfield or pyritic)
- The groundwater regime (static, mobile or highly mobile)
- The design sulphate class (DS class) and
- The aggressive chemical environment for concrete (ACEC class)

Lithos reports clearly state each of the above for the site being considered.

The concentrations of sulphate in aqueous soil/fill extracts are determined in the laboratory using the gravimetric method. The results are expressed in terms of SO_4 for direct comparison with BS 5328:1997. The pH value of each sample was determined by the electrometric method.

SD1 also discusses determination of "representative" sulphate concentration from a number of tests. Essentially if <10 samples of a given soil-type have been tested, the highest measured sulphate concentration should be taken. If >10 samples have been tested, the mean of the highest 20% of the sulphate test results can be taken. With respect to groundwater, the highest sulphate concentration should always be taken.

With respect to pH (soil & groundwater) the value used is the lowest value if <10 samples have been tested and the mean of the lowest 20% if >10 samples have been tested.

Oedometer (Consolidation) tests

Oedometer tests measure a soil's consolidation properties, and are performed by applying different loads to a soil sample and measuring the deformation response. Typically the sample is subject to 5 incremental pressures (4 loading & 1 unloading), and the convention is for each subsequent pressure to be double the previous pressure. BS1377 suggests the **initial** pressure should be:

a) For stiff soils the effective overburden pressure*
b) For firm soils "somewhat less" than the effective overburden pressure
c) For soft soils "appreciably less" than the effective overburden pressure, usually 25 kPa or less
d) For very soft soils very low, typically 5 kPa or 10 kPa

* Effective **overburden pressure** (kNm^{-2}) = depth (m) x soil bulk unit weight (kNm^{-3})

Results from these tests are used to predict how a soil in the field will deform in response to a change in effective stress.

Triaxial tests

This test measures the mechanical properties of a soil by placing the sample between two parallel platens which apply stress in one (usually vertical) direction, with fluid used to apply a confining pressure in the perpendicular directions. During the test, the surrounding fluid is pressurized, and then stress on the platens is increased until the material in the cylinder fails.

From triaxial test data, it is possible to extract fundamental material parameters, including its angle of shearing resistance, apparent cohesion, and dilatancy angle. These parameters are then used in computer models to predict how the material will behave in a larger-scale engineering application.

Quick (single stage, Unconsolidated, Undrained tests) are most appropriate for foundation design. This is because load is applied relatively quickly, and shear strength of the clay will be lowest initially; after the applied load causes some consolidation of the ground (after drainage results in dissipation of short-term excess pore water pressure), the in-situ clays will become progressively stronger and hence the factor of safety will increase. Confining pressure is specified as equivalent to overburden pressure (kNm^{-2}).

Foundations on granular soils would use effective shear strength parameters (c' and phi') to assess safe bearing capacity, as the soil would fully drain quickly. These effective shear strength parameters could be determined from Consolidated Undrained (or sometimes the more expensive Consolidated Drained) triaxial tests, but often correlations to the SPT are used.

Unconsolidated Undrained triaxial tests are most appropriate for assessment of the stability of fill slopes on clays. Similar to foundations, the application of load gradually increases the strength of the clays and hence the critical case is the short term undrained condition.

Consolidated Undrained (or sometimes **Consolidated Drained**) triaxial tests are most appropriate for assessment of the stability of cut slopes in clays. This is because unloading of the ground leads to short term reduction in pore pressures that approximately balance the unloading, hence the soil strength is largely unchanged. Over time the reduced pore pressures suck water in, which leads in to the progressive increase in pore pressure and loss of strength. The fully drained state is critical, which must be modelled using effective strength parameters and a reasonable estimate of the long term water table conditions.

Slopes formed in granular soils would use effective shear strength parameters (c' and phi') to assess safe bearing capacity, as the soil would fully drain quickly. These effective shear strength parameters could be determined from Consolidated Undrained (or sometimes the more expensive Consolidated Drained) triaxial tests, but often correlations to the SPT are used.

Determination of analytical suite

An assessment of potential contaminants associated with the former usages of the site is undertaken with reference to CLR 8 "Potential contaminants for the assessment of land" and the relevant DETR Industry Profile(s).

Common contaminants

Common **Inorganic** Contaminants include:

- Metals, most notably cadmium, copper, chromium, mercury, lead, nickel, and zinc
- Semi-metals, most notably arsenic, selenium, and (water soluble) boron
- Non-metals, most notably sulphur
- Inorganic anions, most notably cyanides (free & complex), sulphates, sulphides, and nitrates

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

Total cyanide (CN) is determined by acid extraction; whereas free cyanide is the water soluble fraction. Complex cyanide is "bound" in compounds and is hard to breakdown. Laboratory determination of complex CN involves subjecting the sample to UV digestion for determination of both free and total CN.

Thiocyanate (SCN) is a different species combined with sulphur.

Elemental sulphur (S) and free sulphur are the same. Total sulphur is all forms, including that present in sulphates (SO_4), sulphides etc.

There are 2 forms of chromium (Cr), chromium VI and chromium III. Chromium VI is the more toxic of these. In soils, total chromium is determined by a strong aqua regia acid digestion. Chromium VI is an empirical method based on a water extract test.

Common **Organic** Contaminants include hydrocarbons, phenols, and polychlorinated biphenyls.

Petroleum is a mixture of hydrocarbons produced from the distillation of crude oil, and includes aliphatics (alkanes, alkenes and cycloalkanes), aromatics (benzene and derivatives) and hydrocarbon-like compounds containing minor amounts of oxygen, sulphur or nitrogen. Petroleum hydrocarbons can be grouped based on the carbon number range:

- GRO – Gasoline Range Organics (typically C_6 to C_{10}). Also referred to as PRO – Petroleum Range Organics
- DRO – Diesel Range Organics (typically C_{10} to C_{28})
- LRO - Lubricating Oil Range Organics (typically C_{28} to C_{40})
- MRO – Mineral Oil Range Organics (typically C_{18} to C_{44})

However, it should be borne in mind that the terms "GRO" and "DRO" analysis are purely descriptive terms, the exact definition of which varies. Total Petroleum Hydrocarbons (TPH) is also a poorly defined term; some testing laboratories regard TPH as hydrocarbons ranging from C_5-C_{40}, whereas others define TPH as C_{10}-C_{30}.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictated by the nature of the source (e.g. petrol, diesel, engine oil etc). Furthermore, different hydrocarbons are affected differently by weathering processes, and this can result in further variation in the chemical composition of the TPH.

Gasoline contains light aliphatic hydrocarbons (especially within the C_4 to C_5 range) that are volatile. The aromatic hydrocarbons in gasoline are primarily benzene, toluene, ethylbenzene and xylenes, referred to as BTEX. Small amounts of polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene may also be present. Diesel and light fuel oils have higher molecular weights than gasoline. Consequently, they are less volatile and less water soluble. About 25 to 35% is composed of aromatic hydrocarbons. BTEX concentrations are generally low.

Heavy Fuel Oils are typically dark in colour and considerably more viscous than water. They contain 15 to 40% aromatic hydrocarbons. Polar nitrogen, sulphur and oxygen-containing compounds (NSO) compounds are also present. Lubricating Oils are relatively viscous and insoluble in groundwater. They may contain 10 to 30% aromatics, including the heavier PAHs. NSO compounds are also common.

Polycyclic Aromatic Hydrocarbons (PAHs) have two or more fused benzene rings as a structural characteristic. PAH compounds are present in both petrol and diesel, although in significantly lower concentrations than in coal tars. Certain PAH compounds are carcinogenic (benzo(a)pyrene) and\or mobile in the environment (naphthalene).

Volatile Organic Compounds (VOCs) are organic chemicals, and most are liquids that readily evaporate on exposure to air. Examples include benzene, toluene, xylene, chloroform etc. Semi-Volatile Organic Compounds (sVOCs) include phenol and benzo(a)pyrene, and have relatively low boiling points. Both groups of chemicals are readily absorbed through skin and some, such as benzene, are believed to be linked to tumour growth.

Phenols are compounds that have a hydroxyl group (-OH) attached to an aromatic ring (ie include a benzene ring and an –OH group). Most are colourless solids. A solution of phenol in water is known as carbolic acid, and is a powerful antiseptic. However, phenol vapour is toxic, and skin contact can result in burns.

Polychlorinated Biphenyls (PCBs) were used in pre-1974 transformers as dielectric fluids. PCB's are of increasing toxicity relative to the degree of chlorination. Acute symptoms of PCB poisoning are irritation of the respiratory tract leading to coughing and shortness of breath. Nausea, vomiting and abdominal pain are caused by ingestion of PCB's.

Dioxins and furans (polychlorinated dibenzodioxins and polychlorinated dibenzofurans) are some of the most toxic chemicals known; in the environment, they tend to bio-accumulate in the food chain. Dioxin is a general term that describes a group of hundreds of chemicals that are highly persistent in the environment. The most toxic compound is 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD.

Dioxin is formed by burning chlorine-based chemical compounds with hydrocarbons. The major source of dioxin in the environment comes from waste-burning incinerators and also from backyard burn-barrels. Dioxin pollution is also affiliated with paper mills which use chlorine bleaching in their process and with the production of Polyvinyl Chloride (PVC) plastics and with the production of certain chlorinated chemicals (like many pesticides).

Methods of analysis (organic compounds)

TPH by GC-FID is an analytical technique which only detects hydrocarbons (aliphatic and aromatic) in the range C_{10} to C_{40} (volatiles, heavy tars, humic material and sulphur are not detected). The laboratory can provide a broad, 'banded' breakdown of the TPH results into gasoline range organics (GRO), diesel range organics (DRO) and heavier lubricating oil range organics (LRO), or fully speciated results with the reporting of hydrocarbon concentrations in 14 specific carbon bandings based upon behavioural characteristics, e.g. aliphatic C_6 to C_8, aromatic C_{10} to C_{12} etc.

Speciated VOC (by GC-MS) analysis quantifies the concentrations of 30 USA-EPA priority compounds. These include chlorinated alkanes and alkenes (in the molecular weight range chloroethane to tetrachloroethane); trimethylbenzenes; dichlorobenzenes; and the 4 BTEX compounds (benzene, ethyl-benzene, toluene & xylene).

Speciated sVOC by (GC-MS) analysis quantifies the concentrations of a variety of organic compounds, including the 16 USA-EPA priority PAHs, phenols, 7 USA EPA priority PCB congeners, herbicides & pesticides.

Note: PAHs are hydrocarbons and consequently (where present) will be picked-up when scheduling TPH by GC-FID.

Note: Risk assessment models require physiochemical properties (solubilities, toxicities etc) of compounds in order to model their behaviour in the environment. These physiochemical properties cannot be derived from a single "TPH", "GRO" or "DRO" value. However, the carbon banded fractions can be used in risk assessment models.

Current UK guidance

The UK approach to contaminated land is set out in Land Contamination Risk Management (2020). The approach is based upon risk assessment, where risk is defined as the combination of the probability of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

In the context of land contamination, there are three essential elements to any risk: (1) a contaminant source; (2) a receptor (eg controlled water or people); and (3) a pathway linking (1) and (2). Risk can only exist where all three elements combine to create a pollutant linkage. Risk assessment requires the formulation of a conceptual model which supports the identification and assessment of pollutant linkages.

Lithos adopt a tiered approach to risk assessment, consistent with UK guidance and best practice. The initial step of such a risk assessment (or Tier 1) is the comparison of site data with appropriate UK guidance levels, Lithos risk-derived screening values, or remedial targets. It should be noted that exceedance of Tier 1 does not necessarily mean that remedial action will be required.

Soil screening values used by Lithos

In March 2002 DEFRA and the Environment Agency published a series of technical papers (R&D Publications CLR 7, 8, 9 & 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 & 10 and all corresponding SGV and Tox reports were withdrawn and superseded by new guidance including:

- Guidance on Comparing Soil Contamination Data with a Critical Concentration - CL:AIRE and CIEH, May 2008
- Evaluation of models for predicting plant uptake of chemicals from soil - Science Report – SC050021/SR
- Human health toxicological assessment of contaminants in soil - Science Report: SC050021/SR2
- Updated technical background to the CLEA model - Science Report: SC050021/SR3
- CLEA Software Handbook, Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

In December 2013 Defra published the results of research project SP1010 – Development of Category 4 Screening Levels (C4SLs) for Assessment of Land Affected by Contamination. The objective of this project was to provide technical guidance in support of Defra's revised Statutory Guidance for Part 2A of the Environmental Protection Act 1990 (Part 2A). The revised Statutory Guidance, published in April 2012, introduced a new four-category system for classifying land under Part 2A, where Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is acceptably low. Project SP1010 aimed to deliver:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- Demonstration of the methodology, via derivation of C4SLs for 6 substances – arsenic, cadmium, chromium IV, lead, benzene & benzo(a)pyrene.

The methodology for deriving both the previous Soil Guideline Values and the Category 4 Screening Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology. Development of C4SLs has been achieved by modifying the toxicological and\or exposure parameters used within CLEA (while maintaining current exposure parameters).

Part 2A Statutory Guidance was developed on the basis that C4SLs could be used under the planning regime. Defra anticipate that, where they exist, C4SLs will be used as generic screening criteria, and Lithos consider C4SLs to be suitable for use as Tier 1 Screening Values. Lithos have discussed this matter with both NHBC and YALPAG (collection of Yorkshire & Lincolnshire local authorities) and received confirmation that they are satisfied with this approach.

The CLEA conceptual site model assumes a source located in a sandy loam, with 6% soil organic matter (SOM) - equivalent to 3.5% total organic carbon (TOC). However, many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with revised, lower screening values may be required. Other CLEA default characteristics adopted by Lithos are:

Sandy Loam characteristics (source)	Default values adopted
Total porosity (fraction)	0.53
Water filled porosity (fraction)	0.33
Air filled porosity (fraction)	0.2

Lithos have derived Screening Values for five different CSMs (scenarios); these are:

A - Residential with gardens, but no cover (or only up to 300mm)

B - Residential with gardens and 600mm 'clean' cover

C - Residential apartments with landscaping (i.e. no home grown produce)

D - Commercial/industrial with landscaping

E – Importation of soil cover

The **exposure** pathways considered for each scenario are detailed in the table below.

Scenario	Land use	Pathways	Justification
A	Residential with garden, but no cover (or only up to 300mm)	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	Minimal cover – insufficient to break any pathways therefore all exposure pathways are relevant.
B	Residential with garden minimum 600mm cover	• Inhalation of indoor vapours • Inhalation of outdoor vapours	The 600mm cover removes the risk from all pathways other than inhalation.
C	Residential apartments with landscaped areas and minimum 300mm cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. However consumption of home grown produce not included as unlikely to be grown in landscaped areas. Where vegetables are to be grown site specific QRA may be required.

Scenario	Land use	Pathways	Justification
D	Commercial/ industrial with landscaped areas no cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. Assumed the commercial development consists of offices to provide a conservative assessment.
E	Importation of soil for cover in garden and landscaped areas	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of outdoor vapours and dust	Material used as cover to break existing pathways therefore all direct and indirect pathways relevant; however cover is **not** placed below plots therefore indoor inhalation is not relevant.

Lithos have assumed the source of contamination is directly below the building foundation; i.e. a depth to source of 0.15m as opposed to the CLEA default of 0.65m. This assumption provides for a more conservative approach than the UK default.

Lithos have derived Tier 1 values for a number of inorganic and organic determinands in the context of the five Scenarios A to E. The Tier 1 values are **not** intended to be used when considering potential risks associated with:

- Existing land uses in the context of Part 2A of the Environment Protection Act 1990;
- End uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; or
- Groundwater and surface water

Inorganic Tier 1 values for scenarios A to E

Inorganic contaminant	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
As	32	37	37	Use (A) in SI Report for initial "screen" If >5 x A, then consider increase of cover to 1,000mm	40	640	37	C4SL adopted
Cd	10	26	26		149	410	26	C4SL adopted
Cr			4,000		4,000	28,767	4,000	Assumes Cr is CrIII
Pb	450	200	200		314	2,330	200	C4SL adopted
Ni	130		109		123	892	109	Assessment of health risk only
Se	350		434		596	13,018	434	
Hg	170		199		244	3,603	199	Assumes in an inorganic compound
Vn			584		586	4,994	584	
B			5		5	5	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Cu			100		100	100	100	
Zn			200		200	200	200	

Organic Tier 1 values for scenarios A to E

Organic contaminant (all sourced via CLEA)	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
Benzene	0.33	0.87	0.7	<1^	<1^	63	<1	<1 based on professional judgement and lower than calculated value.
Toluene	610		836	2,048	1,912	5,000	<1	Scenario D based on professional judgement and lower than calculated value.
Ethyl Benzene	350		379	592	566	5,000	<10	
Xylenes	240		535	590	585	5,000	<10	Scenario E based on professional judgement and lower than calculated value.
Phenol	420		1,434	3,360	2,264	5,000	<10	
PCBs			2	8	2	38	N/A	Based on toxicity of EC7
Benzo(a)pyrene		5	5	25	5	76	5	C4SL adopted. Scenario B 5 times scenario A
Naphthalene			6	6	6	619	<10	Scenario E based on professional judgement and lower than calculated value
Gasoline Range Organics			22	23	23	2178	626	See 3-step assessment of TPH below ^Based on professional judgement and lower than calculated value
Diesel Range Organics			215	218	215	^5,000	1,429	
Lubricating Range Org			3,299	5,000	3,829	^5,000	3,299	

* *For a residential end use*

The significance of PAHs can be determined by considering indicator compounds. In most cases benzo(a)pyrene (BaP) is adopted as an indicator due to the amount of toxicological data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. A surrogate marker approach can be used to estimate the toxicity of a mixture of PAHs in soil using toxicity data for individual indicator compounds within that mixture. Exposure to the surrogate marker is assumed to represent exposure to all PAHs in that matrix. The surrogate marker approach relies on a number of assumptions:

- Surrogate marker (BaP) must be present in all soil samples
- Profile of the different PAH relative to BaP should be similar in all samples
- PAH profile in the soil samples should be similar to that used in the pivotal toxicity study[1]

To assess the PAH profile in a soil sample, the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated. The ratio relative to BaP should lie within an order of magnitude above and below the mean ratio to BaP.

[1] SP1010 Appendix E, Provisional C4SIs for benzo(a)pyrene as a surrogate marker for PAHs, CL:AIRE 2013

Naphthalene should also be considered separately against its generic screen. Whilst classed as a PAH, naphthalene is more volatile and mobile in the environment than most other PAHs. As such the significance of naphthalene cannot be considered within the surrogate marker approach.

Similarly, **TPH** cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "The UK approach for evaluating human health risks from petroleum hydrocarbons in soils". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG). The TPHCWG have broken down "TPH" into representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the bandings.

The significance of speciated TPH results can be assessed by following the 3 steps outlined in the tables below.

Step	Result	Action
1. Consider indicator compounds: Are BTEX, naphthalene, benzo(a)pyrene above their respective Tier 1 values?	Yes	Remediation or dQRA required
	No	Proceed to Step 2
2. Consider individual TPH fractions: are they above respective screening values?	Yes	Remediation or dQRA required
	No	Proceed to Step 3
3. Assess Cumulative effects: Is the calculated Hazard Index for each source >1	Yes	Remediation or dQRA required
	No	TPH compounds pose no significant risk

The equation used to assess cumulative effects in step 3 is shown below.

$$HI = \sum_{F_i=1}^{16} HQ\ F_i = \frac{Measured\ concentration\ F_i\ (mg\,kg^{-1})}{SGV\ F_i\ (mg\,kg^{-1})}$$

where HI = Hazard Index
HQ = Hazard Quotient
F_i = Fraction $_i$
SGV = Soil Guideline Value

Statistical Assessment

Current UK guidance is provided by CL:AIRE[2], and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

However, in the context of site investigation to assess the significance of contamination on brownfield sites which are typically underlain by **heterogenous made ground**, some remediation is almost always required (placement of soil cover, excavation of gross contamination etc). Consequently, in such circumstances, it is not necessary to demonstrate that made ground soils are "clean" and therefore there is no need to test large numbers of samples and undertake statistical analysis. Sample results can simply be compared directly with appropriate screening values (e.g. Lithos Tier 1 values).

The CL:AIRE (2020) guidance replaces the withdrawn "Guidance on Comparing Soil Contamination Data with a Critical Concentration" (2008).

The old approach to statistical analysis was based on a definitive yes/no answer which required limited consideration of the dataset and Conceptual Site Model. It was widely accepted that this did not allow sites or risk to be adequately assessed. The updated approach requires a comprehensive understanding of the datasets within the context of the Conceptual Site Model.

Current guidance requires that:

- A robust CSM is in place which identifies source areas, averaging areas and averaging zones
- Sampling locations are relatively evenly spread across the site and were selected using simple or stratified random sampling with no targeting being undertaken
- The field data and CSM do not suggest the presence of a hotspot of contamination which should be treated as a separate zone
- The samples are all taken from a similar same depth and within the same material type across the zone being assessed
- A minimum of 10 samples have been taken. It should be appreciated that confidence in a dataset increases as the number of samples obtained and tested from a zone increases.

The statistical analysis assumes a homogenous distribution of strata and contamination and therefore the dataset will be normally distributed (symmetric, log symmetric or fat tailed).

A normally distributed dataset is assessed using a number of statistical tools to generate a Dot and Box Plot which includes summary statistics and confidence intervals. The review of statistical data enables the assessor to make a decision, with an associated level of confidence, where the true mean of the sample population lies in relation to the critical concentration.

It is essential when using statistics to assess sample data that all decisions relate back to the conceptual site model. Statistics cannot indicate if contamination on a site is likely to present a risk to the end user, this is the role of the 'competent person' i.e. Lithos.

However, broadly speaking the following applies:

- Mean and UCL below the critical concentration – no further assessment required.
- Mean below the critical concentration, but UCL above – consider the CSM and likely sources.
- Mean and UCL above the critical concentration – further assessment required, remediation likely depending on the CSM.
- LCL, Mean & UCL above the critical concentration – further assessment required, remediation likely.

[2] *CL:AIRE, 2020.Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.*

Other screening values used by Lithos

Tier 1 risk assessment of **hazardous gas** is undertaken through reference to the following documents (and further information is presented in Generic Note No. 5 – Hazardous Gas):

- Approved Document C, Building Regulations 2000
- Boyle & Witherington (2007) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC
- CIRIA C665 (2007) – Assessing risks posed by hazardous ground gases to buildings
- BS 8485:2015 – Code of Practice for the characterisation & remediation from ground gas in affected developments

With respect to the assessment of potential **phytotoxic effects** of contaminants, Lithos refer to The Sewage Sludge in Agriculture: Code of Practice 2018 for copper and zinc (at pH 5.5 to 6.0). The CLEA derived Tier 1 value is adopted for nickel due to its human health effects.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, 'Concrete in aggressive ground', 2005.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that: "*In general … it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn*".

Tier 1 **groundwater risk assessments** are always site specific and compare leachate or groundwater concentrations with the appropriate water quality standard based on the CSM and consideration of relevant water quality impacts and assessments.

Waste classification & WAC

In the context of waste soils generated by remediation and\or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated 'natural' soil, bricks, concrete, tiles & ceramics)
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds)
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds)

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

Landfill operators require Waste Acceptance Criteria (WAC) laboratory data, if soil waste is classified as **hazardous**. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Lithos typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated, for example where redevelopment proposals include basement construction etc. If off-site disposal of soils classified as hazardous waste during redevelopment is anticipated, then WAC analysis should be scheduled at an early stage in the remediation programme. However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous, and these contaminants can often be dealt with by alternative technologies (e.g. by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required.

Possible action in event of Tier 1 exceedance

Should any of the Tier 1 criteria detailed above be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

1. Undertake further statistical analysis following the approach set out in Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration, 2020 (see above) in order to determine whether contaminant concentrations of inorganic contaminants within soil\fill actually present a risk (only applicable to assessing the risk to human health).
2. Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
3. Based on a qualitative risk assessment, advocate an appropriate level of remediation to "break" the pollutant linkage - for example the removal of the contaminated materials or the provision of a clean cover.

Prior to undertaking any statistical analysis the issue of the **averaging area** requires further consideration. Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration, 2020 provides some guidance on averaging areas noting that they are the area within which a receptor may be exposed to contamination but leaving the site assessor to determine the appropriate averaging area for their site.

Lithos consider the entire site needs to be characterised by reference to the Conceptual Site Model. Consequently, Lithos gather and analyse sample results by fill type, and\or by former use in a given sub-area of the site, before undertaking statistical analysis; i.e. the averaging area is associated with the extent of a particular fill type, or an area affected by spillage\leakage.

In terms of brownfield redevelopment, this is considered a more appropriate methodology which provides a more representative sample population for statistical analysis. As such the entire site is considered in terms of the proposed end use, be this residential with, or without gardens.

Analysis by soil\fill type is appropriate for essentially immobile contaminants associated with a particular fill type, for example arsenic in colliery spoil, metals in ash & clinker, sulphate in plaster-rich demolition rubble etc.

Analysis by former use is appropriate where more mobile contaminants have entered the ground, for example diesel associated with leakage from a former fuel tank, downward migration of leachable metals through granular materials, various soluble contaminants present in a wastewater leaking into the ground via a fractured sewer etc. In these circumstances, it may be appropriate to undertake statistical analysis of sample results from a variety of different soil\fill types. However, consideration would have to be given to factors such as porosity which might influence impregnation of a mobile contaminant into the soil mass, i.e. contamination would normally be more pervasive and significant in granular soils than cohesive soils

05 – Hazardous gas
Generic notes – geoenvironmental investigations

General

Hazardous gas is considered to be any mixture of potentially explosive, toxic or asphyxiating gases, most notably methane, carbon dioxide and oxygen (deficiency). In addition, radon, a naturally occurring radioactive gas is also considered. Further information about radon is included in Notes 01 – Environmental Setting.

Assessment of potential risks associated with hazardous gas are based on a review of data obtained from the Landmark Information Group, the Environment Agency and the Local Authority and the British Geological Survey. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Where landfilling has occurred within 250m of the site boundary, the Local Planning Authority may request a landfill gas investigation in accordance with the Town and Country Planning General Development Order, 1988.

Sources

Potential sources of hazardous gas include:

- Landfill sites
- Made ground, especially where significant depths are present
- Shallow mineworkings associated with coal extraction
- Geological strata, including peat, organic silts, coal and limestone (reaction with acidic waters), granite (radon)
- Groundwater can sometimes act as a "carrier" for hazardous gas
- Leakages from pipelines or storage tanks
- Sewers, septic tanks and cess pits

Generation

Wherever biodegradable material is deposited, landfill gas (principally a mixture of methane and carbon dioxide) is likely to be generated by microbial activity. Carbon dioxide is an asphyxiant and toxic; methane is flammable and a mixture containing between 5% and 15% methane by volume in air is explosive. Landfill gas in the ground is unlikely in itself to pose a significant risk, though it may damage vegetation. However, infiltration of landfill gas into confined spaces (e.g. cellars, services, etc) may give rise to considerable risk.

There is no typical figure for the length of time that landfill gas will be evolved, but at many sites significant gas generation continues for at least 15 years after the last deposit of waste.

Migration

Gas migration from a landfill site may occur in several ways. It may migrate through adjacent strata; the distance of migration being dependent on the pressure gradients, volume of gas and permeability of the strata. Where there are faults, cavities and fissures within the strata, gas may move considerable distances. Other migration pathways for gas include man-made features such as mine shafts, roadways and underground services.

Gas migration is influenced by a number of climatic factors, such as atmospheric pressure variations, water table level variations and the influence of a covering of snow or ice over the surface of the site and surrounding area.

Gas monitoring procedure

Lithos adopt a standard gas monitoring procedure, in accordance with CIRIA guidance. This procedure involves the measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration
- Gas emission rate
- Methane, oxygen and carbon dioxide concentrations using an infra-red gas analyser
- Standing water level using a dipmeter.

In addition, ground conditions at each sampling location are recorded together with prevailing weather conditions and any other observations such as any vandalism. Where samples of gas are required for laboratory analysis, Gresham Tubes or multi-layer Tedlar / ALTEF sampling bags are used. Gas concentrations in the well are typically recorded immediately before and after retrieval of a sample.

Current guidance

CIRIA Report 151 (1995)[i] identified that there was inadequate guidance on trigger concentrations for ground gases. CIRIA concluded that the most important aspect of a gas regime below or adjacent to a site was the surface emission rate, i.e. how quickly the gas is coming out of the ground. The lower the surface emission rate the lower the risk. CIRIA Report C665 (2007)[ii] advocates two methodologies for characterising sites:

A – All developments except low rise housing. The advocated methodology is that proposed by Wilson & Card, 1999[iii]

B – Low rise housing. An alternative (traffic light) methodology, derived by Boyle and Witherington, 2006[iv] for NHBC

Both methodologies refer to Gas Screening Values (GSV); previously referred to as limiting borehole gas volume flow.

A – All developments except low rise housing

(Wilson & Card, 1999)[v] revised Table 28 of CIRIA 149[v] in terms of borehole gas volume flow rate (now GSV) in order to achieve a more consistent design of protection measures. This was done to reflect the importance of recognising the gas surface emission rate. Wilson & Card then developed a method for classifying gassing sites (Table 1 below), which took into account the combined gas concentration and GSV.

Characteristic Situation	Gas Screening Value, CH_4 or CO_2 (l/hr)	Additional limiting factors	Typical source of generation
1	<0.07	Methane not to exceed 1% v/v and carbon dioxide not to exceed 5% v/v	Natural soils with low organic content
2	<0.7	Borehole air flow rate not to exceed 70 litre/hr otherwise increase to Characteristic Situation 3	Natural soil, high peat/organic content
3	<3.5		Old landfill, inert waste, mineworkings flooded.
4	<15	Quantitative Risk Assessment required to evaluate scope of protection measures.	Mineworkings – susceptible to flooding, completed landfill, inert waste
5	<70		Mineworkings unflooded, inactive
6	>70		Recent landfill site

Notes: Borehole flow rate = volume of gas (regardless of composition) which is escaping from well (l/hr). Gas Screening Value (litre/hour) = gas concentration (%) / 100 x borehole flow rate (l/hr). To facilitate design implementation, the limiting values for both methane and carbon dioxide are identical.

B – Low rise housing.

NHBC have developed a characterisation system similar to that of Wilson & Card above, but specific to low-rise housing development (Boyle and Witherington) (Table 8.7). This approach compares measured gas emission rates with generic "Traffic Lights". The Traffic Lights include "Typical Maximum Concentrations" for initial screening, and risk-based Gas Screening Values (GSVs) for consideration of situations where the Typical Maximum Concentrations are exceeded. Calculations are carried out for both methane and carbon dioxide and the worst case adopted in order to establish the appropriate protection measures.

Table 8.7 NHBC Traffic light system for 150 mm void

Traffic Light Classification	Methane [1]		Carbon Dioxide [1]	
	Typical Maximum Concentration [5] (%v/v)	Gas Screening Value [2,4,6] (l/hr)	Typical Maximum Concentration [5] (%v/v)	Gas Screening Value [2,3,4,6] (l/hr)
Green	1	0.16	5	0.78
Amber 1	5	0.63	10	1.56
Amber 2	20	1.56	30	3.13
Red				

Notes:

1. The worst gas-regime identified at the site, either methane or carbon dioxide, recorded from monitoring in the worst temporal conditions, will be the decider for which Traffic Light and GSV is allocated.
2. Generic GSVs are based on guidance contained within "The Building Regulations: Approved Document C" (2004) and assume a sub-floor void of 150 mm thickness.
3. A leak of gas from the sub-floor void into a small room (e.g. downstairs toilet with soil pipe potentially passing into sub-floor void) of dimensions 1.50m × 1.50m × 2.50m, with a total room volume of 5.63m^3 has been considered.
4. The GSV, in litres per hour, is as defined in Wilson and Card (1999) as the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered.
5. The Typical Maximum Concentrations can be exceeded in certain circumstances should the conceptual site model indicate it is safe to do so. This is where professional judgment will be required, based on a thorough understanding of the gas regime identified at the site where monitoring in the worst temporal conditions has occurred.
6. The GSV thresholds should not generally be exceeded without completion of a detailed gas risk assessment taking into account site-specific conditions.

---

i Harries CR, Witherington PJ and McEntee JM (1995). Interpreting measurements of gas in the ground. CIRIA Report 151

ii CIRIA (2007) – Assessing risks posed by hazardous ground gases to buildings.

iii Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.

iv Boyle & Witherington (2006) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC

v Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.

Appendix B

Drawings

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CLIENT	KCS DEVELOPMENTS LTD
JOB TITLE	ROSLYN AVENUE, NETHERTON
DRAWING TITLE	SITE LOCATION PLAN
DRAWN	LB
DATE	13/06/2024
CHECKED	AG
DATE	13/06/2024
STATUS	FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑
SCALE	1:25,000
SHEET	A4
DRAWING NO.	5080/1
REVISION	

SCHEDULE OF ACCOMMODATION	
TYPE 1A - 1 BED APARTMENT- 560 SQ FT (52 sq m) (2 person) - 1no. Off street parking spaces	6
TYPE 2A- 2 BED SEMI-DETACHED- 775 SQ FT (72 sq m) (3 person) - Off street parking spaces - varies	28
TYPE 2B - 2 BED TERRACE - 850 SQ FT (79 sq m) (4 person) - Off street parking spaces - varies NOTE - Integral access at ground floor level	4
TYPE 2C - 2 bed bungalow 675 sq ft (62.7 sqm) (3 person) (1 storey) 1 no. off street parking space	1
TYPE 3A - 3 BED SEMI-DETACHED - 931 SQ FT (86.5 sq m) (4 person) - 2no. off street parking spaces	8
TYPE 3B - 3 BED DETACHED -1,029 sq ft (95.8 sqm) (5 person) - 2 no. off street parking spaces	20
TYPE 3C - 3 bed bungalow 842 sq ft (78.2 sqm) (4 person) (1 storey) 2 no. off street parking space	1
TYPE 4A - 4 BED DETACHED - 1,076 sq ft (100 sqm) (5 person) - 3 no. off street parking spaces	14
TOTAL	82
21 no. visitors parking spaces	

KEY

- VP Visitors parking
- Garden shed/cycle storage
- Bin storage
- Indicative bin presentation point
- Aspect
- Pedestrian Crossing point
- Visabilty splay

LANDSCAPING KEY

- New tree
- Fruit Trees
- Scrub land
- Grass - EM10 - Tussock meadow mixture
- Grass - EG22 - Strong lawn mixture
- Grass - EL1 - Flowering mixture
- Grass - EM3 - Special general purpose meadow mixture
- Native Species Hedge
- Highway/footpath - Tarmac finish to engineers details
- Shared surface - Block paving to engineers details.
- Secondary Footpath - Timber edge path with crushed gravel to engineers details.
- 1800mm high timber fence
- 1200mm high post and mesh agricultural fence with self closing pedestrian gate at access points.
- Retaining structure up to 1m
- Retaining structure between 1m - 2m
- Retaining structure over 2m

N W E S

NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM ELLIS HEALEY (ARCHITECTURE) DRAWING REFERENCE 2246 PL 105B, DATED NOVEMBER 2023.

REV.	DESCRIPTION	DATE

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JOB TITLE

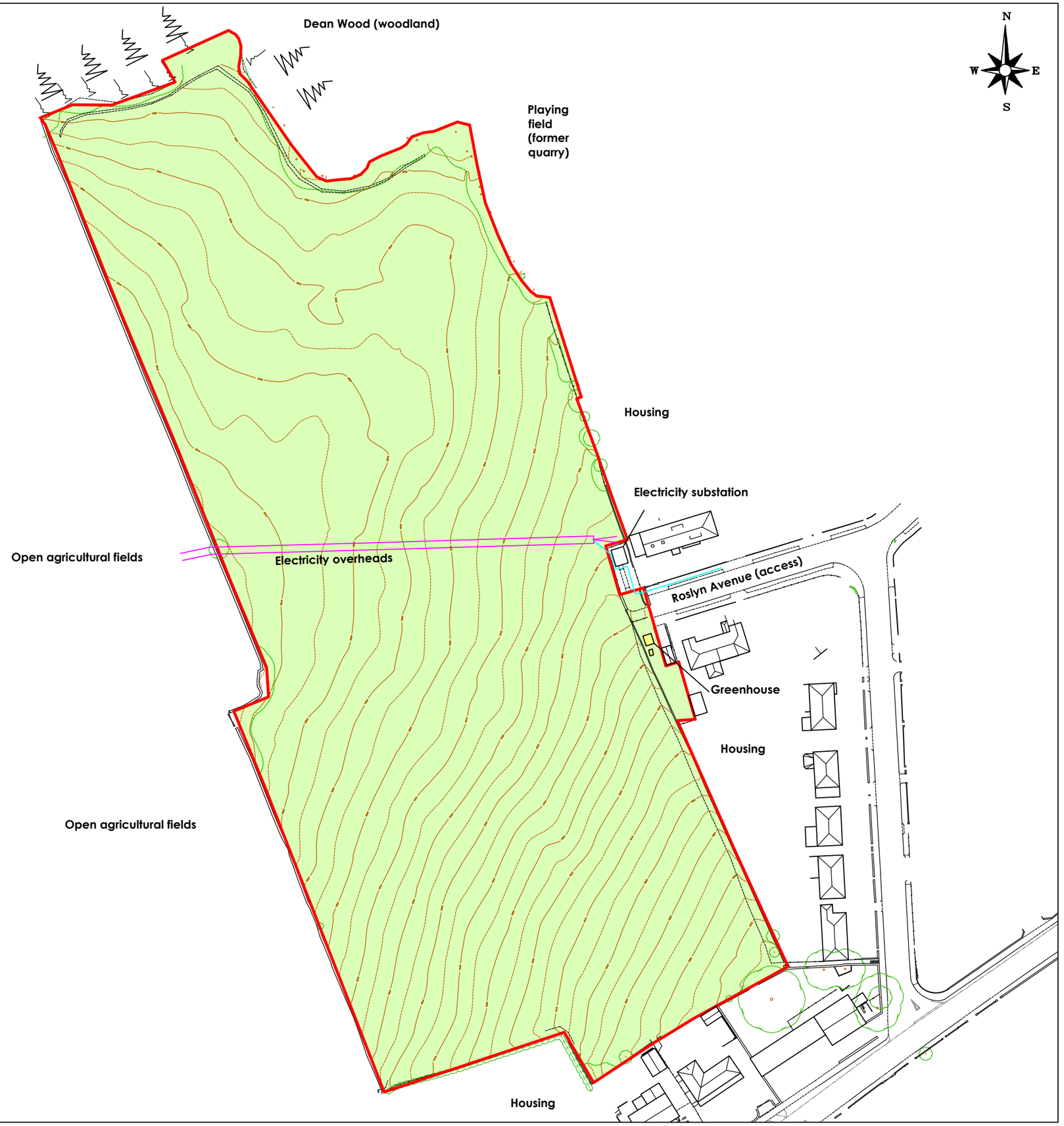
ROSLYN AVENUE, NETHERTON

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
LB	13/06/2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	13/06/2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
NOT TO SCALE	A3	5080/2	



NOTES

- GRASS & OVERGROWN AREAS
- BUILDING
- LINE OF ELECTRICITY OVERHEADS
- LINE OF UNDERGROUND ELECTRIC
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

ROSLYN AVENUE, NETHERTON

DRAWING TITLE

SITE FEATURES

DRAWN	DATE	STATUS
LB	14/06/2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	14/06/2024	DRAFT ☐
		FINAL ☑

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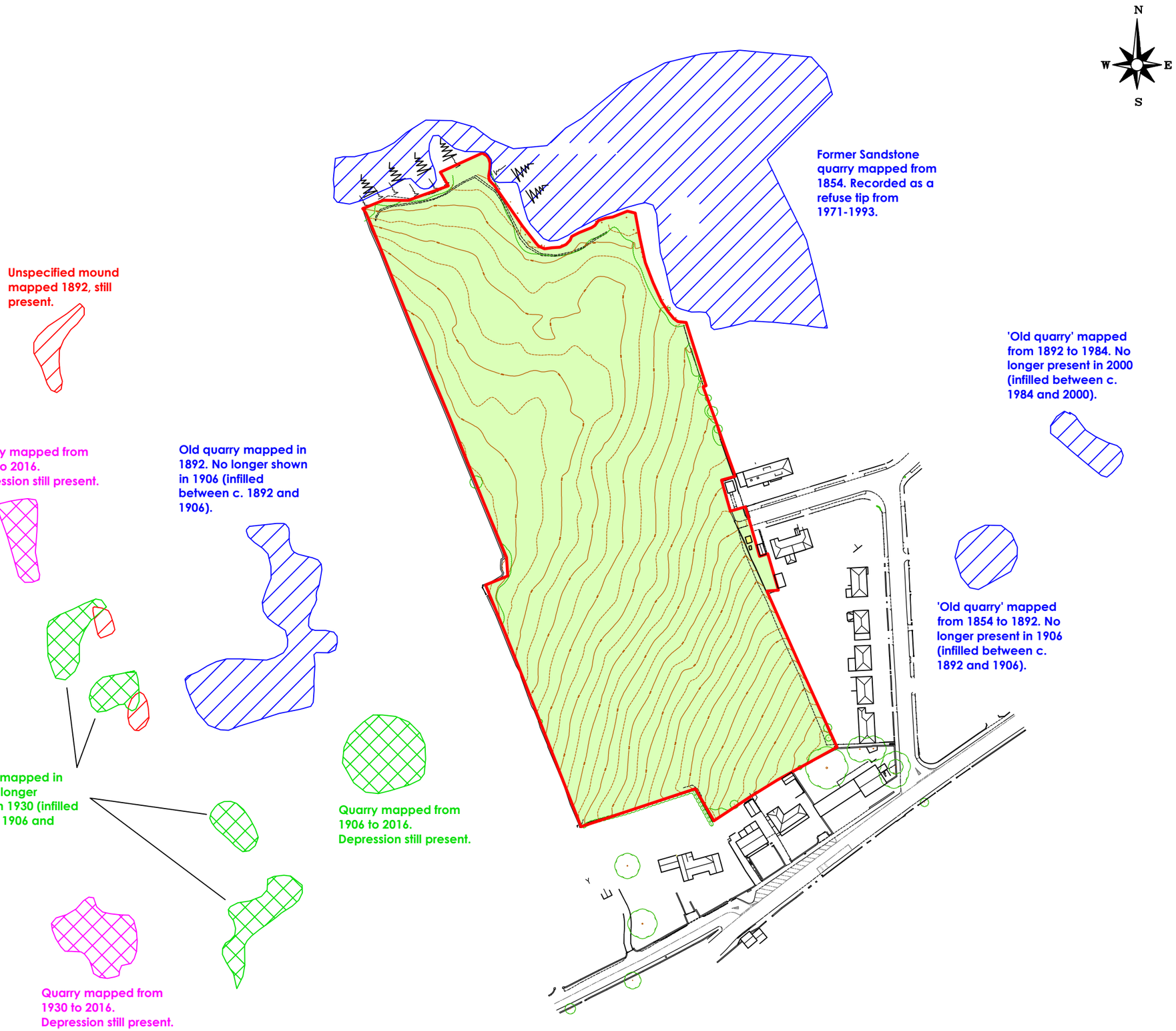

NOTES

- GRASS & OVERGROWN AREAS
- BUILDING
- SANDSTONE QUARRIES (1892 OS MAP)
- UNSPECIFIED FEATURES (1892 OS MAP)
- SANDSTONE QUARRIES (1906 OS MAP)
- SANDSTONE QUARRIES (1932 OS MAP)
- APPROXIMATE SITE BOUNDARY

QUARRY OUTLINES AND DATES ARE APPROXIMATE AND HAVE BEEN ESTIMATED AFTER REVIEW OF THE PROVIDED OS PLANS.

REV.	DESCRIPTION	DATE

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JOB TITLE

ROSLYN AVENUE, NETHERTON

DRAWING TITLE

SITE FEATURES (HISTORICAL)

DRAWN	DATE	STATUS
LB	19/06/2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	19/06/2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	5080/3A	

NOTES

- GRASS & OVERGROWN AREAS
- BUILDING
- LINE OF ELECTRICITY OVERHEADS
- LINE OF UNDERGROUND ELECTRIC
- APPROXIMATE SITE BOUNDARY
- APPROXIMATE LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE

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KCS DEVELOPMENTS LTD

JOB TITLE

ROSLYN AVENUE, NETHERTON

DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	DATE	STATUS
LB	14/06/2024	FOR COMMENT ☐
		FOR APPROVAL ☐
CHECKED	DATE	DRAFT ☐
AG	14/06/2024	FINAL ☑

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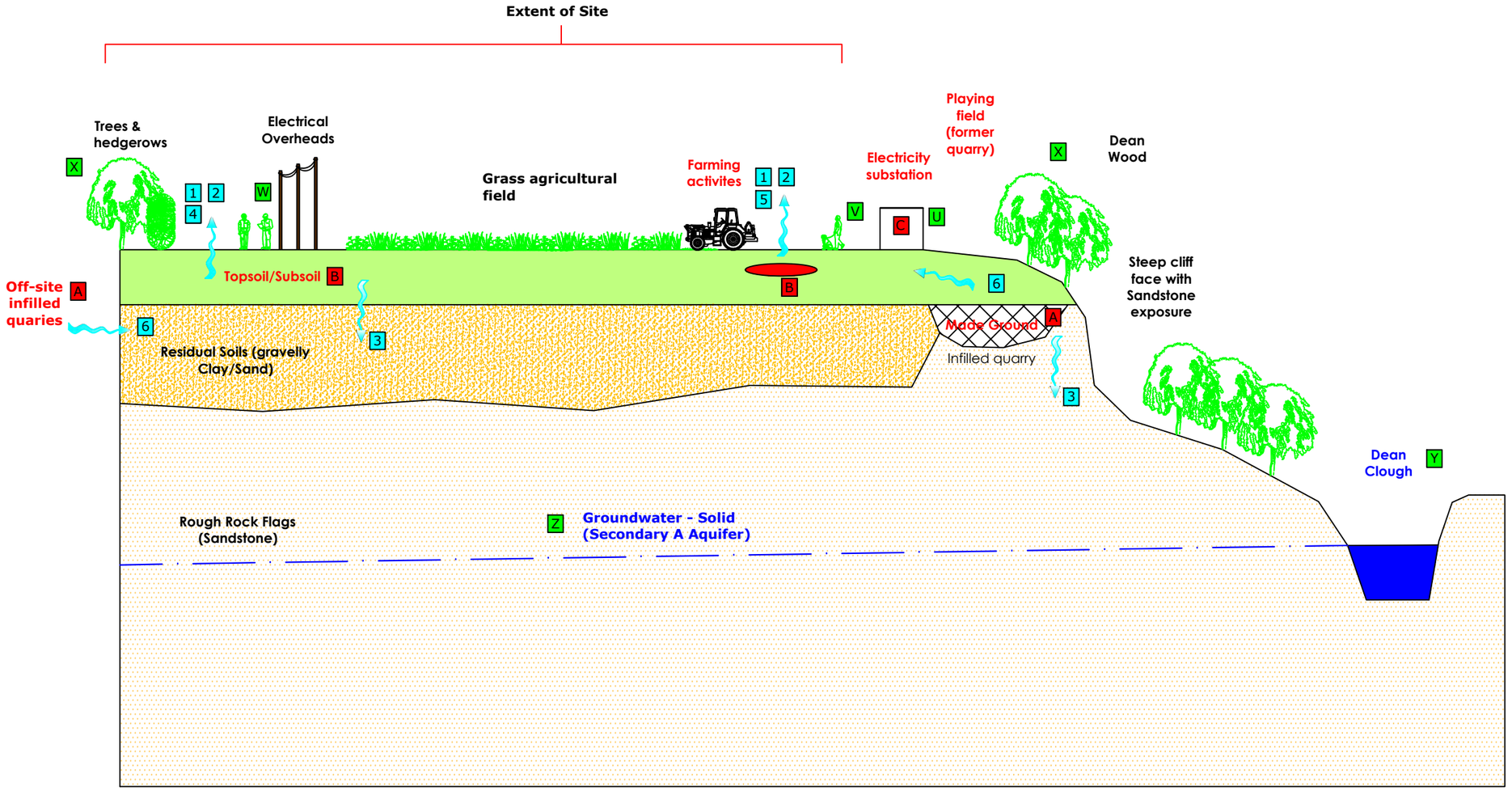
NOT TO SCALE	A3	5080/4	



SOURCES	PATHWAYS	RECEPTORS
A MADE GROUND - INFILLED QUARRIES (INORGANICS/ORGANICS/GAS)	1 DERMAL CONTACT	U BUILDINGS
B TOPSOIL (FARMING ACTIVITIES - INORGANICS/ORGANICS)	2 INGESTION/INHALATION	V END USERS (RESIDENTS)
C ELECTRICITY SUBSTATION (PCBs)	3 LEACHING OF CONTAMINANTS	W SITE WORKERS
	4 UPTAKE BY PLANTS	X VEGETATION
	5 VOLATILISATION	Y SURFACE WATERS
	6 MIGRATION OF GAS	Z GROUNDWATER

NOTES

REV.	DESCRIPTION	DATE

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JOB TITLE

ROSLYN AVENUE, NETHERTON

DRAWING TITLE

PRELIMINARY CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
LB	18/06/2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	18/06/2024	DRAFT ☐
		FINAL ☑

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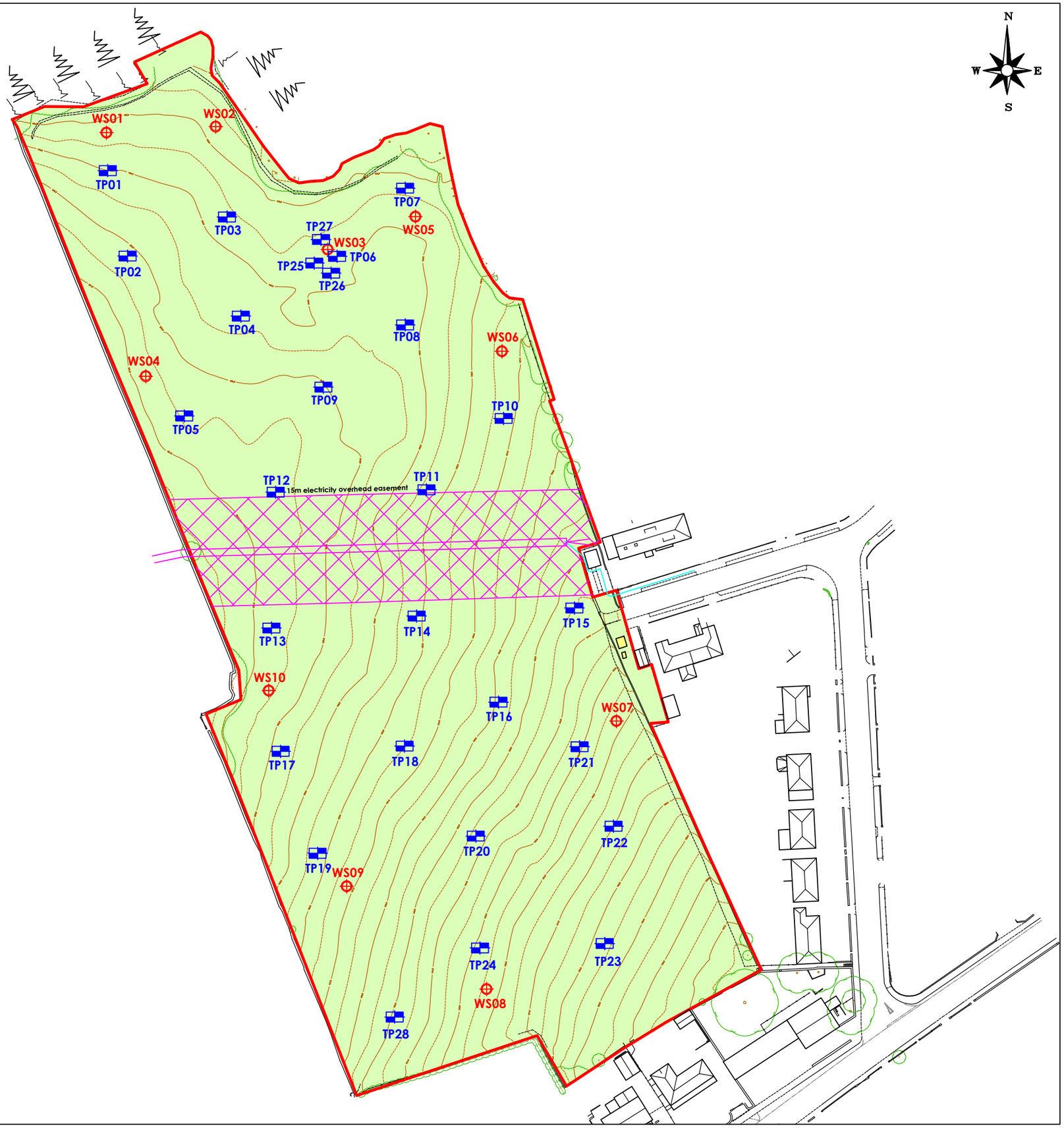

NOTES

- TRIAL PIT LOCATION
- WINDOW SAMPLE LOCATION
- APPROXIMATE SITE BOUNDARY
- GRASS & OVERGROWN AREAS
- BUILDING
- LINE OF ELECTRICITY UTILITY (OVERHEAD)
- LINE OF ELECTRICITY UTILITY (UNDERGROUND)
- 15m EASEMENT AWAY FROM OVERHEADS

EXPLORATORY HOLE LOCATIONS BASED ON DATA FROM A HAND-HELD GPS (+/- 3M ACCURACY)

REV.	DESCRIPTION	DATE

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KCS DEVELOPMENTS LTD

JOB TITLE

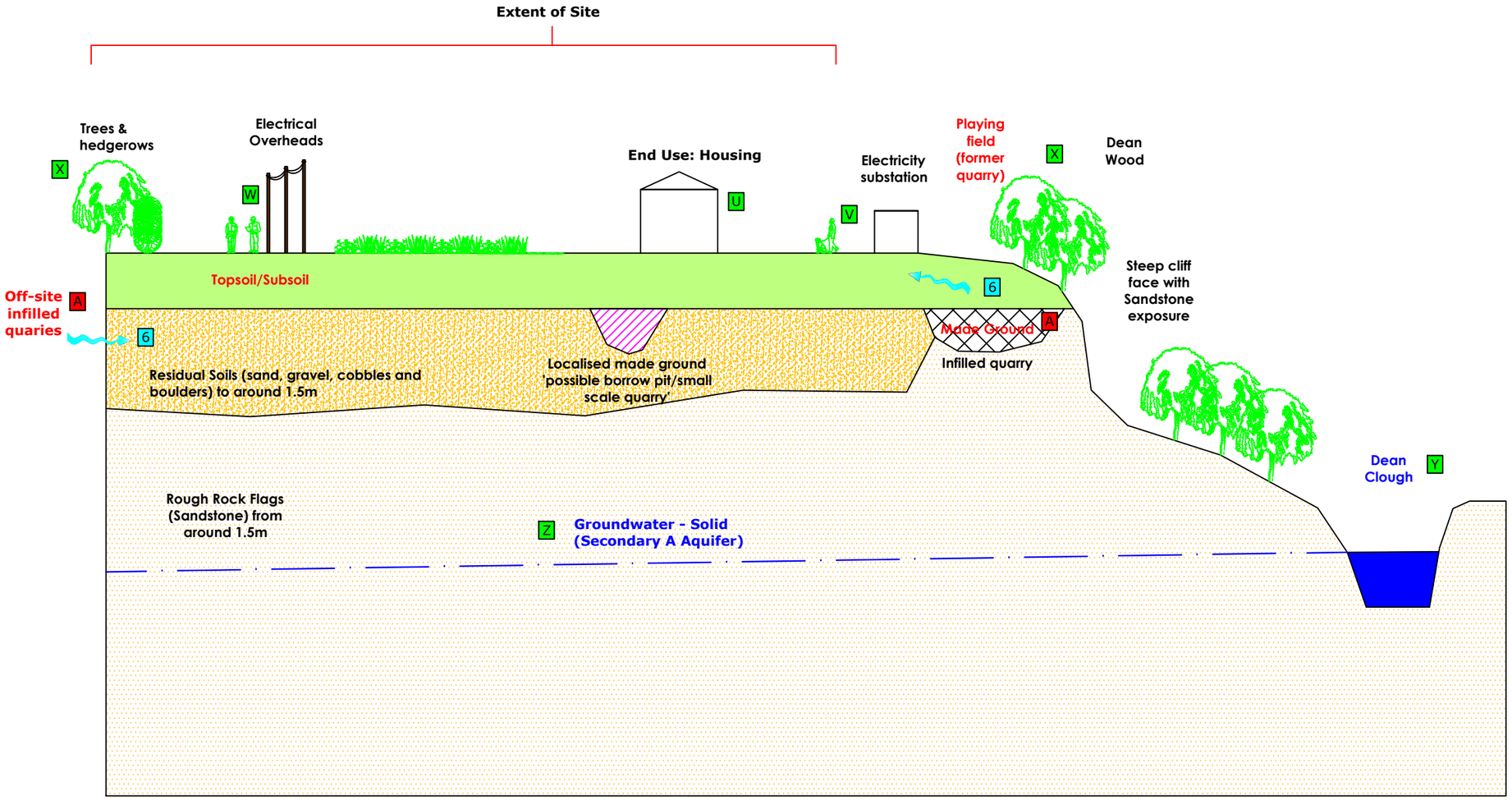
ROSLYN AVENUE, NETHERTON

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS

DRAWN	DATE	STATUS
LB	01/07/2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	01/07/2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1250	A3	5080/6	



SOURCES	PATHWAYS	RECEPTORS
A INFILLED QUARRIES (GAS)	6 MIGRATION OF GAS	U BUILDINGS
		V END USERS (RESIDENTS)
		W SITE WORKERS
		X VEGETATION
		Y SURFACE WATERS
		Z GROUNDWATER

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

KCS DEVELOPMENTS LTD

JOB TITLE

ROSLYN AVENUE, NETHERTON

DRAWING TITLE

REVISED CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
LB	22/07/2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
AG	22/07/2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	5080/7	

Appendix C

Commission

002/5080/AG

15th May 2024

Mr A Calvert
Fortem Consultants
11 The Covert
Dringhouses
York
YO24 1JN

LITHOS CONSULTING

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Dear Andrew

Roslyn Avenue, Netherton

Further to your recent invitation, please find attached our proposal for undertaking a site investigation on the above land. We understand that proposed development will include 82 traditional 2 storey domestic dwellings with associated gardens, POS and adoptable roads and sewers, a sketch layout has been provided.

Review of the information supplied suggests that the site consists of a single parcel of land of (c. 3.68 ha). Review of Google Maps suggests the majority of the site is used for arable farmland, accessed off Roslyn Avenue to the east. Topography slopes towards the west, with a steep drop/cliff along the northern boundary.

Brief review of internet data and the Betts desk study provided suggests the site:

- Appears to have remained undeveloped throughout its history;
- Is located within 250m of a known landfill site;
- Is not within a groundwater source protection zone;
- Is in an area where the risk of encountering UXO is considered low; and
- Is largely located beyond the Coal Authority's defined coalfields.

Brief examination of the relevant geological map suggests the site is underlain by Rough Rock Flags and Rough Rock Sandstone likely completely weathered near surface to a clayey gravel or gravelly clay.

The scope of works outlined in this letter should enable us to assess abnormal development issues, associated with the ground. However, the nature of site investigation is such that it is not always possible to foresee all the potential issues. Consequently, it is sometimes necessary to recommend additional work, but where this occurs we will inform you immediately, provide costs, and seek your further instruction. We have visited site and reviewed available internet data and our geological maps in order to minimise the likelihood of further work.

Our site investigation will be undertaken in accordance with UK good practice (as outlined in BS5930, BS10175, LCRM etc). Our Report may not be fully compliant with Eurocode 7 (EC7) and will not purport to be a Ground Investigation Report, nor a Geotechnical Design Report as defined by EC7. Our ground appraisal is intended to assist others as they proceed with design of the proposed development.

This proposal allows for the following works:

Desk study: Environmental search data and historical maps (contained within the Betts DS) will be reviewed in order to determine whether past land uses have had any effect on the proposed development. In addition, published geological plans of the area will be examined.

We will also visit site to review current operations and undertake a walkover survey. It is assumed that reliance on Betts DS is available, if not and 'fresh' environmental search data is required, there would be an E\O cost of £*** on Item A.

Given the age of the CA report in the Betts DS (2016) a consultant's mining report will be obtained.

We will complete a more detailed review of the Betts DS report.

Fieldwork: We have allowed for 2 day's trial pitting (c. 20 to 25 no. trial pits) and a day's dynamic sampling using a mini percussion drilling rig to install gas well. All trial pits and boreholes will be supervised and logged by an experienced geoenvironmental engineer.

This proposal has been put together without a recent site visit. If ground conditions are found to be significantly wet/boggy at the time of the investigation, it may be necessary to hire additional resources (bog mats, tracked excavators, tractors, stone etc) in order for works to continue. We will discuss the requirement for any such items and associated costs with you prior to ordering.

Trial pitting will enable us to determine the:

- Nature of any made ground, including:
  - visual/olfactory evidence of potential contamination and the proportion of undesirable elements e.g. biodegradable matter, relict foundations etc
  - the proportion of "oversize", boulder-sized material
- Nature, distribution and thickness of shallow soils
- Suitability of the ground for soakaways
- Suitability of the ground for founding structures and highways

We have assumed that it will be possible to excavate the pits and move around site using a wheeled JCB 3CX-type excavator, but this proposal has been put together without a recent site visit. If ground conditions are found to be significantly wet/boggy at the time of the investigation, it may be necessary to hire a tracked 360° excavator (E\O of £***).

The mechanical excavator used to excavate trial pits will be equipped with a breaker to enable excavation where necessary in bedrock (for soakaway tests).

Representative soil samples of natural and man-made ground, including any contaminated samples, will be taken during the works. In-situ shear strengths of any cohesive soils encountered will be determined by the use of a hand-held shear vane.

We will make every effort to compact arisings and 'sweep' them over each trial pit. However, you should be aware that on completion of the investigation, "graves" of spoil (each about 3m long by 1m wide) unsuitable for trafficking, will be left up to 400mm proud at each trial pit location. At this stage, no allowance has been made for any further reinstatement such as removal of excess arisings, replacement of turf etc.

If the pitting encounters significant thicknesses of made ground or very soft/loose deposits (neither considered likely), boreholes may be required to obtain geotechnical data from greater depth. We will advise you of any need for boreholes within 2 days of completion of the pitting.

Soakaway testing will also be carried out in at least 3 to 4 pits in order to assess suitability of the ground for plot and highway surface water drainage. This will provide an 'initial sweep' at relatively wide spacings and often with only 1 or 2 fills.

It should be noted that if the initial soakaway tests yield satisfactory results, in order to obtain approvals from the LLFA, Highways etc, the drainage designer is likely to require further testing: (a) within 25m of proposed chamber locations; and (b) to include 3 fills.

Mini-boreholes are proposed here in order to allow the installation of c. 10 shallow gas monitoring wells.

Exploratory holes will be positioned a hand-held GPS (typically +/- 3m accuracy); if required we could arrange for a **surveyor** to pick-up exploratory holes (and provide co-ordinates/ground levels) for an E\O cost of £***.

Given the backfilled quarries and adjacent area of landfill within 250m of the site, we have allowed for the installation of wells in c. 10 holes and monitoring for hazardous **gas** (and any shallow groundwater).

The generation potential of this gas source is considered likely to be Low. Therefore, in accordance with CIRIA Report C665, we have initially allowed for 9 visits over a 6-month period. A hazardous gas risk assessment will be issued on completion of monitoring.

We strongly recommend that groundwater / gas wells be decommissioned after monitoring has been completed. Decommissioning involves removal of the metal covers, unscrewing the upper 1m to 2 m of pipework and filling the void / remaining well with bentonite.

Decommissioning of monitoring wells removes the potential for groundwater pollution caused by accidental spillages during the construction phase and prevents gas migration into sub-floor voids and removes 'obstructions' to farm machinery. Subject to your instruction, we will decommission accessible wells after the last monitoring visit for an E\O price of £***. We will contact you to seek instruction following issue of our gas risk assessment.

Testing: This will comprise routine **geotechnical** soils analysis, including 15 moisture content & Atterberg limits, and 15 pH & water-soluble sulphate and 5 gradings.

This site is greenfield and therefore we could obtain in-situ CBR values from plate tests on site. However, at this stage, we will simply estimate CBR values from strata descriptions and classification test results.

The site is understood to be essentially Greenfield, and therefore testing of potentially **contaminated** samples should only be required if made ground is encountered in the exploratory holes. However, we have allowed for analysis of topsoil (15 samples) to confirm its suitability for re-use. The test suite will include heavy metals and speciated PAH; 3 samples will also be analysed for pesticides.

If more significant made ground is encountered, we will inform you immediately and provide costs for the recommended chemical testing.

Within in our proposal we have allowed for the screening (ID) of 15 samples for asbestos. In the event that positive IDs are reported, it is likely that we will need to schedule further analysis (asbestos quantification), in order to determine the significance of the results. Asbestos quantification is currently a relatively expensive test and consequently we have not allowed for it at this stage. We will inform you immediately after receipt of results if we consider asbestos quantification is required.

Visible contaminants, sharps and the clay/sand/silt content of 3 topsoil samples will be determined to check compliance with BS3882 requirements.

Reporting & timescales: In order to provide you with sufficient information to enable assessment of abnormal costs at the earliest opportunity we will issue a concise overview report within 3 days of fieldwork completion.

On completion of the desk study, fieldwork and laboratory testing a comprehensive, factual and interpretative report will be issued. This will contain exploratory hole logs, laboratory test results, copies of all relevant correspondence and drawings of the site. The report will include qualitative risk assessment with respect to both controlled waters and human health. The report will also include consideration of foundation types.

At the time of writing, fieldwork could be commenced within 3 weeks of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report will be issued within 4 weeks of fieldwork completion. This report will comment on issues associated with hazardous gas, but the gas risk assessment will not be issued until monitoring is completed.

This report will include a **mining risk assessment** in accordance with Coal Authority guidance.

A completed copy of the **HBF** Contaminated Land Assessment Form will be included in an Appendix to our Report. However, this site is greenfield, and therefore consideration of soil contaminant concentrations should not be required (as stated in the UKWIR guidance) and the use of 'standard' polyethylene water supply pipes should be acceptable.

Invoicing: The attached proposal provides a breakdown of the costs associated with this project. This breakdown is for information only and the proposal can be regarded as a lump sum price of **£*** ** plus VAT. Variation will only occur in the event that a given item is not undertaken or that substantial additional works are recommended, in which case we will inform you immediately, provide costs for the required works, and seek your prior consent. Revision of the costings provided may be required if works are not instructed within **3 months** of the date this proposal was issued.

Our proposal allows for submission of a single piece of correspondence with NHBC and\or the local authority to address any queries they may have. Any further meetings, correspondence etc, would be chargeable.

We will submit invoices for this project on completion of each Item(s) instructed.

Please note if following instruction of the works outlined in this proposal, it is necessary to subsequently **postpone or cancel**, this should be done at least 3 working days before Lithos are due to commence intrusive investigation on site. We reserve the right to charge a cancellation fee in the event of later notification to cover plant / drill rig costs and abortive consultancy time. The cancellation fee will not exceed £***(plus VAT.

Health, safety & welfare: The works outlined above will be carried out in accordance with Lithos' task- and site- specific Risk Assessments and Method Statements.

Details of welfare will be included within the Method Statements. However, this investigation is expected to be completed within 3 working days and therefore it is not considered reasonably practicable to provide formal welfare facilities, and our proposal makes no allowance for so doing.

Utility plans are required in order to protect operatives from the hazards associated with striking buried services and avoid potentially substantial disruption\repair costs. We will make every effort not to damage any services (including review of utility plans and use of a CAT detector). However, Lithos cannot accept liability for damage to any underground services that are not accurately marked on plans made available to us prior to commencement of our field investigation, or have not been accurately marked on the ground by a responsible third party (e.g. utility company, site owner).

Most developers have copies of the necessary utility plans (including electricity, gas, water, drainage & telecom), and it would be appreciated if you could forward these prior to the proposed fieldworks. However, if you do not have the necessary plans, Lithos will obtain them direct from each of the utility companies.

Under the **CDM** Regulations 2015, Lithos must be provided with pre-construction information already in your possession, or information that can reasonably be obtained through sensible enquiry. This information must be relevant to the project, have an appropriate level of detail, and be proportionate to the nature of the risks.

If no other designers or contractors have been appointed, Lithos could perform the role of Principal Contractor but only for the duration of the site investigation outlined in this proposal. If you require us to perform the role of Principal Contractor, please make this clear in your instruction. It should be

noted that we are not suitably qualified to perform this role where other designers or contractors are also appointed.

It is anticipated that the site investigation outlined in this proposal will be undertaken several months before any construction is commenced on site. Consequently, our works can be considered in isolation and, given the anticipated number of person days on site, this site investigation is not notifiable to the HSE.

Further work: In addition to the investigation outlined above, the following further works may ultimately be required:

- If deep infrastructure is proposed (and pitting encounters hard rock at shallow depth), **rotary cored** boreholes may be required to provide further information (spacing of bedding, fractures, strength etc).
- If the initial **soakaway** tests yield satisfactory results, it may be necessary to:
  - Undertake further testing in order to obtain approvals from the LLFA etc: (a) within 25m of proposed chamber locations; and (b) to include 3 fills.
  - Install groundwater monitoring wells to depths of around 5m in at least 3 boreholes. Given the anticipated depth to bedrock, these boreholes might need to be advanced by rotary probing.
  - The wells should then be monitored on at least 7 occasions; monthly for 3 months, and then bi-monthly for a further 8 months.

Terms & conditions: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

Yours sincerely

Adam Gombocz
Director
for and on behalf of
LITHOS CONSULTING LIMITED

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" means these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording your unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing;

"Documents" means all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of us, and whether in paper form or stored electronically or on disk, or otherwise;

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Project" means the project described in the Proposal and any enquiry from you on which we have based our Proposal;

"Proposal" means the offer document prepared by us in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by us pursuant to the Agreement and as set out in the Proposal and includes any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment" as amended from time to time.

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

2 APPOINTMENT

2.1 You agree to engage us and we agree to provide the Services in accordance with the provisions of this Agreement.

3 OUR OBLIGATIONS

3.1 We shall perform the Services using the reasonable standard of skill and care normally exercised by qualified members of our profession, performing similar services under similar conditions.

3.2 We shall use all reasonable endeavours to perform the Services in accordance with relevant environmental and safety legislation.

4 YOUR OBLIGATIONS

4.1 Throughout the period of this Agreement you shall afford to us, or procure for our benefit, access to any site where access is required for the performance of the Services.

4.2 You accept responsibility for ensuring that we are notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards, which you shall clearly mark on the ground or identify on accurate location plans supplied to us prior to the commencement of the Services. You shall also inform us in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. You shall indemnify us against all costs, losses, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If you discover any conflict, defect or other fault in the information or designs provided by us pursuant to the Agreement, you will advise us in writing of such defect, conflict or other fault and we shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

5 COPYRIGHT

5.1 The copyright in all Intellectual Property prepared by or on behalf of us in connection with the Project for delivery to you shall remain vested in us.

5.2 You shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable you to copy and use the Intellectual Property but solely for your own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by us.

5.3 Should you wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, you must obtain our prior written consent. The giving of such consent shall be at our absolute discretion and shall be upon such terms as we may require. We shall not be liable to you for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on our behalf.

5.4 Ownership of any proposals submitted to you that are not subsequently confirmed as part of the Services to be provided for you remain with us and such proposals must not be used as the basis for any future work undertaken by you or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of you being in default of payment of any fees or other amounts due, we may suspend further use of the licence on giving no less than 2 calendar days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

6 CONFIDENTIALITY

6.1 Neither you nor we shall at any time disclose to any person any confidential information concerning the business, affairs, customers, clients or suppliers of the other party or of any member of the group of companies to which the other party belongs, except as permitted by clauses 6.2 and 6.4.

6.2 Each party may disclose the other party's confidential information:

(a) to its employees, officers, representatives, contractors, sub-contractors or advisers who need to know such information for the purposes of exercising the party's rights or carrying out its obligations under or in connection with this Agreement. Each party shall ensure that its employees, officers, representatives, contractors, sub-contractors or advisers to whom it discloses the other party's confidential information comply with this paragraph 6; and

(b) as may be required by law, to a court of competent jurisdiction or any governmental or regulatory authority.

6.3 Neither you nor we shall use any other party's confidential information for any purpose other than to exercise our rights or perform our respective obligations under or in connection with this Agreement.

6.4 Subject to the above and our privacy policy which can be found on www.lithos.co.uk, we shall be permitted to use information related to the Services we provide in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

7 ASSIGNMENT

7.1 You may assign the benefit of this Agreement on two occasions with our prior written consent (not to be unreasonably withheld) and any additional assignments shall be with our prior consent.

7.2 We may at any time assign, mortgage, charge, subcontract, delegate, declare a trust over or deal in any other manner with any or all of our rights and obligations under this Agreement.

8 INSURANCE

8.1 We shall maintain a professional indemnity insurance policy covering our liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION POUNDS) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, We shall maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under this Agreement, provided such insurance is available at commercially reasonable rates and terms.

8.2 If for any period such insurance is not available at commercially reasonable rates and terms, we shall inform you and shall obtain in respect of such period such reduced level of professional indemnity insurance as is available and as would be fair and reasonable in the circumstances for us to obtain.

9 PAYMENT

9.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

9.2 You shall pay you any VAT properly chargeable on the Services and any amount expressed as payable to us under this Agreement is exclusive of VAT unless stated otherwise.

9.3 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

9.4 If you dispute the amount included for payment in an invoice then you must serve a written notice on us no later than 14 calendar days before the final date for payment. If no notice is given within the required timeframe the amount due shall be the amount stated in the invoice.

9.5 If you fail to pay any monies in accordance with the foregoing payment provisions, we shall be entitled to charge interest on any monies owed to us, such interest to be at a rate of 4% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis. The parties acknowledge that our liability under this clause 10.5 is a substantial remedy for the purposes of section 9(1) of the Late Payment of Commercial Debts (Interest) Act 1998.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, our total liability under or in connection with this Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either the level of insurance cover referred to within clause 8.1 above, or 20 times the total value of invoices issued to you for the Services.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against us after the expiry of a period of six years from the date of the completion (or termination) of the Services under this Agreement.

10.3 Whilst we usually scan for potential exploratory locations with a Cable Avoidance Tool, we shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 We shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by us or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless we have been advised in writing of the same by you and have been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

11 DELAY

We shall comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond our reasonable control and in the event of any such circumstances arising we undertake to complete the Services within a reasonable period, but will not be liable to you for any delay as a result.

12 TERMINATION

12.1 The Agreement may be terminated by either of us in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of termination must be given to the party which is insolvent by the other party.

12.2 If for any reason our Services are suspended for a period in excess of three calendar months then we shall be entitled to terminate our appointment under this Agreement in respect of the Services by no less than seven days written notice to you.

12.3 If you fail to pay in full any sum due under the terms of this Agreement by the final date for payment for that sum and no effective pay less notice is issued, we may serve written notice to you demanding payment within 14 days of such notice. If you fail to comply with such notice, we shall be entitled to terminate our employment under this Agreement forthwith.

12.4 Any termination of our appointment howsoever caused shall be without prejudice to our rights to require payment for all Services performed up to the date of such termination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

13 THIRD PARTY RIGHTS

The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

14 COLLATERAL WARRANTIES & LETTERS OF RELIANCE

We shall consider and may consent to a request from you for us to enter into a collateral warranty or letter of reliance with a third party with regard to the Services provided under this Agreement. The giving of such consent shall be at our absolute discretion and providing we agree to our standard form of collateral warranty or letter of reliance (subject to any reasonable changes to be approved by us at our absolute discretion) and in return for payment of a fee (to be notified at the time of the request).

15 NOTICES

15.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by pre-paid first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to our respective registered office addresses.

15.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by pre-paid first class post.

16 ENTIRE AGREEMENT

16.1 The Agreement constitutes the complete and entire agreement between us with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against us in respect of the Services can only be made in contract under the provisions of this Agreement and not otherwise under the law or tort or otherwise.

16.2 No amendments, modifications or variation of this Agreement shall be valid unless made in writing and agreed to by us; such agreement must be recorded in writing by at least one of us.

16.3 We shall not be bound by any standard or printed terms or conditions furnished by you in any of your documents unless we specifically state in writing separately from such documents that we intend such terms and conditions to apply.

17 DISPUTES, JURISDICTION AND GOVERNING LAW

17.1 This Agreement shall be governed by and construed in accordance with English law and we irrevocably and unconditionally submit to the jurisdiction of the English Courts.

17.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between us may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

Liam Barton

Subject: FW: 240610LITHOS_RE: 240509LITHOS_Roslyn Avenue, Netherton - SI Quote (5080)

From: Andrew Calvert <andrew.calvert@fortemconsultants.co.uk>
Sent: Monday, June 10, 2024 3:21 PM
To: Adam Gombocz <Adam.Gombocz@lithos.co.uk>
Subject: 240610LITHOS_RE: 240509LITHOS_Roslyn Avenue, Netherton - SI Quote (5080)

Roslyn Avenue, Netherton (1174)
Phase 2 Site Investigation Appointment

Adam

As discussed recently I am pleased to confirm your appointment on behalf of KCS Developments Ltd, to undertake the Phase 2 Site Investigation in accordance with the attached fee proposal. As a result of the agreements we have in place in relation to drainage, there is no requirement for soakaway testing and as such your fee proposal is to be adjusted to £***.

Please can you confirm your preferred start date and period of work on site so I can arrange access through my client. In addition please confirm if there is anything else you need to proceed.

Any questions, please give me a call.

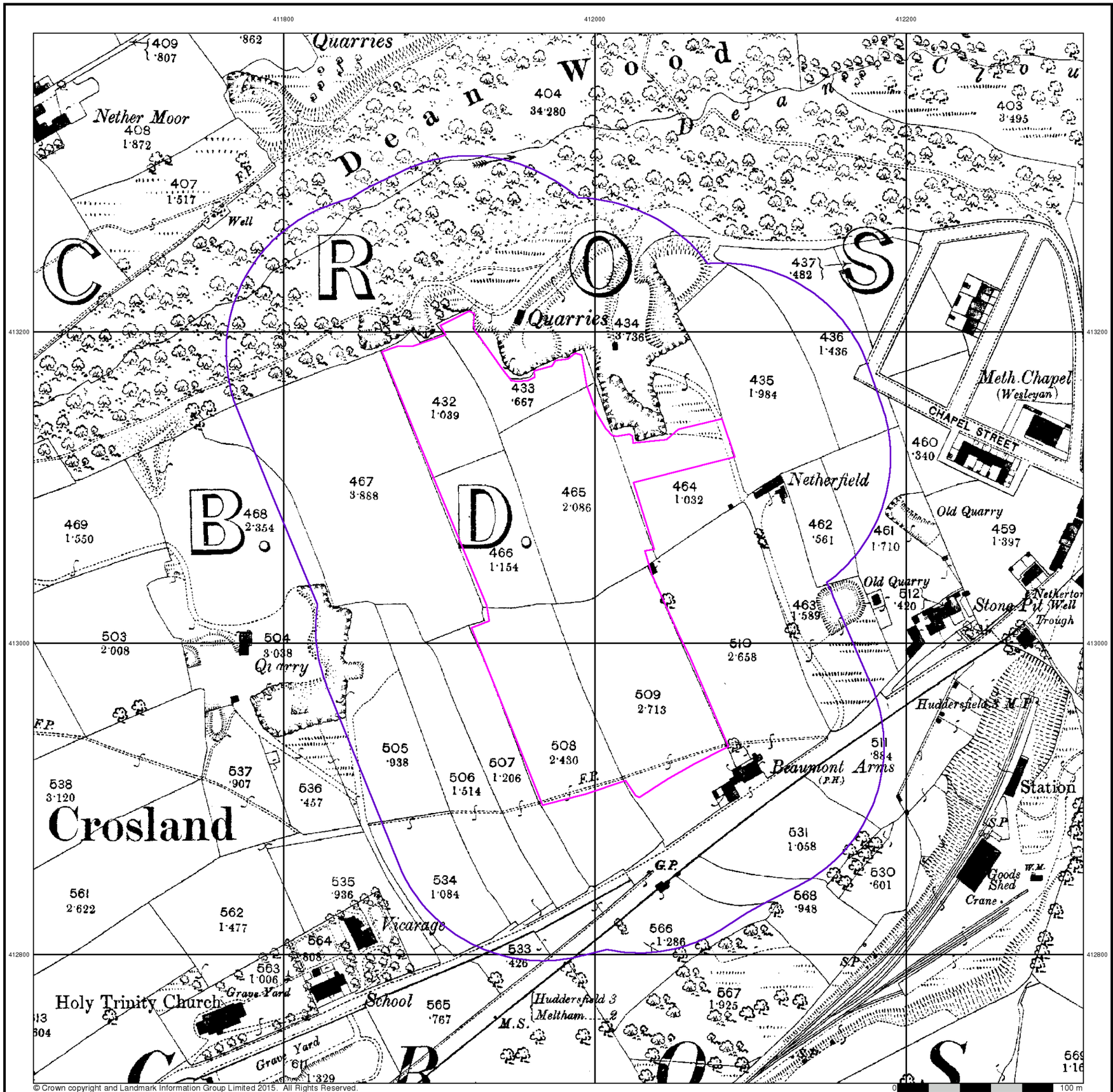
Regards

Andrew Calvert
Director

FORTEM
T: 07377 556170
W: www.fortemconsultants.co.uk

Appendix D

Historical OS Plans



Envirocheck®

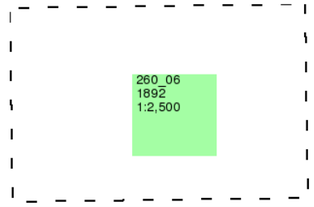
Yorkshire

Published 1892

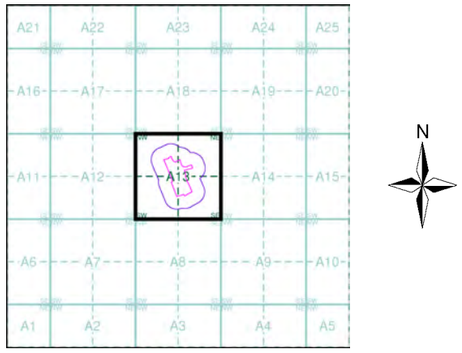
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

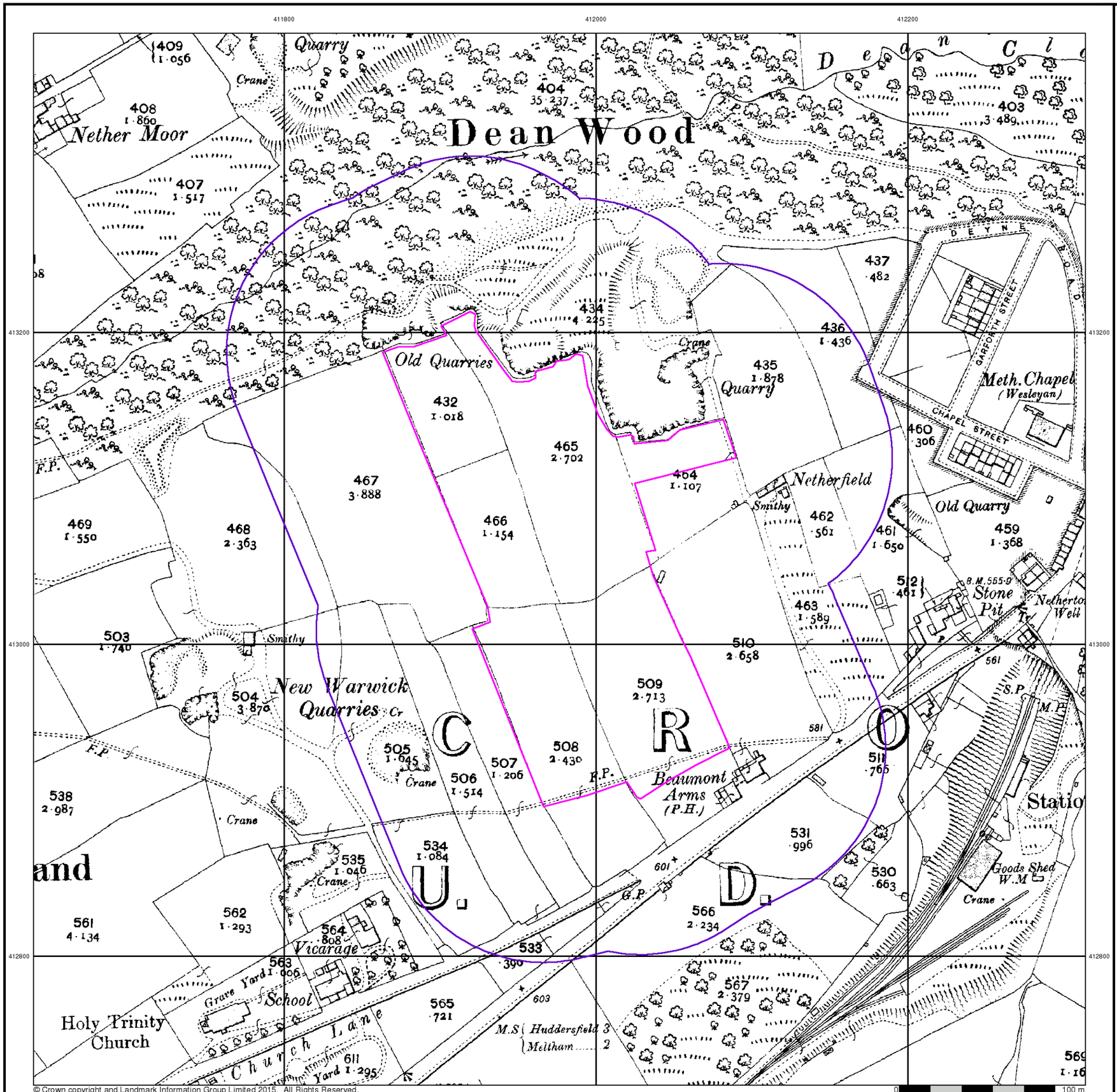
Order Number:	87399786_1_1
Customer Ref:	16RED116
National Grid Reference:	411980, 413060
Slice:	A
Site Area (Ha):	3.68
Search Buffer (m):	100

Site Details

16 Roslyn Avenue, Netherton, HUDDERSFIELD, HD4 7EW

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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Yorkshire

Published 1906

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

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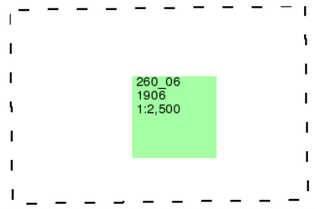
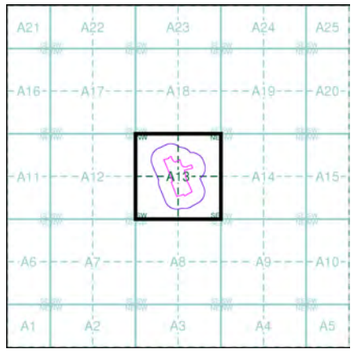


Historical Map - Segment A13



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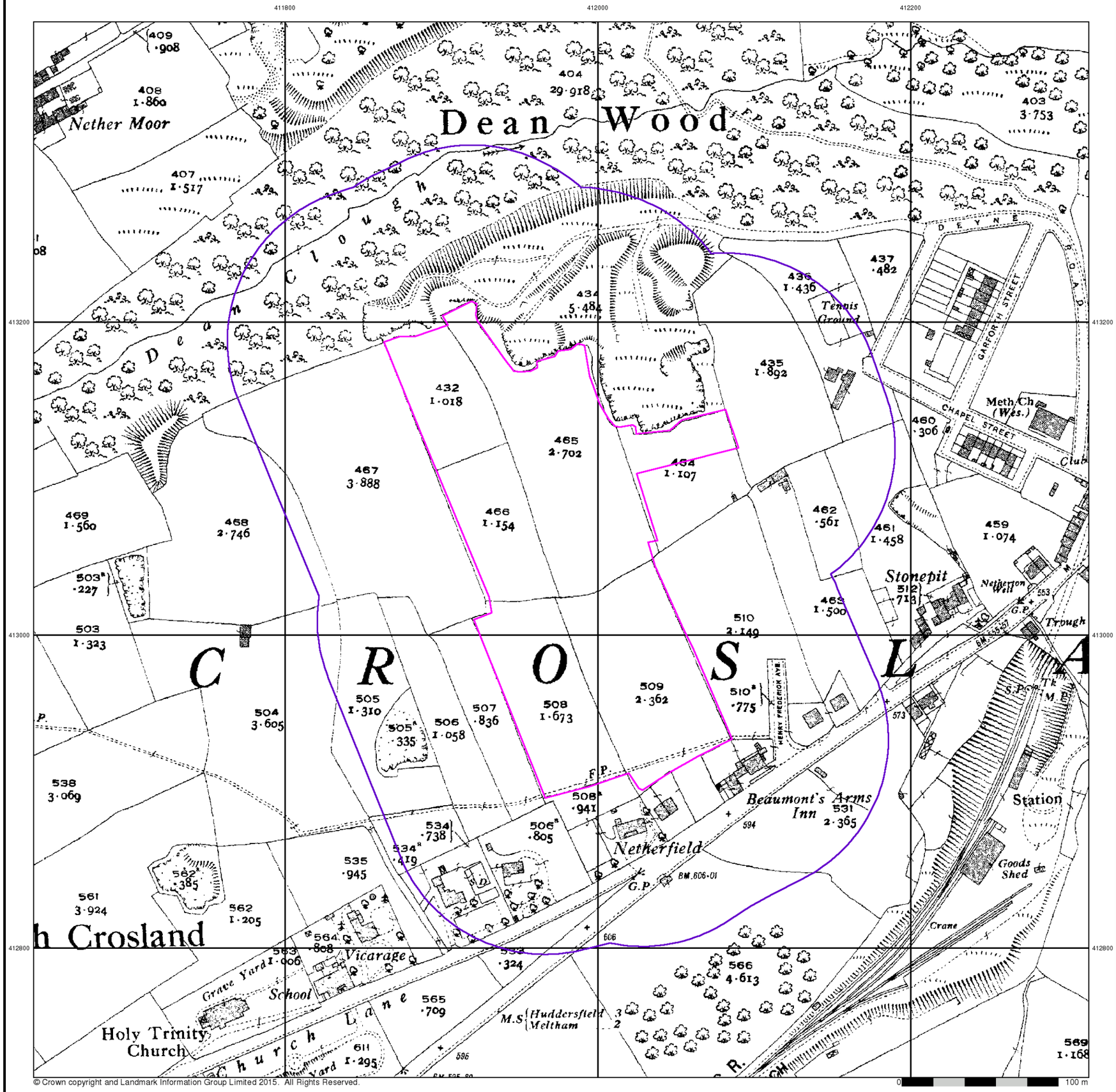

0 100 m

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Yorkshire

Published 1932

Source map scale - 1:2,500

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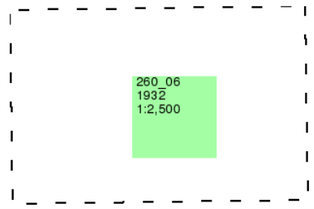
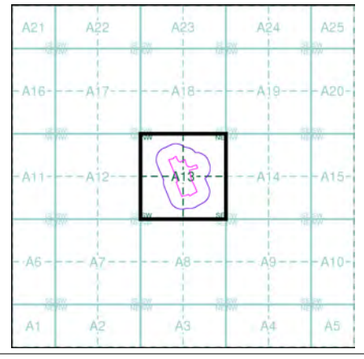


Historical Map - Segment A13



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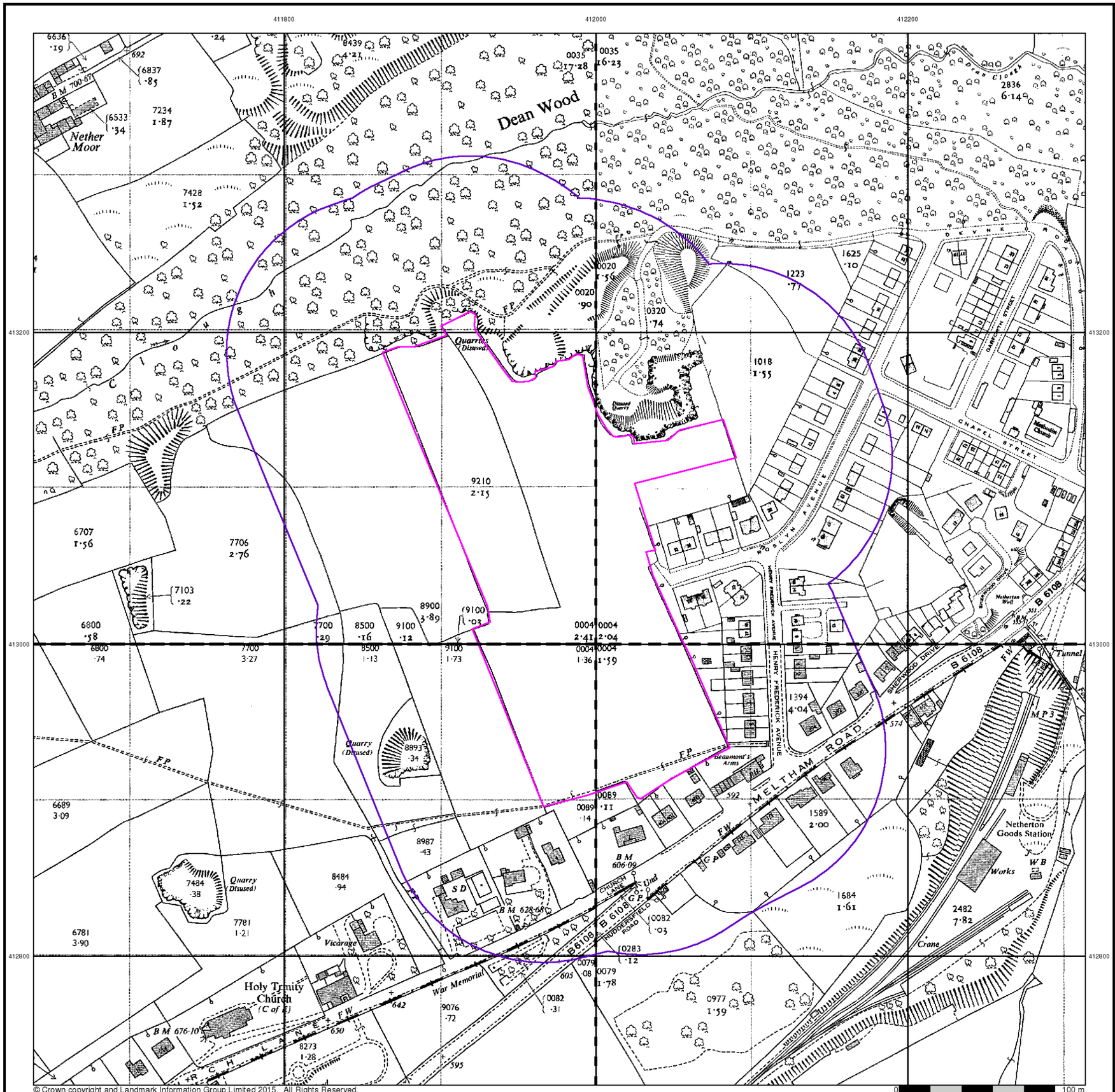

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Ordnance Survey Plan

Published 1961 - 1963

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

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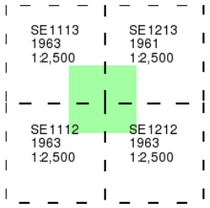
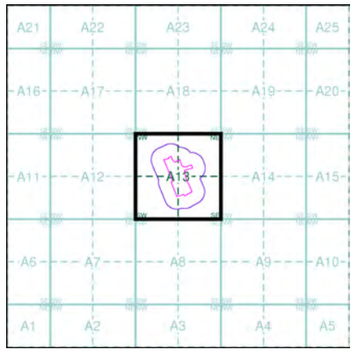


Historical Map - Segment A13



Order Details

Order Number:	87399786_1_1
Customer Ref:	16RED116
National Grid Reference:	411980, 413060
Slice:	A
Site Area (Ha):	3.68
Search Buffer (m):	100

Site Details

16 Roslyn Avenue, Netherton, HUDDERSFIELD, HD4 7EW

Landmark Information Group
Tel: 0844 844 9952
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Web: www.envirocheck.co.uk

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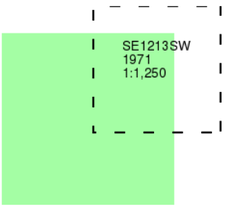
Ordnance Survey Plan

Published 1971

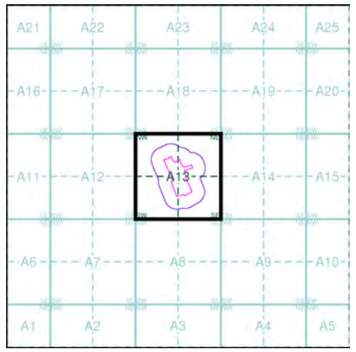
Source map scale - 1:1,250

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



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Search Buffer (m):	100

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16 Roslyn Avenue, Netherton, HUDDERSFIELD, HD4 7EW

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Fax: 0844 844 9951
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Appendix E

Search Responses & other Correspondence

Envirocheck® Report:

Datasheet

Order Details:

Order Number:
87399786_1_1

Customer Reference:
16RED116

National Grid Reference:
411980, 413060

Slice:
A

Site Area (Ha):
3.68

Search Buffer (m):
1000

Site Details:

16 Roslyn Avenue
Netherton
HUDDERSFIELD
HD4 7EW

Client Details:

Mr M Fawcett
Betts Geo Environmental
Old Marsh Farm Barns
Welsh Road
Sealand
Flintshire
CH5 2LY

Contents

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination.
For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.

In the attached datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

Copyright Notice

Natural England Copyright Notice

Ove Arup Copyright Notice

Peter Brett Associates Copyright Notice

Radon Potential dataset Copyright Notice

Report Version v50.0

Envirocheck®

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1	Yes	Yes	Yes	n/a
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 2			2	4
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control					
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls					
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 3		Yes		
Pollution Incidents to Controlled Waters	pg 3		1	4	11
Prosecutions Relating to Authorised Processes					
Registered Radioactive Substances					
River Quality	pg 6				1
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register					
Water Abstractions	pg 6		2	1	4 (*29)
Water Industry Act Referrals					
Groundwater Vulnerability	pg 15	Yes	n/a	n/a	n/a
Drift Deposits			n/a	n/a	n/a
Bedrock Aquifer Designations	pg 15	Yes	n/a	n/a	n/a
Superficial Aquifer Designations			n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
Detailed River Network Lines	pg 15		Yes	Yes	n/a
Detailed River Network Offline Drainage	pg 19			Yes	n/a

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Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Waste					
BGS Recorded Landfill Sites	pg 20	1			1
Historical Landfill Sites	pg 20				2
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)	pg 20				3
Licensed Waste Management Facilities (Locations)	pg 21				1
Local Authority Landfill Coverage	pg 21	1	n/a	n/a	n/a
Local Authority Recorded Landfill Sites					
Potentially Infilled Land (Non-Water)	pg 21	1	3	1	6
Potentially Infilled Land (Water)	pg 22		1	1	4
Registered Landfill Sites	pg 22				2
Registered Waste Transfer Sites					
Registered Waste Treatment or Disposal Sites					
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					

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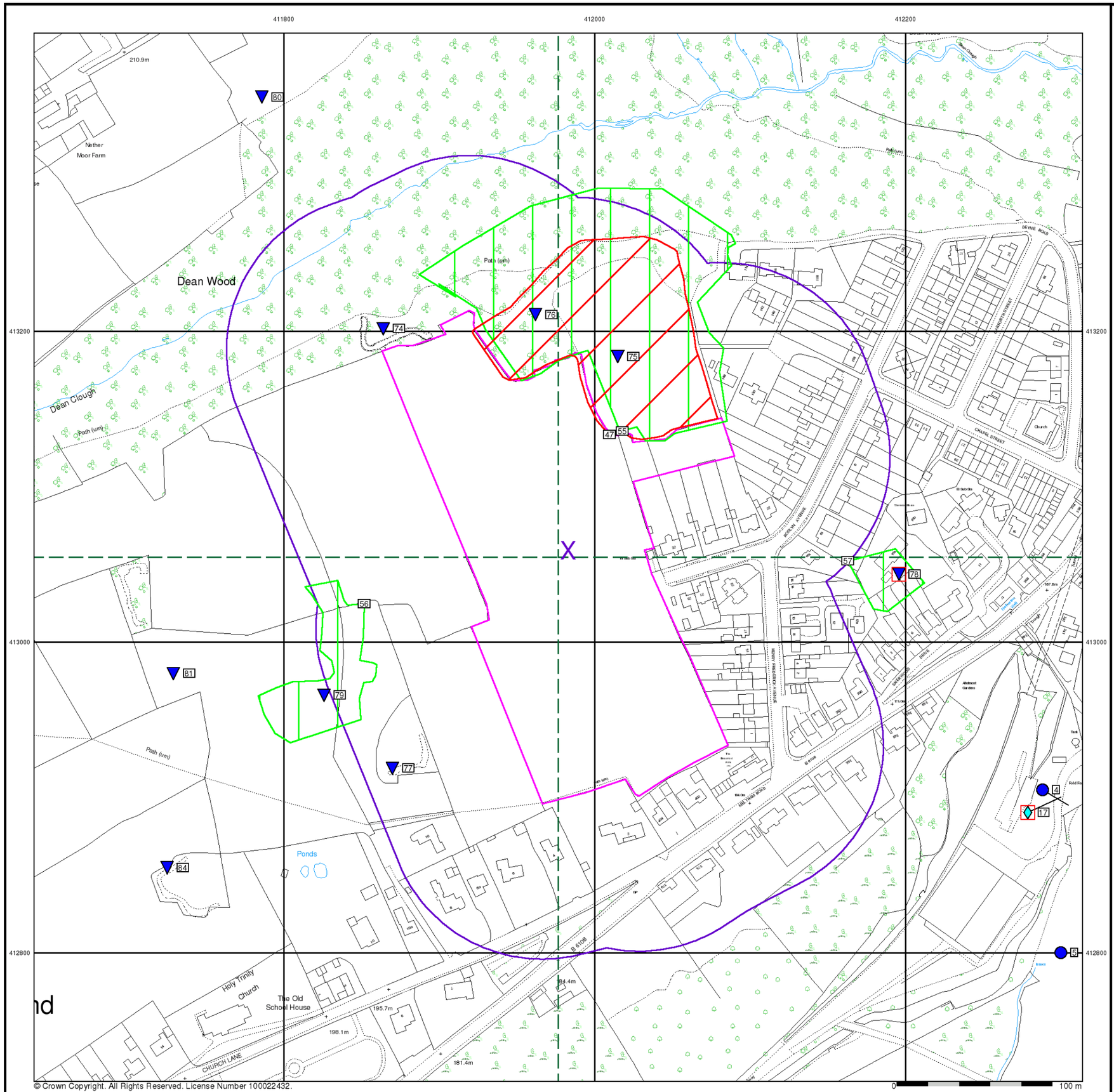
Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Geological					
BGS 1:625,000 Solid Geology	pg 23	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 23	Yes	Yes	Yes	Yes
BGS Recorded Mineral Sites	pg 27		13	5	14
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
Brine Compensation Area			n/a	n/a	n/a
Coal Mining Affected Areas	pg 32	Yes	n/a	n/a	n/a
Mining Instability			n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain	pg 32	Yes		n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 32	Yes		n/a	n/a
Potential for Compressible Ground Stability Hazards	pg 32	Yes	Yes	n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 32	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 33	Yes	Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 33		Yes	n/a	n/a
Radon Potential - Radon Affected Areas	pg 33	Yes	n/a	n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries	pg 34		5	1	18
Fuel Station Entries					
Points of Interest - Commercial Services	pg 36		1		1
Points of Interest - Education and Health					
Points of Interest - Manufacturing and Production	pg 36		4	5	6
Points of Interest - Public Infrastructure	pg 37		2		3
Points of Interest - Recreational and Environmental	pg 38				7
Gas Pipelines					
Underground Electrical Cables					

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland	pg 39	1			7
Areas of Adopted Green Belt	pg 39	1			
Areas of Unadopted Green Belt					
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones					
Ramsar Sites					
Sites of Special Scientific Interest					
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					



Envirocheck®

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID
- Several of Type at Location
- Pylon
- Overhead Transmission Line

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Hazardous Substances

- COMAH Site
- Explosive Site
- NIHHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

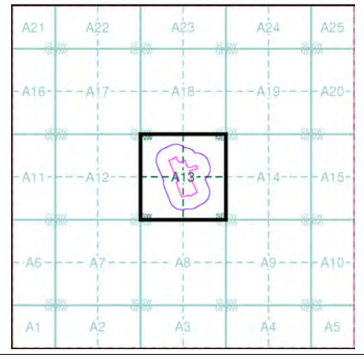
Geological

- BGS Recorded Mineral Site

Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Site Sensitivity Map - Segment A13



Order Details

Order Number:	87399786_1_1
Customer Ref:	16RED116
National Grid Reference:	411980, 413060
Slice:	A
Site Area (Ha):	3.68
Plot Buffer (m):	100

Site Details

16 Roslyn Avenue, Netherton, HUDDERSFIELD, HD4 7EW

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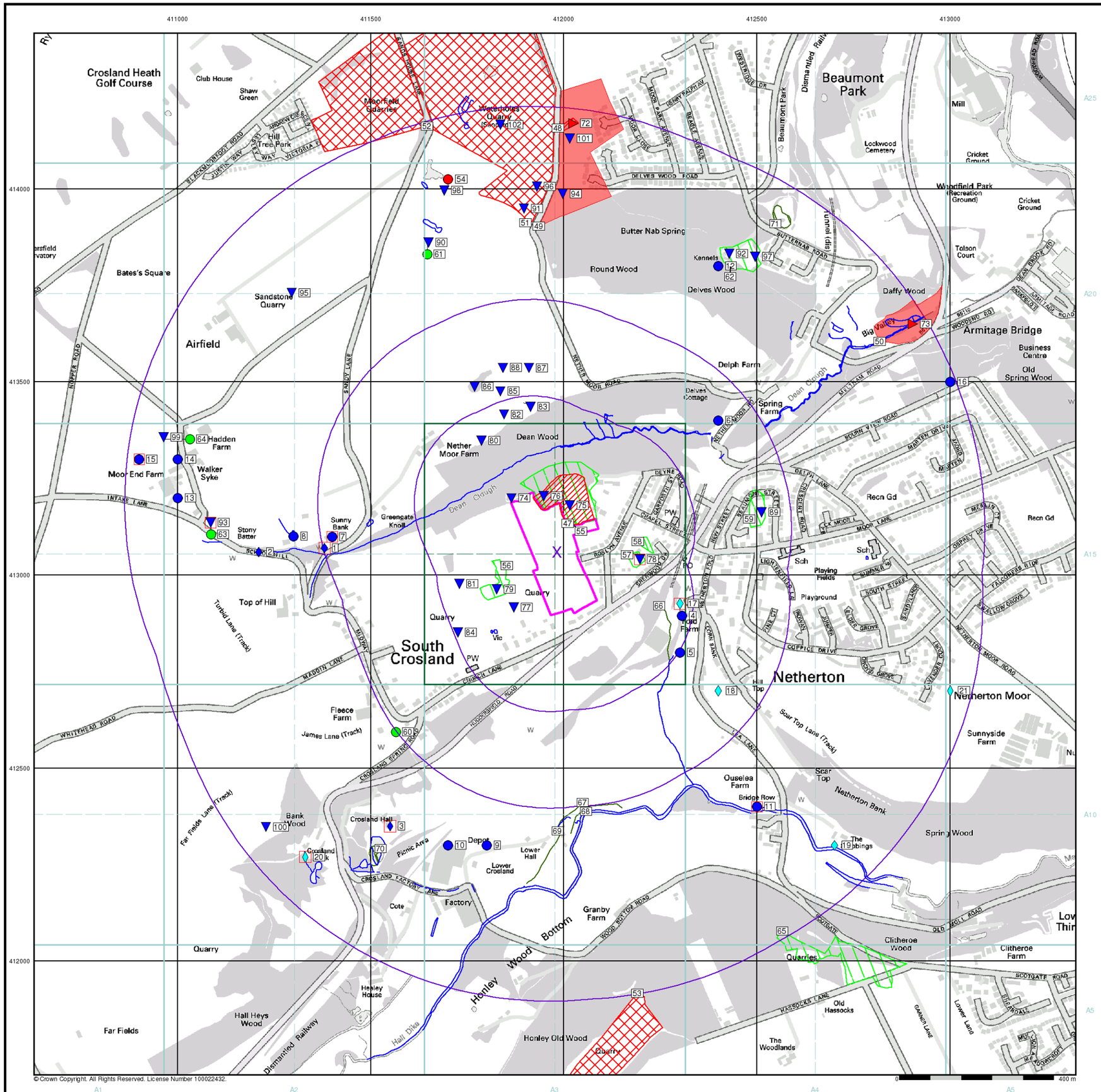

Envirocheck®

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Map ID | Several of Type at Location

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
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- Water Abstraction
- Water Industry Act Referral

Hazardous Substances

COMAH Site | Explosive Site | NIHHS Site | Planning Hazardous Substance Consent | Planning Hazardous Substance Enforcement

Geological

- BGS Recorded Mineral Site

Waste

- BGS Recorded Landfill Site (Location)
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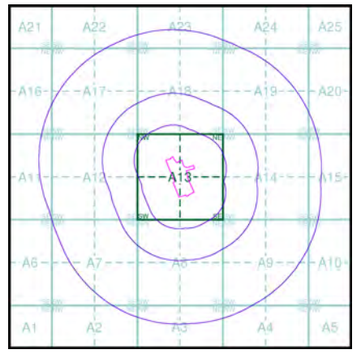
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Site Sensitivity Map - Slice A



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Envirocheck®

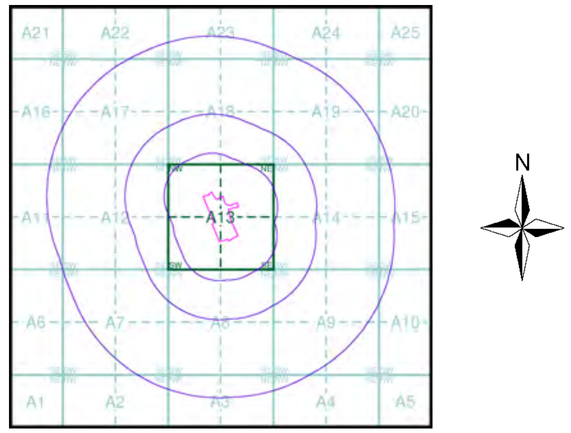
General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A



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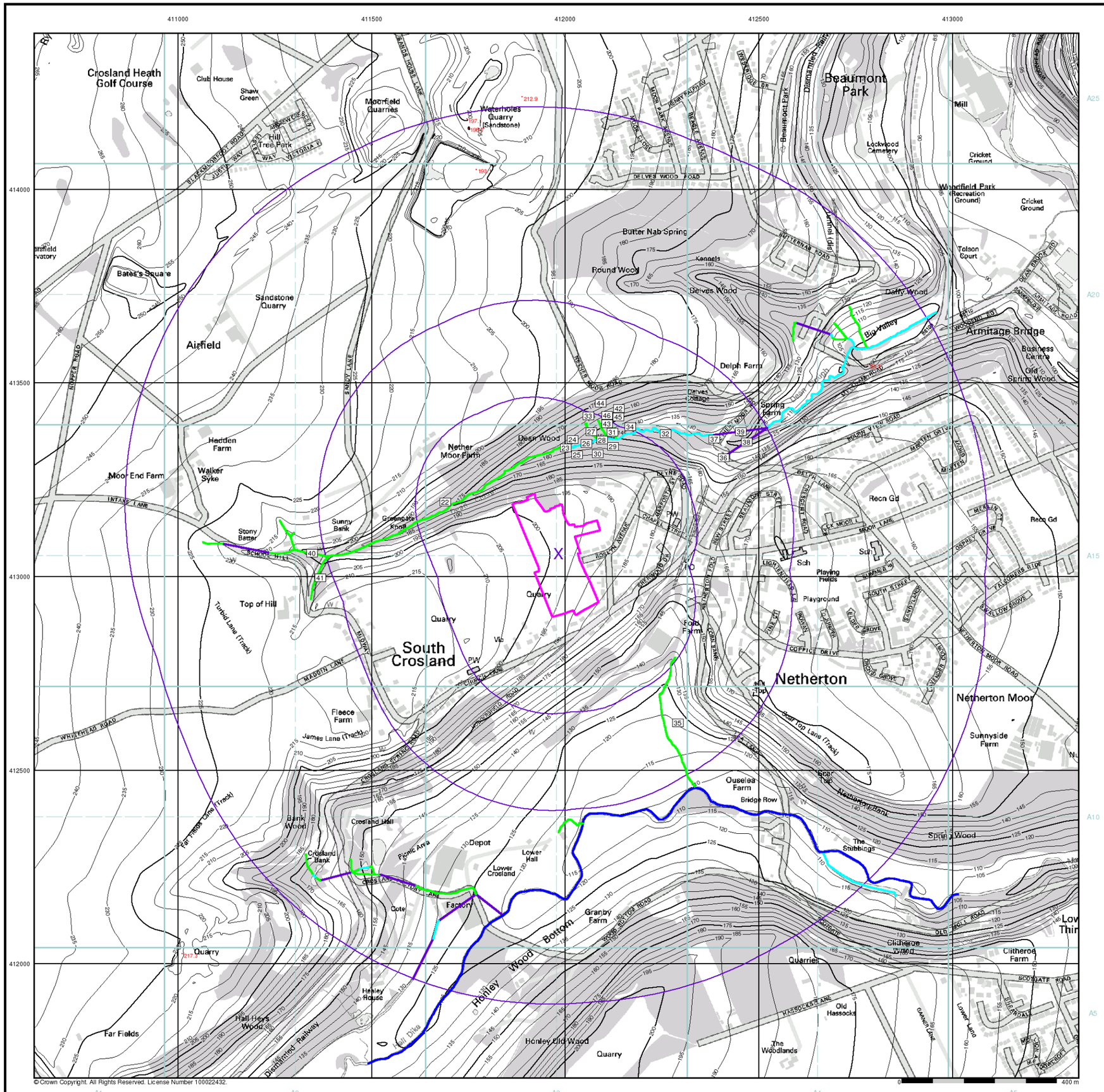


General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

Detailed River Network Data

- Primary River
- Secondary River
- Tertiary River
- Canal
- Canal Tunnel
- Undefined River
- Lake/Reservoir
- Offline Drainage Feature
- Extended Culvert (greater than 50m)
- Underground River (inferred)
- Underground River (local knowledge)
- Downstream of High Water Mark
- Downstream of Seaward Extension
- Not assigned River feature

Contours (height in metres)

Standard Contour 105 100 95

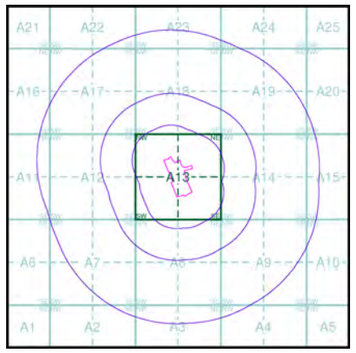
Master Contour

Spot Height *167.3

MLW Mean Low Water

MHW Mean High Water

EA/NRW Detailed River Network Map - Slice A



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Envirocheck®

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Risk of Flooding from Surface Water

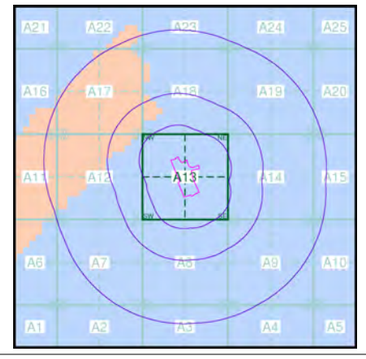
- High - 30 Year Return
- Medium - 100 Year Return
- Low - 1000 Year Return

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



Order Details

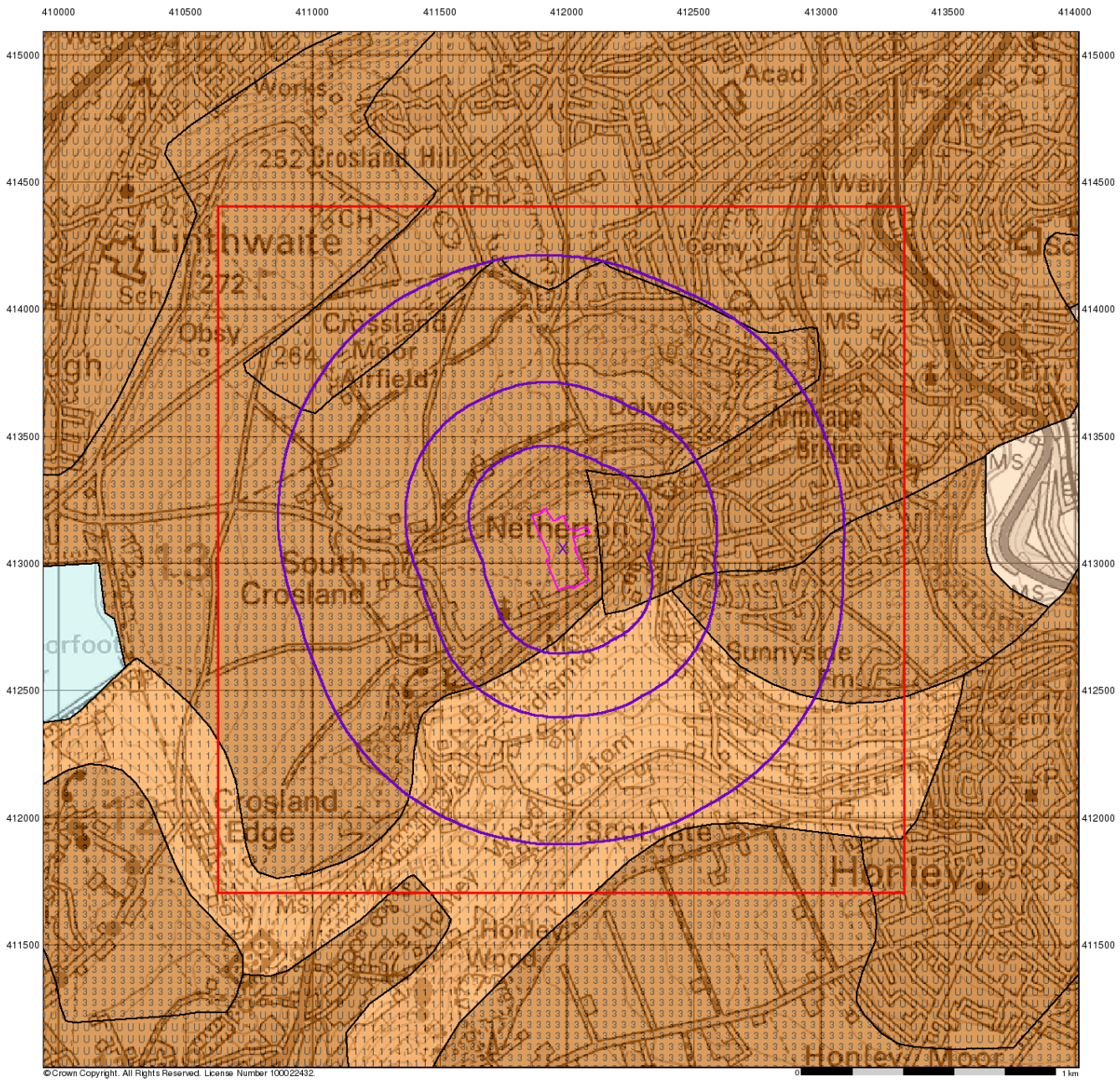
Order Number:	87399786_1_1
Customer Ref:	16RED116
National Grid Reference:	411980, 413060
Slice:	A
Site Area (Ha):	3.68
Search Buffer (m):	1000

Site Details

16 Roslyn Avenue, Netherton, HUDDERSFIELD, HD4 7EW

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Groundwater Vulnerability

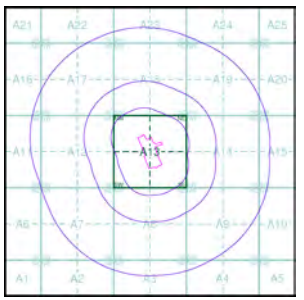
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes	Soil Classes
Major Aquifer (Highly Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Minor Aquifer (Variably Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Non Aquifer (Negligibly Permeable)	
Water or Sea	
Drift Deposit	

Site Sensitivity Context Map - Slice A



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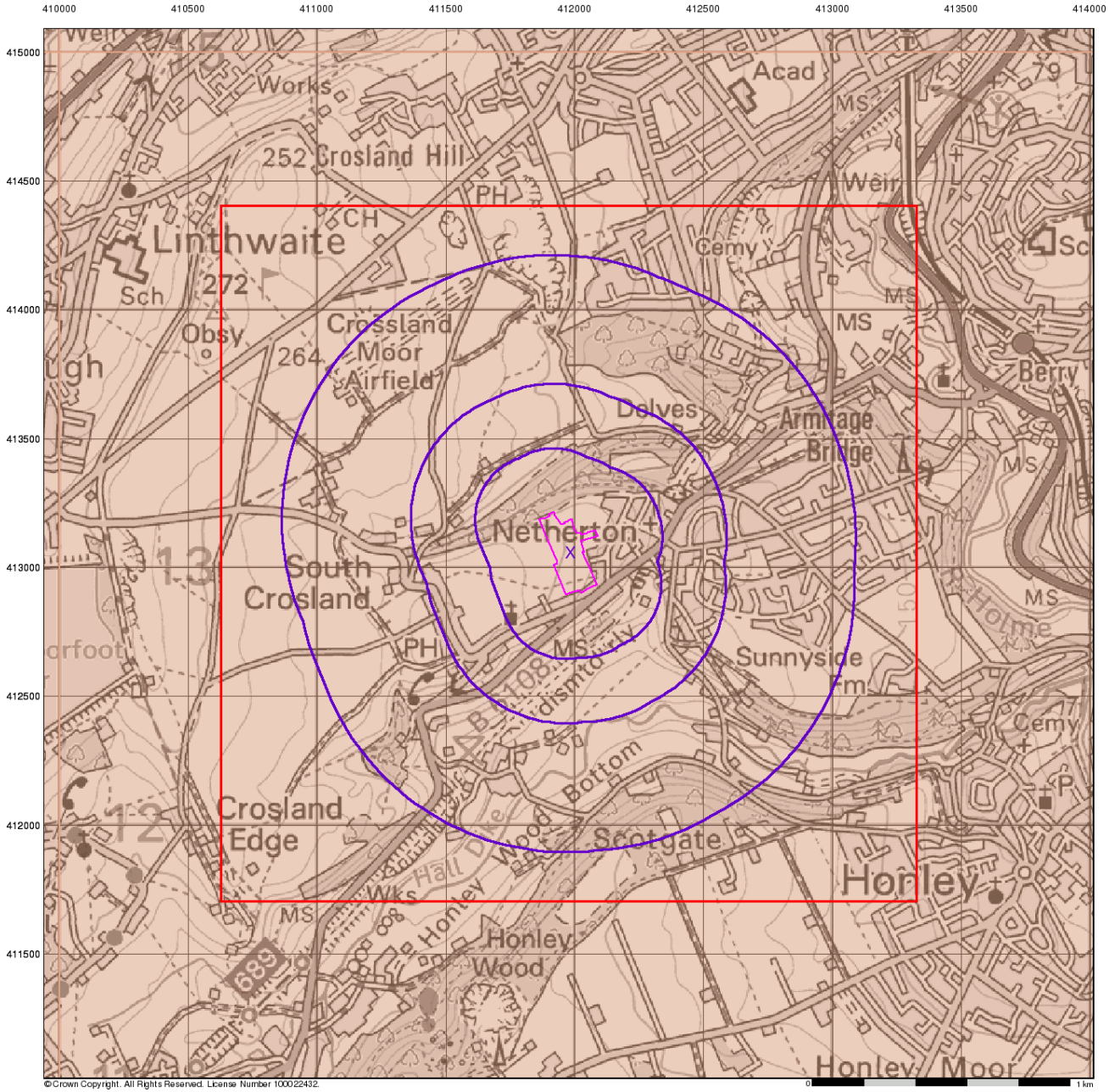


Envirocheck®

Bedrock Aquifer Designation

General

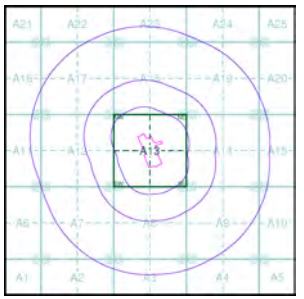
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



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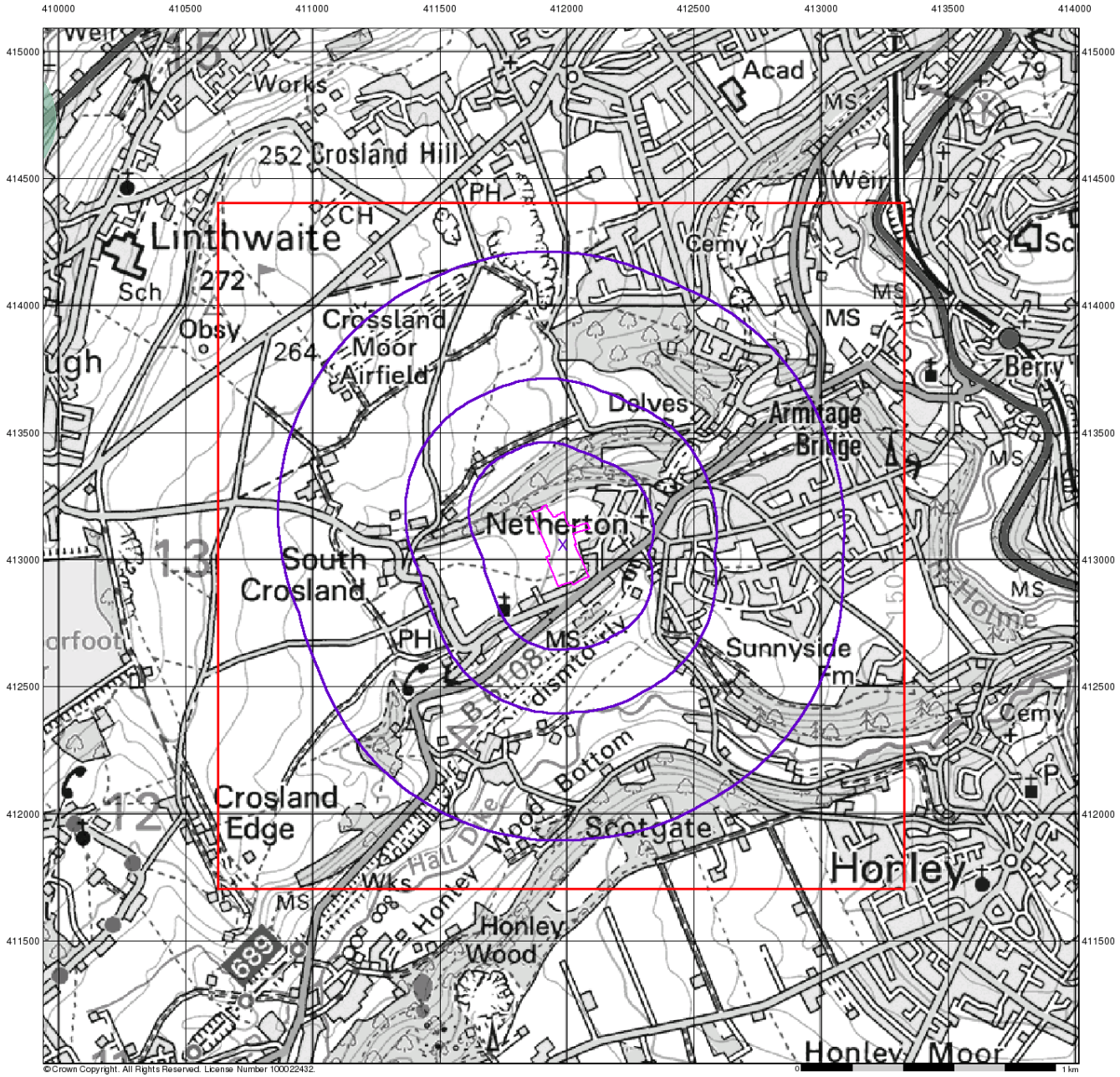


Source Protection Zones

General

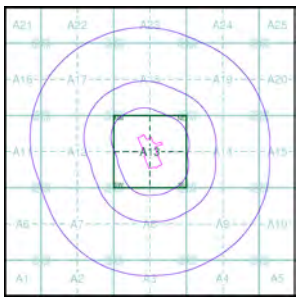
Specified Site | Specified Buffer(s) | Bearing Reference Point

Slice | Map ID

Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)
- Source Protection Zone Borehole

Site Sensitivity Context Map - Slice A



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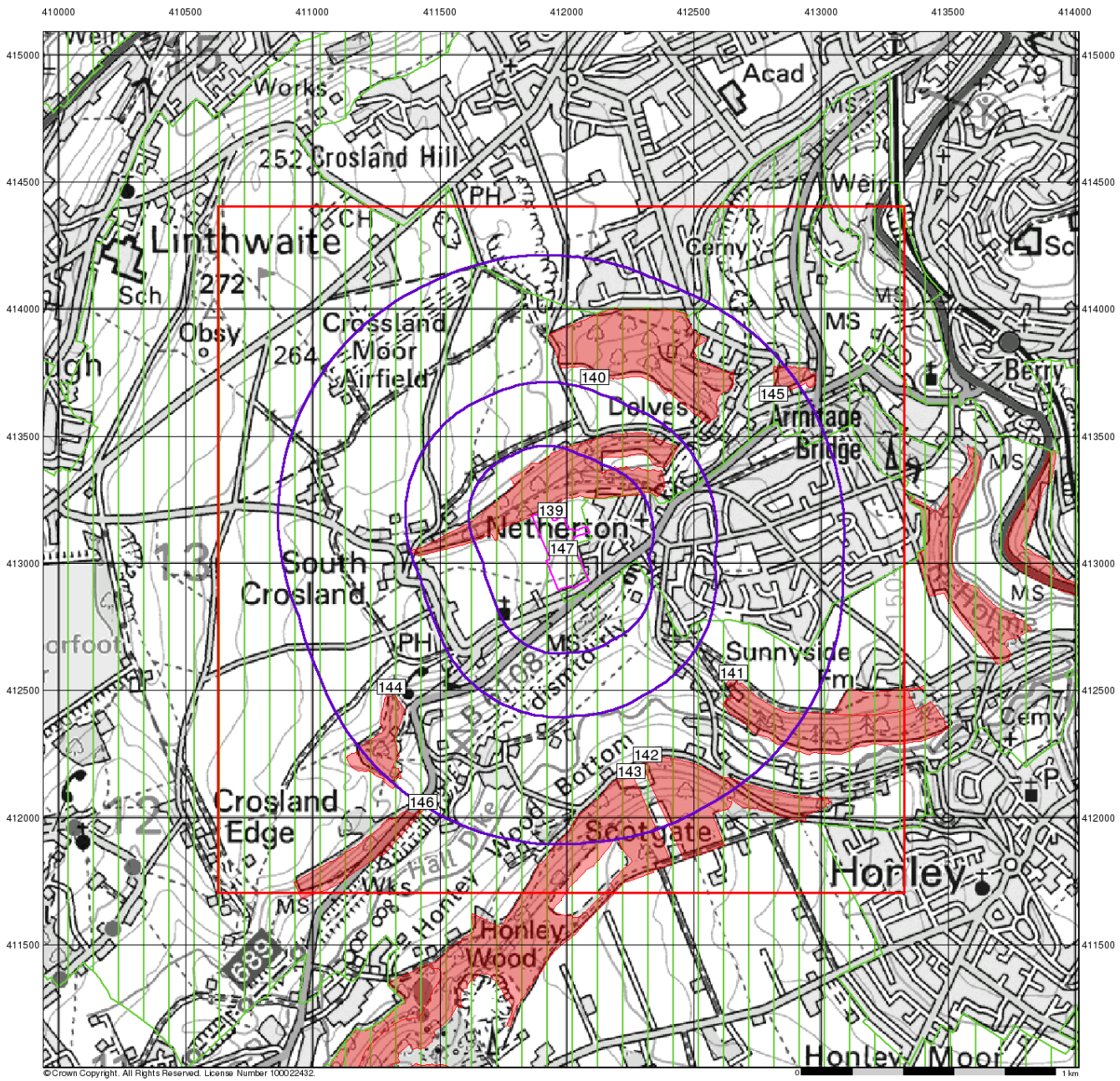


Sensitive Land Uses

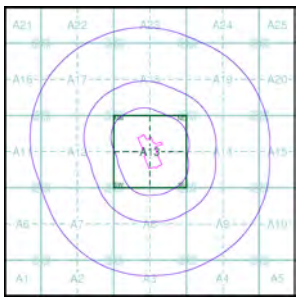
General

Specified Site | Specified Buffer(s) | Bearing Reference Point
Slice | Map ID

Sensitive Land Uses

- Ancient Woodland
- Area of Adopted Green Belt
- Area of Unadopted Green Belt
- Area of Outstanding Natural Beauty
- Environmentally Sensitive Area
- Forest Park
- Local Nature Reserve
- Marine Nature Reserve
- National Nature Reserve
- National Park
- Nitrate Sensitive Area
- Nitrate Vulnerable Zone
- Ramsar Site
- Site of Special Scientific Interest
- Special Area of Conservation
- Special Protection Area
- World Heritage Sites

Site Sensitivity Context Map - Slice A



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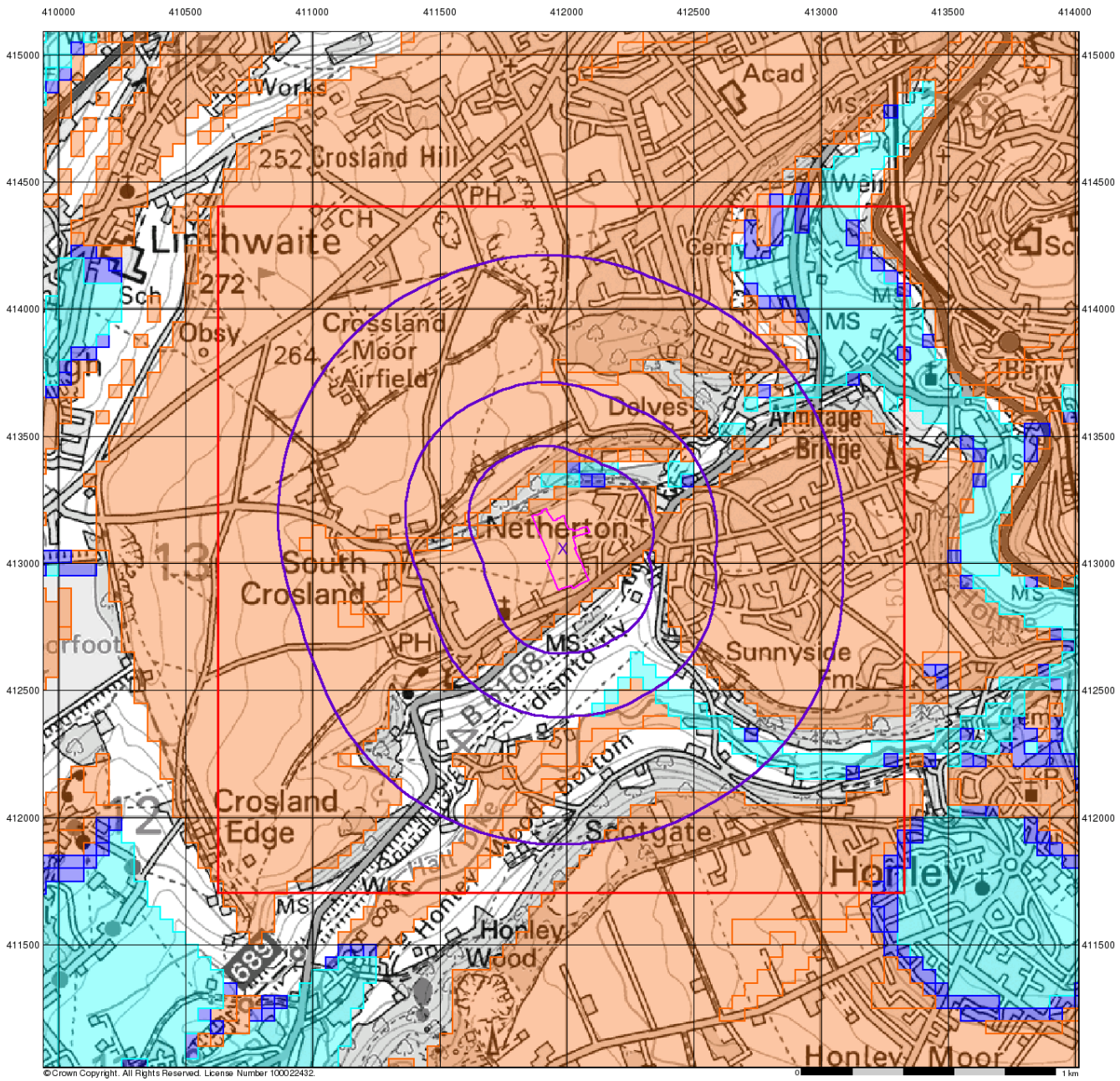

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BGS Flood GFS Data

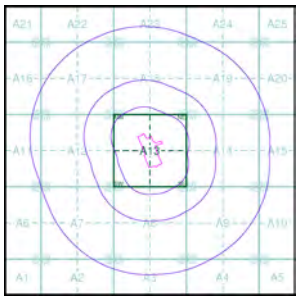
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice

Agency and Hydrological (Flood)

- Limited Potential for Groundwater Flooding to Occur
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Potential for Groundwater Flooding to Occur at Surface

Site Sensitivity Context Map - Slice A



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Geology 1:10,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WMGR	Infilled Ground	Artificial Deposit	Holocene - Holocene
	WGR	Worked Ground (Undivided)	Void	Holocene - Holocene
	MGR	Made Ground (Undivided)	Artificial Deposit	Holocene - Holocene
	SLIP	Landslide Deposit	Unknown/Unclassified Entry	Quaternary - Quaternary

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Sand and Gravel	Flandrian - Pleistocene
	HEAD	Head	Clay, Silt, Sand and Gravel	Quaternary - Ryazanian

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	RF	Rough Rock Flags	Sandstone	Yeadonian - Yeadonian
	RR	Rough Rock	Sandstone	Yeadonian - Yeadonian
	MGCZ	Unnamed Sandstone of Marsdenian Age (In Millstone Grit Group)	Sandstone	Marsdenian - Marsdenian
	HDW	Huddersfield White Rock	Sandstone	Marsdenian - Marsdenian
	MG	Millstone Grit Group [See also Migr]	Mudstone, Siltstone and Sandstone	Namurian - Namurian
	Rock			
	Fault			

Envirocheck® Geology

Geology 1:10,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:10,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around a site. This mapping may be more up to date than previously published paper maps.

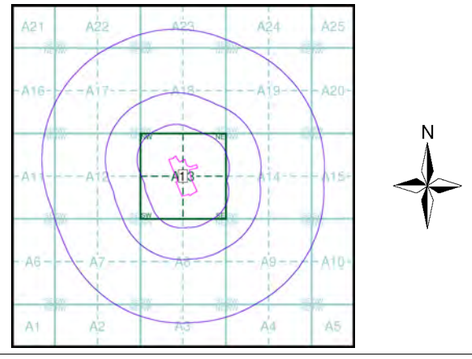
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page.

Please Note: Not all of the layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:10,000 Maps Coverage

Map ID: 1
Map Name: SE11SW
Map Date: 2005
Bedrock Geology: Available
Superficial Geology: Available
Artificial Geology: Available
Faults: Available
Landslip: Available
Rock Segments: Available

Geology 1:10,000 Maps - Slice A



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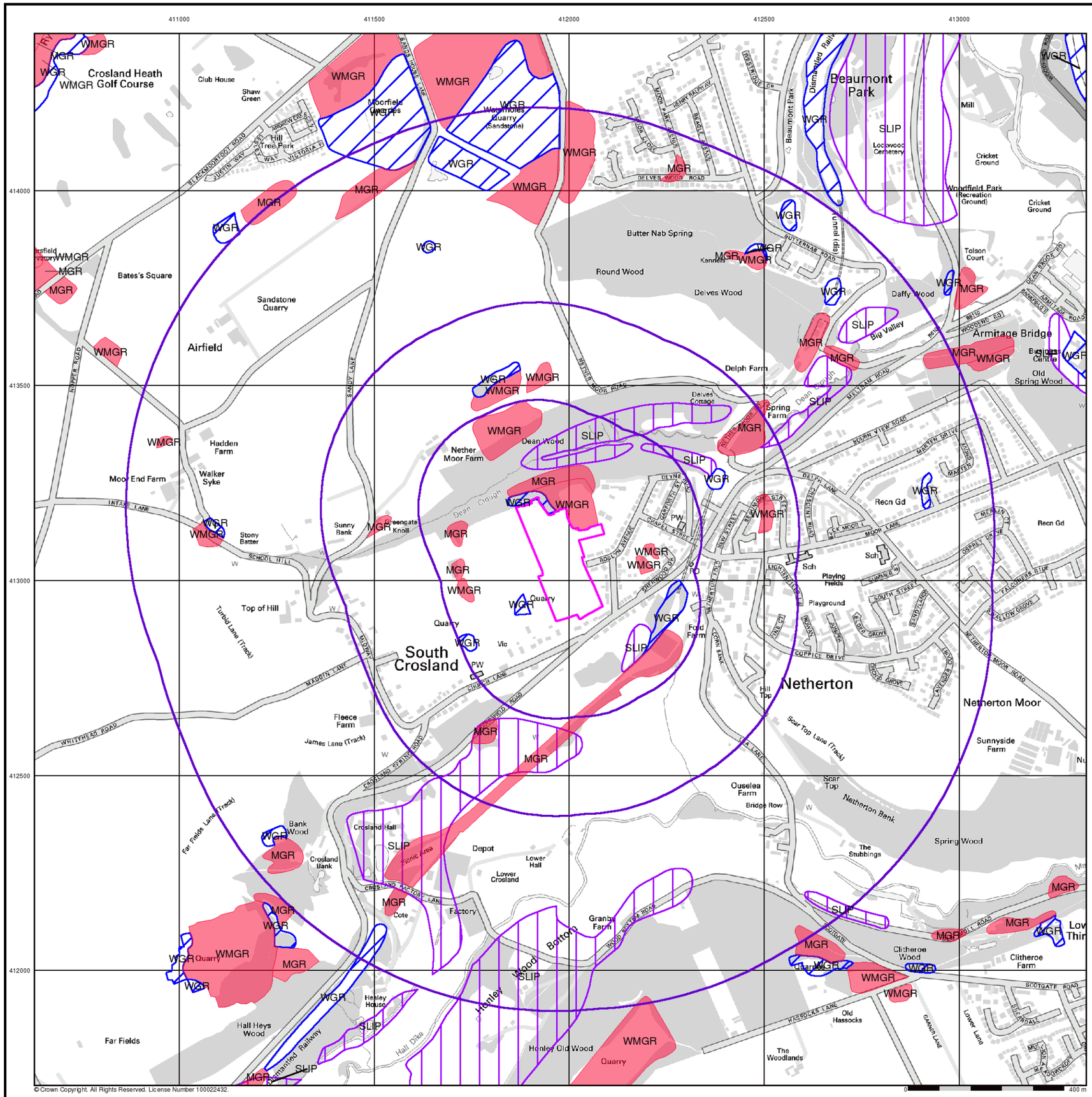


Envirocheck® Geology

Artificial Ground and Landslip

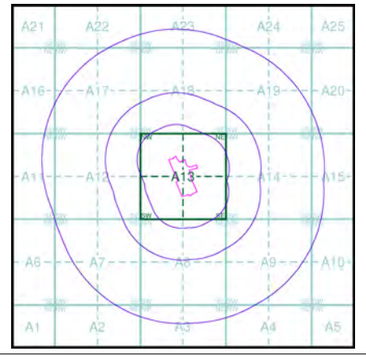
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A



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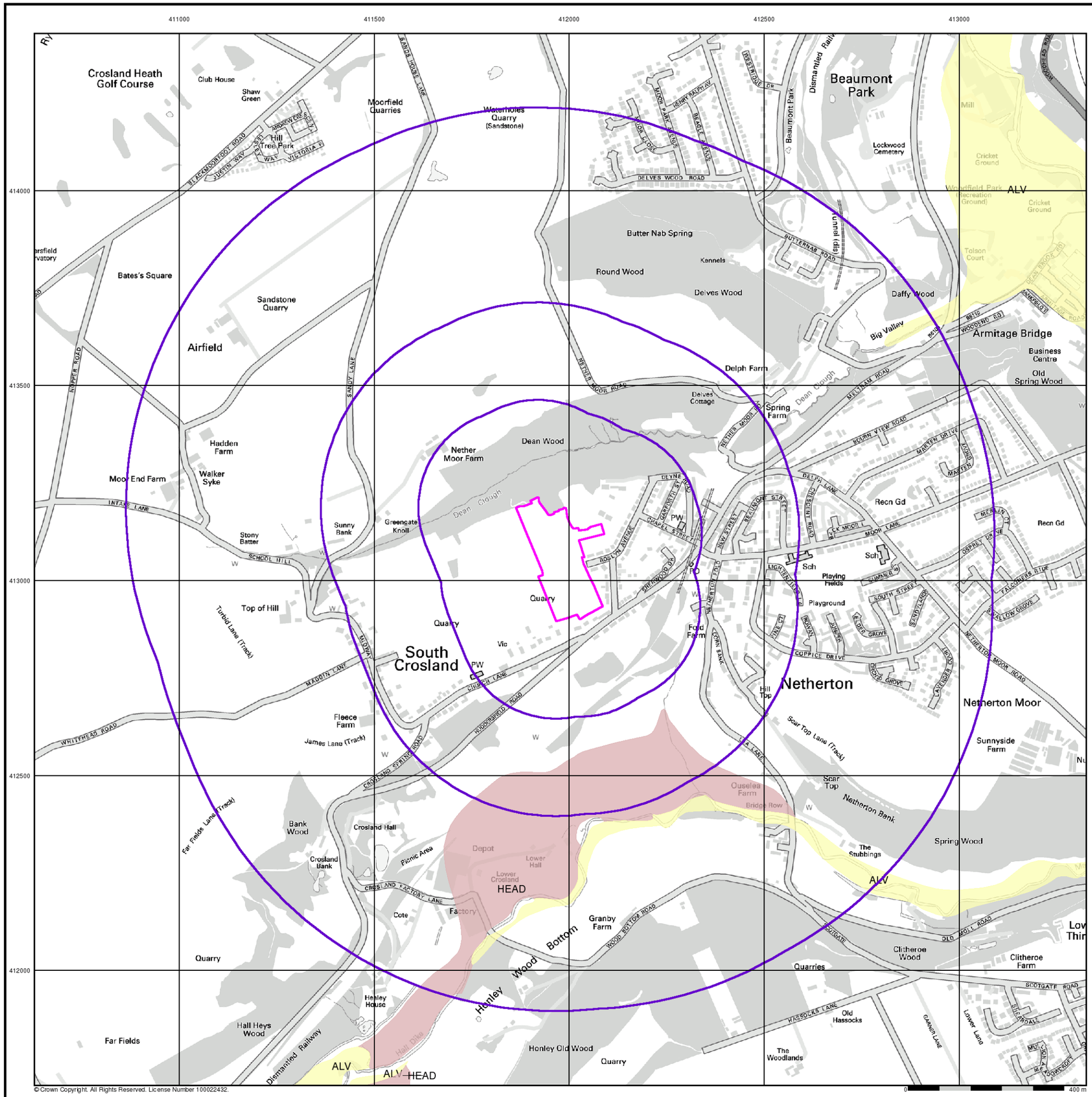


Envirocheck® Geology

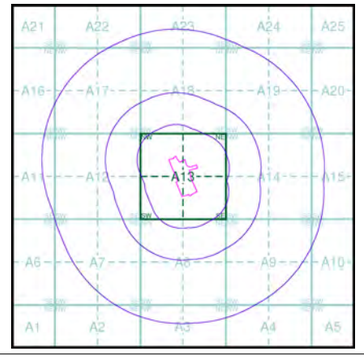
Superficial Geology

BGS 1:10,000 Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



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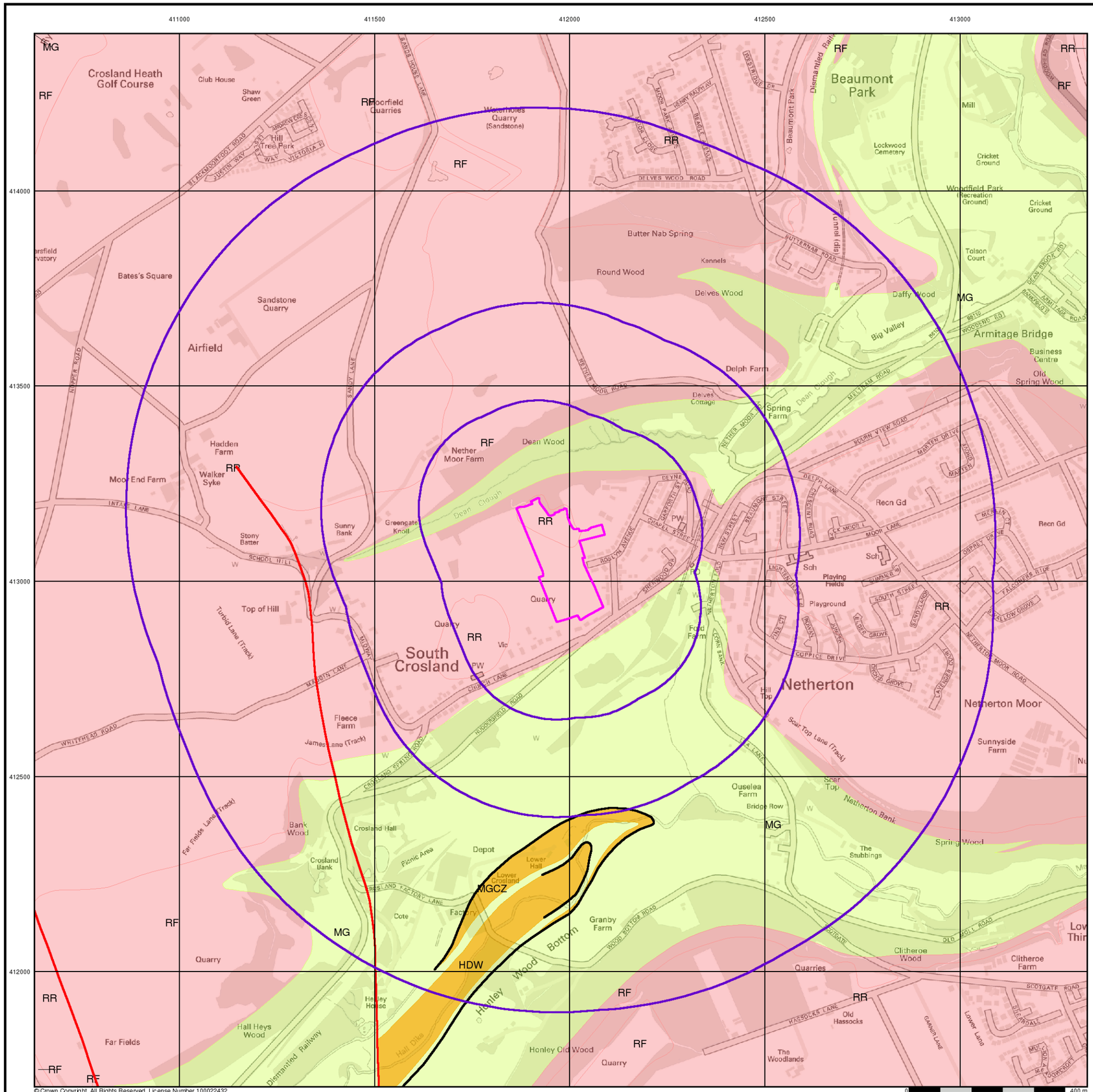


Envirocheck® Geology

Bedrock and Faults

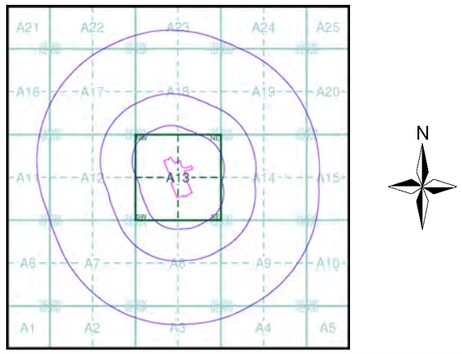
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults and thin beds mapped as lines such as coal seams and mineral veins. These are not restricted by age and could relate to features of any of the 1:10,000 geology datasets.

Bedrock and Faults Map - Slice A



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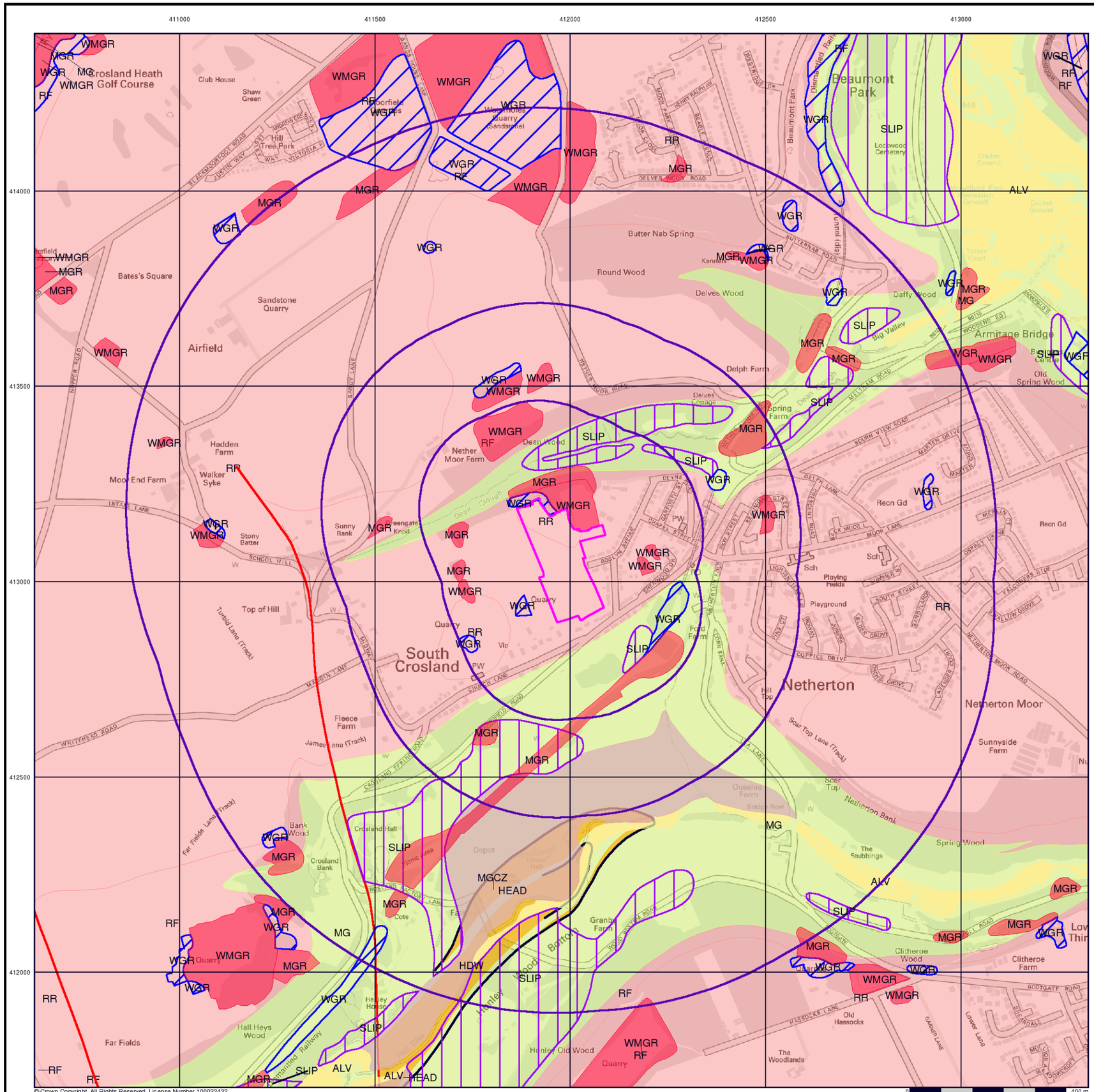


Envirocheck® Geology

Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

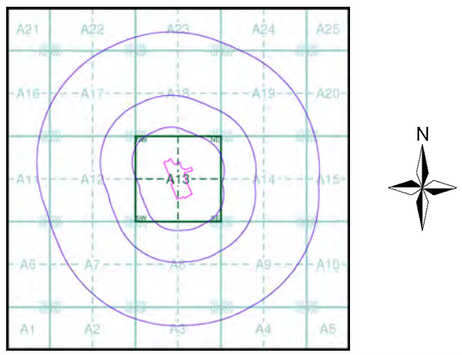
Additional Information

More information on 1:10,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
NG12 5GG
Telephone: 0115 936 3143
Fax: 0115 936 3276
email: enquiries@bgs.ac.uk
website: www.bgs.ac.uk

Combined Geology Map - Slice A



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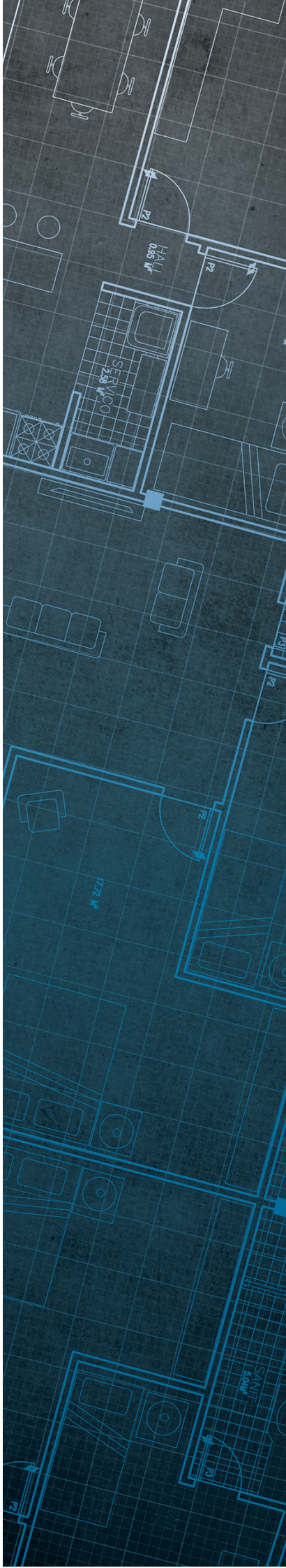
The Coal Authority

Consultants

Coal Mining Report

Land At Roslyn Avenue
Netherton
Huddersfield
Kirklees
HD4 7EW

Date of enquiry:	**12 June 2024**
Date enquiry received:	**12 June 2024**
Issue date:	**12 June 2024**
Our reference:	**51003430665001**
Your reference:	**PO22524**



Consultants

Coal Mining Report

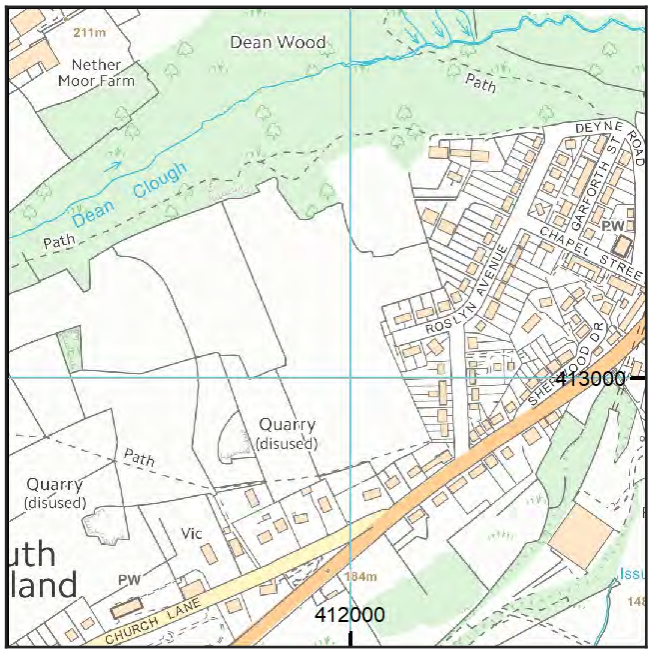
This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

LITHOS CONSULTING

Enquiry address

Land At Roslyn Avenue
Netherton
Huddersfield
Kirklees
HD4 7EW



Approximate position of property

How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

@coalauthority
/company/the-coal-authority
/thecoalauthority
/thecoalauthority

Section 1 – Mining activity and geology

Past underground mining
No past mining recorded.

Probable unrecorded shallow workings
None.

Spine roadways at shallow depth
No spine roadway recorded at shallow depth.

Mine entries
None recorded within 100 metres of the enquiry boundary.

Abandoned mine plan catalogue numbers
None available.

Outcrops
No outcrops recorded.

Geological faults, fissures and breaklines
No faults, fissures or breaklines recorded.

Opencast mines
None recorded within 500 metres of the enquiry boundary.

Coal Authority managed tips
None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

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

Site investigations
None recorded within 50 metres of the enquiry boundary.

Remediated sites
None recorded within 50 metres of the enquiry boundary.

Coal mining subsidence
The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas
None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes
None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining
None recorded.

Coal mining licensing
None recorded within 200 metres of the enquiry boundary.

Court orders
None recorded.

Section 46 notices
No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

Withdrawal of support notices
The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

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

Section 4 – Further information

Based on the responses in this report, no further information has been highlighted.

Future development

If development proposals are being considered, technical advice relating to both the investigation of coal and former coal mines and their treatment should be obtained before beginning work on site. All proposals should apply specialist engineering practice required for former mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or coal mines without first obtaining the permission of the Coal Authority.

MINE GAS: Please note, if there are no recorded instances of mine gas within 500m of the enquiry boundary, this does not mean that mine gas is not present within the vicinity. The Coal Authority Mine Gas data is limited to only those sites where a Mine Gas incident has been recorded. Developers should be aware that the investigation of coal seams, mine workings or mine entries may have the potential to generate and/or displace underground gases. Associated risks both to the development site and any neighbouring land or properties should be fully considered when undertaking any ground works. The need for effective measures to prevent gases migrating onto any land or into any properties, either during investigation or remediation work, or after development must also be assessed and properly addressed. In these instances, the Coal Authority recommends that a more detailed Gas Risk Assessment is undertaken by a competent assessor.

Section 5 – Data definitions

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

Past underground coal mining

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

Probable unrecorded shallow workings

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

Spine roadways at shallow depth

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

Mine entries

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

Abandoned mine plan catalogue numbers

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

Outcrops

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

Geological faults, fissures and breaklines

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

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

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

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

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

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

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

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

Mine gas
Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission. Please note, if there are no recorded instances of mine gas reported, this does not mean that mine gas is not present within the vicinity. The Coal Authority Mine Gas data is limited to only those sites where a Mine Gas incident has been recorded.

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

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

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

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

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

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

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

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

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

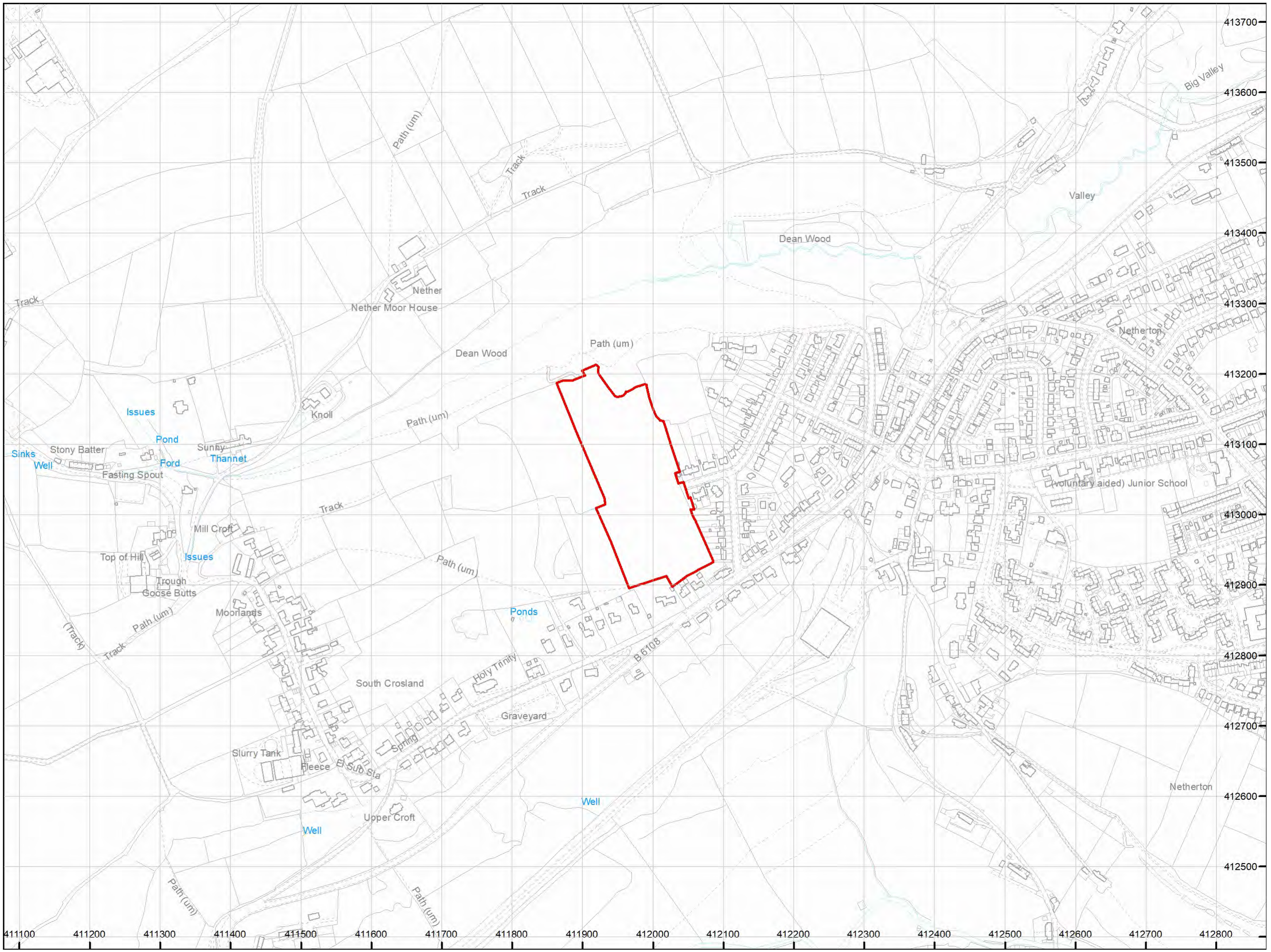
The Coal Authority

Summary of findings

The map highlights any specific surface or subsurface features within or near to the boundary of the site.

Key

Approximate position of the enquiry boundary shown



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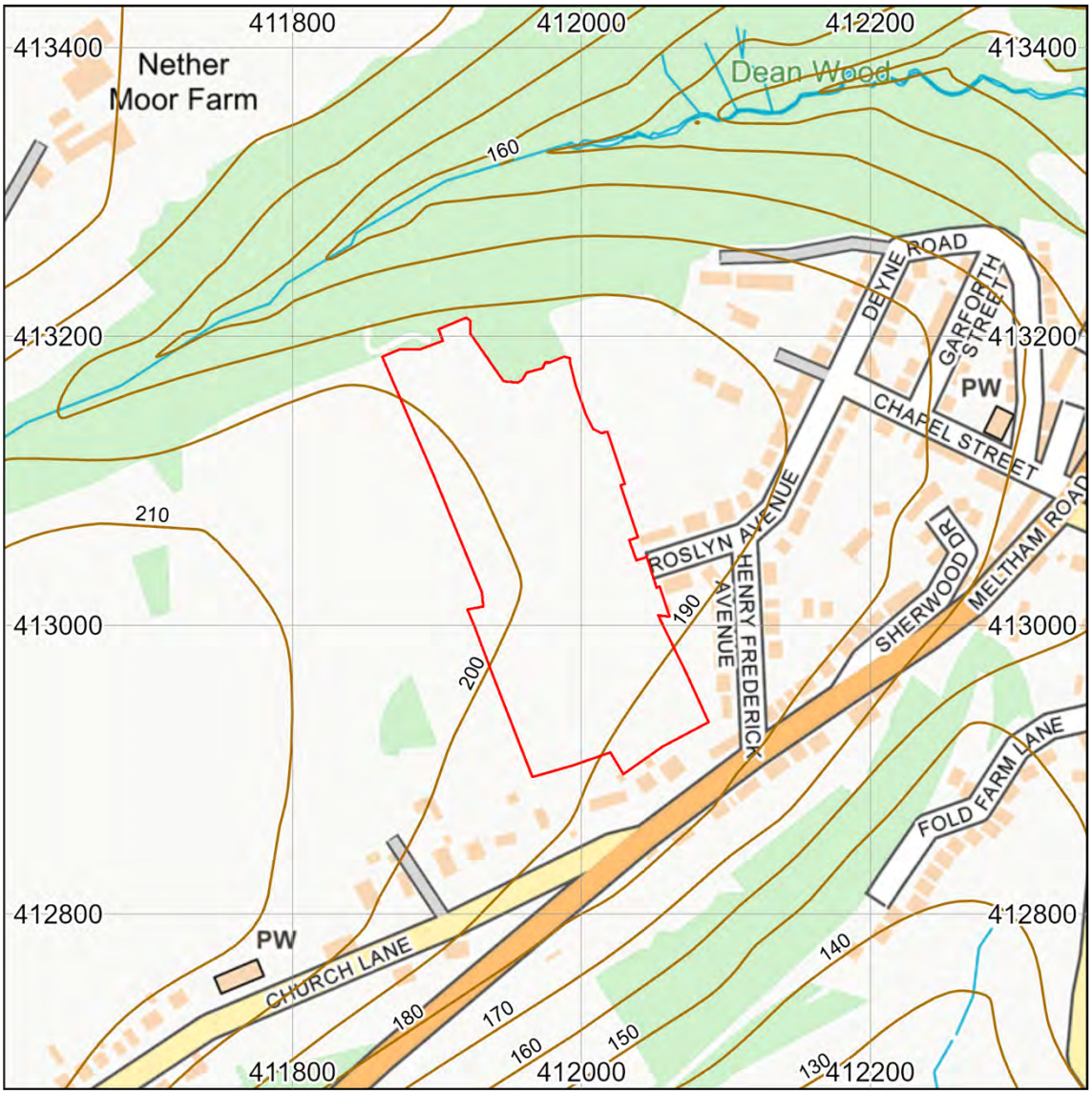
Radon Report

Advisory report on the requirement for radon protective measures in new buildings, conversions and extensions to existing buildings. The report also indicates whether a site is located within a radon Affected Area

Report Id: ***BGS_339187/55356***

Client reference: PO22742/5080

Search location



Contains OS data © Crown Copyright and database right 2024. OS OpenMap Local: Scale: 1:5 000 (1cm = 50 m)
Search location indicated in red

This report describes a site located at National Grid Reference 411975, 413054. Note that for sites of irregular shape, this point may lie outside the site boundary. Where the client has submitted a site plan the assessment will be based on the area given.

Radon Report: UK

When extensions are made to existing buildings in high radon areas, or new buildings are constructed in these areas, the Building Regulations for England, Wales, Scotland and Northern Ireland require that protective measures are taken against radon entering the building.

This report provides information on whether radon protective measures are required. Depending on the probability of buildings having high radon levels, the Regulations may require either:

1. No protective measures
2. Basic protective measures
3. Full protective measures

This is an advisory report on the requirement for radon protective measures in new buildings, conversions and extensions. The report also indicates whether a site is located within a radon Affected Area

Requirement for radon protective measures

The determination below follows advice in *BR211 Radon: Guidance on protective measures for new buildings (2023 edition), which also provides guidance on what to do if the* result *indicates that protective measures are required.*

Is the property in an area where radon protective measures are required for new buildings or extensions to existing ones as described in publication BR211 (2023 edition) Radon: Guidance on protective measures for new buildings?

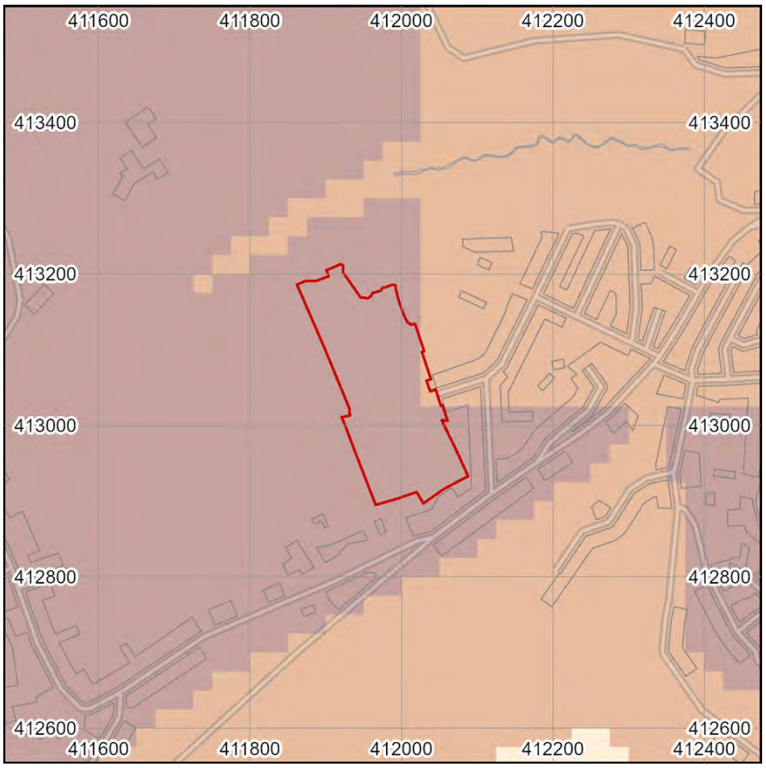
BASIC RADON PROTECTIVE MEASURES ARE REQUIRED FOR THE REPORT AREA.

More details of the protective measures required are available in *BR211 Radon: Guidance on protective measures for new buildings (2023 Edition)*.

Whether or not the radon level in a building is above or below the radon Action Level can only be established by having the building tested. The UKHSA provides a radon testing service which can be accessed at www.ukradon.org or by telephone (01235 822622).

If you require further information or guidance, you should contact your local authority building control officer or approved inspector.

Radon Affected Area



	% Homes estimated to be at or above the action level
	0-1%
	1-3%
	3-5%
	5-10%
	10-30%
	30-100%

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Scale: 1:10 000 (1cm = 100 m)
Search area indicated in red

Is the property in a radon Affected Area as defined by the UK Health Security Agency (UKHSA) and if so what percentage of homes are estimated to be at or above the Action Level? **YES**

Additional Information

THE PROPERTY IS IN A RADON AFFECTED AREA WHERE 3 TO 5% OF HOMES ARE ESTIMATED TO BE AT OR ABOVE THE ACTION LEVEL.

The UKHSA recommends a radon 'Action Level' of 200 Becquerels per cubic metre of air (Bq m^{-3}) for the annual average of the radon gas concentration in a home. Where 1% or more of homes are estimated to be at or above the Action Level the area should be regarded as a radon Affected Area.

This report informs you whether the property is in a radon Affected Area and the percentage of homes that are estimated to be at or above the radon Action Level at this location. Being in an Affected Area does not necessarily mean there is a high radon level within the property; the only way to determine the radon level is to carry out a radon measurement.

The UKHSA advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels at or above the Action Level (200 Bq m^{-3}) should be remediated. Householders with levels between the Target Level (100 Bq m^{-3}) and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers. Whether or not a home is in fact above or below the Action Level or Target Level can only be established by having the building tested. The UKHSA provides a validated radon testing service which can be accessed at www.ukradon.org.

The information in this report provides an answer to one of the standard legal enquiries on house purchase in England and Wales, known as Law Society CON29 Enquiries of the Local Authority (2016); 3.14 Radon Gas: Do records indicate that the property is in a “Radon Affected Area” as identified by the UKHSA. The data can also be used to advise house buyers and sellers in Scotland and Northern Ireland.

If you are buying a new build property in a Radon Affected Area, you should ask the builder whether radon protective measures were incorporated in the construction of the property.

If you are buying a currently occupied property in a radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were at or above the radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and if the results of re-testing confirmed the effectiveness of the measures.

Further information on radon is available from the UKHSA at www.ukradon.org.

What is radon?

Radon is a naturally occurring radioactive gas, which is produced by the radioactive decay of radium which, in turn, is derived from the radioactive decay of uranium. Uranium is found in small quantities in all soils and rocks, although the amount varies from place to place. Radon released from rocks and soils is quickly diluted in the atmosphere. Concentrations in the open air are normally very low and do not present a hazard. Radon that enters enclosed spaces such as some buildings (particularly basements), caves, mines, and tunnels may reach high concentrations in some circumstances. The construction method and degree of ventilation will influence radon levels in individual buildings. A person's exposure to radon will also vary according to how particular buildings and spaces are used.

Inhalation of the radioactive decay products of radon gas increases the chance of developing lung cancer. If individuals are exposed to high concentrations for significant periods of time, there may be cause for concern. In order to limit the risk to individuals, the Government has adopted an Action Level for radon in homes of 200 becquerels per cubic metre (Bq m^{-3}). The Government advises householders that, where the radon level is at or above the Action Level, measures should be taken to reduce the concentration.

Radon in workplaces

The Ionising Radiation Regulations 2017 require employers to take action when radon is present above a defined level in the workplace. Advice may be obtained from your local Health and Safety Executive Area Office or the Environmental Health Department of your local authority. The BRE publishes a guide (BR293)**: Radon in the workplace.** BRE publications may be obtained from the BRE Bookshop, Tel: 01923 664262, email: bookshop@bre.co.uk website: www.brebookshop.com

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- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
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- Note that for some sites, the latest available records may be historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

Report issued by
BGS Enquiry Service

Appendix F

Trial Pit Logs

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP01
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411891.00 - 413172.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 1.50	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown slightly gravelly slightly clayey SAND. Gravel is subangular to subrounded fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL) *Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.2m.*
	0.50	T		0.60			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				1.20			Weak orangish brown medium SANDSTONE. Recovered as angular cobbles. (ROUGH ROCK FLAGS - SANDSTONE)
				1.50			*Difficult to excavate beyond 1.5m with JCB.* End of pit at 1.50 m

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2
3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.2m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP02**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411897.00 - 413146.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 1.90	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.35			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL) *Pit unstable due to overbreak in granular residual soil (cobbles).*
	0.80	T					
				1.10			Weak orangish brown medium SANDSTONE recovered as cobbles with some gravelly sand. (ROUGH ROCK FLAGS - SANDSTONE)
				1.90			*Difficult to excavate beyond 1.90m with JCB.* End of pit at 1.90 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.35m and 1.10m depth during excavation.

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Trial Pit Log

Trialpit No
TP03
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411927.00 - 413158.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 2.50	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty fine SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
	0.20	B					
				0.60			
	0.70	B					Orangish brown very gravelly SAND with low cobble content. Gravel is angular fine to coarse of sandstone. Cobbles are angular of sandstone. (GRANULAR RESIDUAL SOIL) *Pit unstable due to overbreak in granular soils (cobbles) between 0.6m and 1.8m.*
				1.80			Weak orangish brown medium SANDSTONE. Recovered as cobbles with some gravelly sand. (ROUGH ROCK FLAGS - SANDSTONE)
				2.50			*Difficult to excavate beyond 2.5m with JCB.* End of pit at 2.50 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.6m and 1.8m depth during excavation.

AGS

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Trial Pit Log

Trialpit No **TP04**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411931.00 - 413128.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 2.00	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty fine SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.40			Orangish brown very gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
							Pit unstable due to overbreak in granular residual soil (cobbles) between 0.4m and 1.65m.
	0.80	T					
							From 1.1m moderate cobble content. Cobbles are angular of sandstone.
				1.65			Weak orangish brown medium SANDSTONE. Recovered as cobbles with some gravelly sand. (ROUGH ROCK FLAGS - SANDSTONE)
				2.00			*Difficult to excavate beyond 2.0m with JCB.* End of pit at 2.00 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.4m and 1.65m depth during excavation.

AGS

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Trial Pit Log

Trialpit No **TP05**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411914.00 - 413098.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 1.50	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.40			Orangish brown angular COBBLES of sandstone with much sandy GRAVEL. Gravel is angular medium to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
	0.60	T					*Pit unstable due to overbreak in granular residual soil (cobbles) between 0.4m and 1.3m.*
							From 1.0m low boulder (up to 40cm) content. Boulders angular of sandstone.
				1.30			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with some sandy gravel. (ROUGH ROCK FLAGS - SANDSTONE)
				1.50			*Difficult to excavate beyond 1.5m with JCB.* End of pit at 1.50 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.4m and 1.3m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP06
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411959.00 - 413146.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 2.70	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J&T					Dark brown gravelly silty fine SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
	0.60	J,K&T		0.50			MADE GROUND: Yellowish brown angular COBBLES and BOULDERS of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (REWORKED NATURAL) *From 0.5m to 2.4m, cobbles of sandstone are not uniform and vary in size, shape and colour. No structure in sidewall, potentially infilled with natural material. Eastern and northern sidewalls appear 'natural' and stable, west and south sidewalls are unstable with no structure in the sandstone cobbles.*
				2.40			Weak yellowish brown medium SANDSTONE. Recovered as angular cobbles. (ROUGH ROCK FLAGS - SANDSTONE)
				2.70			*Difficult to excavate beyond 2.7m with JCB.* End of pit at 2.70 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.5m and 2.4m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP07
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411980.00 - 413166.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 1.80	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.20			Dark brown gravelly silty fine SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
	0.60	T		1.50			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL) *Pit unstable due to overbreak in granular residual soil (cobbles) between 0.2m and 1.0m.*
				1.80			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with some gravelly sand. (ROUGH ROCK FLAGS - SANDSTONE) *Difficult to excavate beyond 1.8m with JCB.* End of pit at 1.80 m

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4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.2m and 1.0m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP08
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411980.00 - 413126.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 1.50	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T					Dark brown gravelly silty fine SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL) *Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.3m.*
	0.70	D					
	0.80	T					
							From 1.2m low boulder content (up to 40cm). Boulders are angular of sandstone.
				1.30			Weak yellowish brown medium SANDSTONE recovered as cobbles with some gravelly sand. (ROUGH ROCK FLAGS - SANDSTONE)
				1.50			*Difficult to excavate beyond 1.5m with JCB.* End of pit at 1.50 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.3m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP09
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411956.00 - 413107.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 2.20	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
	0.20	B					
				0.50			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
	0.65	T					*Pit unstable due to overbreak in granular residual soil (cobbles) between 0.5m and 1.7m.*
	0.80	D					
				1.70			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with some sand. (ROUGH ROCK FLAGS - SANDSTONE)
							Difficult to excavate beyond 2.2m with JCB.
				2.20			End of pit at 2.20 m

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4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.6m and 1.7m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP10
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412009.00 - 413098.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 1.20	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30			Dark brown gravelly silty fine SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
	0.90	D					Orangish brown angular COBBLES of sandstone with much sandy GRAVEL. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
	1.00	T		1.10			Weak yellowish brown medium SANDSTONE. Recovered as gravel. (ROUGH ROCK FLAGS - SANDSTONE) *Difficult to excavate beyond 1.2m with JCB.*
				1.20			End of pit at 1.20 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP11
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411986.00 - 413077.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 2.00	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is subangular fine to coarse of sandstone. (TOPSOIL)
				0.50			Orangish brown gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
	0.80	D&B					*Pit unstable due to overbreak in granular residual soil (cobbles) between 0.5m and 1.7m.*
							From 1.1m to 1.3m, very gravelly.
				1.30			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				1.70			Weak yellowish brown medium SANDSTONE. (ROUGH ROCK FLAGS - SANDSTONE)
				2.00			*Difficult to excavate beyond 2.0m with JCB.* End of pit at 2.00 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.5m and 1.7m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP12
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411941.00 - 413076.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 1.30	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is subangular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
	0.60	D					*Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3 and 1.2m.*
	0.70	T					*From 0.8m to 1.2m low boulder content (up to 40cm). Boulders are angular of sandstone.*
				1.20			Weak yellowish brown medium SANDSTONE recovered as cobbles. (ROUGH ROCK FLAGS - SANDSTONE)
				1.30			*Difficult to excavate beyond 1.3m with JCB.* End of pit at 1.30 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.2m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP13
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411940.00 - 413035.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 1.80	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL) *Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.4m.*
	0.75	D					
				1.40			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with some gravelly sand. (ROUGH ROCK FLAGS - SANDSTONE)
				1.80			*Difficult to excavate beyond 1.8m with JCB.* End of pit at 1.80 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.4m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP14
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411983.00 - 413039.00 Level:	Date 26/06/2024
Location: Netherton		Dimensions (m): Depth 2.00	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown gravelly SAND with medium cobble content. Gravel is angular fine to coarse of sandstone. Cobbles are angular of sandstone. (GRANULAR RESIDUAL SOIL) *Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.8m.*
	0.55	D&B		0.60			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				1.80			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with some gravelly sand. (ROUGH ROCK FLAGS - SANDSTONE) *Difficult to excavate beyond 2.0m with JCB.*
				2.00			End of pit at 2.00 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.8m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP15
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412030.00 - 413041.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 2.50	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T		0.30			Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
	0.40	J,K&T					Orangish brown and reddish brown very gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
	0.60	D&B		0.70			Yellowish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				1.90			Weak yellowish brown medium SANDSTONE. Recovered as cobbles. (ROUGH ROCK FLAGS - SANDSTONE)
				2.50			*Difficult to excavate beyond 2.5m with JCB.* End of pit at 2.50 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP16
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412008.00 - 413013.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 1.70	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
	0.20	B		0.30			Orangish brown angular COBBLES of sandstone with much very sandy GRAVEL. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
	0.65	T					*Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.3m.*
				1.30			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with some gravelly sand. (ROUGH ROCK FLAGS - SANDSTONE)
				1.70			*Difficult to excavate beyond 1.7m with JCB.* End of pit at 1.70 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.3m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP17
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411943.00 - 412999.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 1.75	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with occasional boulders (up to 40cm) and much very sandy GRAVEL. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
	0.50	T					
							Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.5m.
				1.50			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with occasional boulders and some sand. (ROUGH ROCK FLAGS - SANDSTONE)
				1.75			*Difficult to excavate beyond 1.75m with JCB.* End of pit at 1.75 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.5m depth during excavation.

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Trial Pit Log

Trialpit No
TP18
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411980.00 - 413000.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 1.40	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J,K&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with much very gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
	0.80	D					*Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.1m.*
				1.10			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with occasional boulders and some sand. (ROUGH ROCK FLAGS - SANDSTONE)
				1.40			*Difficult to excavate beyond 1.4m with JCB.* End of pit at 1.40 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.1m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP19
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411954.00 - 412968.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 1.60	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with occasional boulders (up to 40cm) and much gravelly SAND. Gravel is angular fine to coarse of sandstone. Boulders are angular of sandstone. (GRANULAR RESIDUAL SOIL)
	1.00	T					*Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.4m.*
				1.40			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with with some sandy gravel. (ROUGH ROCK FLAGS - SANDSTONE)
				1.60			*Difficult to excavate beyond 1.6m with JCB.* End of pit at 1.60 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.4m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP20
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412001.00 - 412973.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 2.00	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown very gravelly SAND with low cobble content. Gravel is angular fine to coarse of sandstone. Cobbles are angular of sandstone. (GRANULAR RESIDUAL SOIL)
	0.60	D&B					
				1.50			Yellowish brown angular COBBLES of sandstone with some gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				1.70			*Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.7m.* Weak yellowish brown medium SANDSTONE. Recovered as cobbles. (ROUGH ROCK FLAGS - SANDSTONE)
				2.00			*Difficult to excavate beyond 2.0m with JCB.* End of pit at 2.00 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.7m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP21
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412032.00 - 413000.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 1.60	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. 1no. gravel sized fragment of pottery noted. (TOPSOIL)
				0.30			Orangish brown very gravelly SAND with moderate cobble content. Gravel is angular fine to coarse of sandstone. Cobbles are angular of sandstone. (GRANULAR RESIDUAL SOIL)
				0.60			Yellowish brown angular COBBLES of sandstone with occasional boulders (up to 40cm) and some gravelly SAND. Gravel is angular fine to coarse of sandstone. Boulders are angular of sandstone. (GRANULAR RESIDUAL SOIL)
							Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.3m.
				1.30			Weak yellowish brown medium SANDSTONE. Recovered as cobbles with some sandy gravel. (ROUGH ROCK FLAGS - SANDSTONE)
				1.60			*Difficult to excavate beyond 1.6m with JCB.* End of pit at 1.60 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.3m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP22
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412042.00 - 412976.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 2.55	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.40			Yellowish brown sandy angular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
	1.20	T		1.10			Yellowish brown angular COBBLES of sandstone with much sandy GRAVEL. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				1.80			Yellowish brown sandy angular fine to coarse GRAVEL of sandstone with moderate cobble content. Cobbles are angular of sandstone. (GRANULAR RESIDUAL SOIL)
							Pit unstable due to overbreak in granular residual soil (cobbles) between 0.0m and 2.5m.
				2.50 2.55			Weak yellowish brown medium SANDSTONE. Recovered as cobbles and gravel. (ROUGH ROCK FLAGS - SANDSTONE) *Difficult to excavate beyond 2.55m with JCB.* End of pit at 2.55 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.0m and 2.5m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP23
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412040.00 - 412941.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 2.50	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30			Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
	0.70	D&B		1.10			Orangish brown sandy clayey subangular to angular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
				2.10			Yellowish brown angular COBBLES of sandstone with much sandy GRAVEL. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				2.50			Weak yellowish brown medium SANDSTONE. Recovered as gravel and cobbles with some sand. (ROUGH ROCK FLAGS - SANDSTONE) *At 2.3m, sandstone interbedded with grey siltstone and firm thinly laminated brownish grey clay.* *Difficult to excavate beyond 2.5m with JCB.* End of pit at 2.50 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP24
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412002.00 - 412940.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 2.50	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T					Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
	0.20	B		0.50			Orangish brown becoming yellowish brown (at 1.4m) angular COBBLES of sandstone with much sandy GRAVEL and occasional cobble sized lenses of clay. (GRANULAR RESIDUAL SOIL)
				2.30			Weak yellowish brown medium SANDSTONE with occasional interbeds of firm brownish grey clay. Recovered as cobbles and gravel. (ROUGH ROCK FLAGS - SANDSTONE)
				2.50			*Difficult to excavate beyond 2.5m with JCB.* End of pit at 2.50 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP25
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411953.00 - 413144.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 1.10	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				1.00			Weak yellowish brown medium SANDSTONE. Recovered as cobbles and boulders with some sand and gravel. (ROUGH ROCK FLAGS - SANDSTONE) *Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.0m.* *Difficult to excavate beyond 1.1m with JCB.*
				1.10			End of pit at 1.10 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.0m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP26
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411958.00 - 413141.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 1.30	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				1.20			Weak yellowish brown medium SANDSTONE. Recovered as cobbles. (ROUGH ROCK FLAGS - SANDSTONE)
				1.30			*Difficult to excavate beyond 1.3m with JCB.* End of pit at 1.30 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP27
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411955.00 - 413151.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 1.10	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with much gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
				1.00			Weak yellowish brown medium SANDSTONE. Recovered as cobbles. (ROUGH ROCK FLAGS - SANDSTONE) *Difficult to excavate beyond 1.3m with JCB.*
				1.10			End of pit at 1.10 m

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3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP28
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411977.00 - 412920.00 Level:	Date 27/06/2024
Location: Netherton		Dimensions (m): Depth 1.50	Scale 1:20
Client: KCS Developments Ltd			Logged LB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
				0.30			Orangish brown angular COBBLES of sandstone with much sandy GRAVEL. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
							Pit unstable due to overbreak in granular residual soil (cobbles) between 0.3m and 1.3m.
				1.30			Weak yellowish brown medium SANDSTONE. Recovered as cobbles and boulders with some gravelly sand. (ROUGH ROCK FLAGS - SANDSTONE)
				1.50			*Difficult to excavate beyond 1.5m with JCB.* End of pit at 1.50 m

1
2
3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.3m and 1.3m depth during excavation.

AGS

Appendix G

Borehole Logs

Borehole Log

Borehole No. **WS01**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411891.00 - 413183.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
					0.30			Orangish brown becoming yellowish brown sandy angular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
		1.00		50 (9,10/50 for 185mm)	1.00			*Barrel refused at 1.0m.* End of borehole at 1.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

Borehole Log

Borehole No. **WS02**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411924.00 - 413185.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
					0.20			Brown gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
		1.00		58 (1,5/58 for 235mm)				
					1.30			*Barrel refused at 1.3m.* End of borehole at 1.30 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411955.00 - 413146.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
					0.30			POSSIBLE MADE GROUND: Yellowish brown sandy angular fine to coarse GRAVEL of sandstone. (REWORKED NATURAL)
		1.00		N=0 (1,0/0,0,0,0)				
		1.80		50 (13,12/50 for 145mm)	1.80			*Barrel refused at 1.8m.* End of borehole at 1.80 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

LITHOS CONSULTING

Borehole Log

Borehole No.
WS04
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411903.00 - 413110.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
					0.30			Orangish brown and yellowish brown sandy angular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
		1.00		N=50 (7,11/12,14,18,6)				
								Barrel refused at 1.4m.
					1.40			End of borehole at 1.40 m

1

2

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Borehole Log

Borehole No. **WS05**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411983.00 - 413158.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
					0.30			Yellowish brown sandy angular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
		1.00		50 (12,13/50 for 150mm)				
								Barrel refused at 1.2m.
					1.20			End of borehole at 1.20 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

LITHOS CONSULTING

Borehole Log

Borehole No.
WS06
Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412009.00 - 413118.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
					0.30			POSSIBLE MADE GROUND: Brown sandy angular fine to coarse GRAVEL of sandstone. (REWORKED NATURAL)
		1.00		N=4 (1,2/1,0,1,2)				
		1.90		50 (25 for 70mm/50 for 25mm)	1.90			*Barrel refused at 1.9m.*
								End of borehole at 1.90 m

1

2

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Borehole Log

Borehole No. **WS07**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412043.00 - 413008.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
					0.40			Orangish brown becoming yellowish brown sandy angular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
		1.00		N=52 (6,10/12,14,18,8)				
					1.40			*Barrel refused at 1.4m.* End of borehole at 1.40 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

Borehole Log

Borehole No. **WS08**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 412004.00 - 412928.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
					0.30			Brown very gravelly SAND. Gravel is angular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
		1.00		50 (6,5/50 for 280mm)				
								Barrel refused at 1.4m.
					1.40			End of borehole at 1.40 m

1

2

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

Borehole Log

Borehole No. **WS09**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411963.00 - 412958.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)	
					0.30			Yellowish brown sandy angular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)	
		1.00		50 (12,13/50 for 115mm)	1.00			*Barrel refused at 1.0m.* End of borehole at 1.00 m	1
									2

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

Borehole Log

Borehole No. **WS10**

Sheet 1 of 1

Project Name: Roslyn Avenue	Project No. 5080	Co-ords: 411939.00 - 413017.00	Hole Type WS
Location: Netherton		Level:	Scale 1:10
Client: KCS Developments Ltd		Dates: 28/06/2024 - 28/06/2024	Logged By LB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown gravelly silty SAND. Gravel is angular fine to coarse of sandstone. (TOPSOIL)
					0.30			Orangish brown and yellowish brown sandy angular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
		1.00		50 (4,6/50 for 230mm)				
								Barrel refused at 1.4m.
					1.40			End of borehole at 1.40 m

1

2

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

Appendix H

Chemical Results

Certificate of Analysis

Certificate Number	24-13511	*Issued:*	12-Jul-24

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference	24-13511
Client Reference ~	5080
Order No ~	PO22637
Contract Title ~	Roslyn Avenue, Netherton
Description	33 Soil samples.
Date Received	02-Jul-24
Date Started	02-Jul-24
Date Completed	12-Jul-24
Test Procedures	Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Kirk Bridgewood
General Manager

2139

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

	Lab No	2358830	2358831	2358832	2358833	2358834	2358835
	Sample ID ~	TP24	TP22	TP19	TP18	TP17	TP16
	Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	27/06/2024	27/06/2024	27/06/2024	27/06/2024	27/06/2024	27/06/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Preparation							
Stones >10mm	DETSC 1003*	1	% m/m	6.0	9.0	7.0		5.0	6.0
Moisture Content	DETSC 1004	0.1	%	13	15	13		14	14
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	7.5	15	8.4		8.8	17
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.2	0.2	< 0.2		< 0.2	0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.3	0.2		0.2	0.3
Chromium	DETSC 2301#	0.15	mg/kg	11	14	9.6		12	13
Chromium III	DETSC 2301*	0.15	mg/kg	11	14	9.6		12	13
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0		< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	18	26	18		18	35
Lead	DETSC 2301#	0.3	mg/kg	31	46	39		40	61
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.08	0.06		0.12	0.10
Nickel	DETSC 2301#	1	mg/kg	7.0	12	6.1		7.0	10
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5		< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	19	25	18		20	25
Zinc	DETSC 2301#	1	mg/kg	46	56	38		43	59
Inorganics									
pH	DETSC 2008#		pH	5.8	5.1	4.8		5.1	5.7
Total Organic Carbon	DETSC 2084#	0.5	%	2.0	4.1	2.9		2.7	4.5
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l						
Petroleum Hydrocarbons									
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg						
EPH (C10-C12)	DETSC 3311	10	mg/kg						
EPH (C12-C16)	DETSC 3311	10	mg/kg						
EPH (C16-C21)	DETSC 3311	10	mg/kg						
EPH (C21-C35)	DETSC 3311	10	mg/kg						
EPH (C35-C40)	DETSC 3311	10	mg/kg						
EPH (C10-C40)	DETSC 3311#	10	mg/kg						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03		< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03		< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03		< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03		< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.08	0.06		0.06	0.06
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03		< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.16	0.12		0.11	0.14
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.14	0.11		0.09	0.12
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.07	0.05		0.04	0.06

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

			Lab No	2358830	2358831	2358832	2358833	2358834	2358835
			Sample ID ~	TP24	TP22	TP19	TP18	TP17	TP16
			Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
			Other ID ~						
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	27/06/2024	27/06/2024	27/06/2024	27/06/2024	27/06/2024	27/06/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	0.08	0.07		0.06	0.08
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.09	0.07		0.05	0.08
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	< 0.03		< 0.03	0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.05	0.04		< 0.03	0.04
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.03	< 0.03		< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03		< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	< 0.03		< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	0.74	0.52		0.41	0.57
PCBs									
PCB 28 + PCB 31	DETSC 3401#	0.01	mg/kg						
PCB 52	DETSC 3401#	0.01	mg/kg						
PCB 101	DETSC 3401#	0.01	mg/kg						
PCB 118	DETSC 3401#	0.01	mg/kg						
PCB 153	DETSC 3401#	0.01	mg/kg						
PCB 138	DETSC 3401#	0.01	mg/kg						
PCB 180	DETSC 3401#	0.01	mg/kg						
PCB 7 Total	DETSC 3401#	0.01	mg/kg						
Acid Herbicides									
Mecoprop	DETSC 3447	35	ug/kg				< 35		
2,4-D	DETSC 3447	35	ug/kg				< 35		
Bentazone	DETSC 3447	35	ug/kg				< 35		
Picloram	DETSC 3447	35	ug/kg				< 35		
MCPA	DETSC 3447	35	ug/kg				< 35		
Clopyralid	DETSC 3447	35	ug/kg				< 35		
Dicamba	DETSC 3447	35	ug/kg				< 35		
2,3,6-TBA	DETSC 3447	35	ug/kg				< 35		
Dichlorprop	DETSC 3447	35	ug/kg				< 35		
Bromoxynil	DETSC 3447	35	ug/kg				< 35		
Triclopyr	DETSC 3447	35	ug/kg				< 35		
Fenoprop	DETSC 3447	35	ug/kg				< 35		
MCPB	DETSC 3447*	35	ug/kg				< 35		
2,4,5-T	DETSC 3447	35	ug/kg				< 35		
Fluroxypyr	DETSC 3447	35	ug/kg				< 35		
2,4-DB	DETSC 3447	35	ug/kg				< 35		
Ioxynil	DETSC 3447	35	ug/kg				< 35		
Benazolin	DETSC 3447	35	ug/kg				< 35		
PCP	DETSC 3447*	35	ug/kg				< 35		

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

	Lab No	2358836	2358837	2358838	2358839	2358840	2358841
	Sample ID ~	TP15	TP14	TP12	TP10	TP09	TP08
	Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	27/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Preparation							
Stones >10mm	DETSC 1003*	1	% m/m	3.0	4.0	2.0	3.0	2.0	
Moisture Content	DETSC 1004	0.1	%	15	16	17	16	13	
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	12	14	14	11	13	
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.2	0.2	0.3	0.2	0.2	
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.1	0.3	0.3	0.2	
Chromium	DETSC 2301#	0.15	mg/kg	12	13	12	16	15	
Chromium III	DETSC 2301*	0.15	mg/kg	12	13	12	16	15	
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Copper	DETSC 2301#	0.2	mg/kg	28	28	35	28	27	
Lead	DETSC 2301#	0.3	mg/kg	63	74	59	56	63	
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg	0.08	2.0	0.15	0.07	0.20	
Nickel	DETSC 2301#	1	mg/kg	9.6	9.2	8.7	8.2	10	
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Vanadium	DETSC 2301#	0.8	mg/kg	21	23	22	19	25	
Zinc	DETSC 2301#	1	mg/kg	58	50	60	57	66	
Inorganics							
pH	DETSC 2008#		pH	5.2	4.9	5.5	5.3	6.0	
Total Organic Carbon	DETSC 2084#	0.5	%	4.3	4.3	3.9	3.3	3.0	
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l						
Petroleum Hydrocarbons							
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg						
EPH (C10-C12)	DETSC 3311	10	mg/kg						
EPH (C12-C16)	DETSC 3311	10	mg/kg						
EPH (C16-C21)	DETSC 3311	10	mg/kg						
EPH (C21-C35)	DETSC 3311	10	mg/kg						
EPH (C35-C40)	DETSC 3311	10	mg/kg						
EPH (C10-C40)	DETSC 3311#	10	mg/kg						
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.06	0.07	0.06	0.09	0.05	
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.14	0.17	0.19	0.21	0.13	
Pyrene	DETSC 3303#	0.03	mg/kg	0.13	0.15	0.18	0.19	0.12	
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.06	0.06	0.09	0.09	0.06	

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

			Lab No	2358836	2358837	2358838	2358839	2358840	2358841
			Sample ID ~	TP15	TP14	TP12	TP10	TP09	TP08
			Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
			Other ID ~						
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	27/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Chrysene	DETSC 3303	0.03	mg/kg	0.08	0.09	0.13	0.12	0.08	
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.08	0.09	0.14	0.11	0.08	
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	0.05	0.04	< 0.03	
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.04	0.05	0.08	0.07	0.04	
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.03	0.04	0.04	0.03	
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.05	0.04	0.03	
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.58	0.69	1.0	1.0	0.57	
PCBs									
PCB 28 + PCB 31	DETSC 3401#	0.01	mg/kg						
PCB 52	DETSC 3401#	0.01	mg/kg						
PCB 101	DETSC 3401#	0.01	mg/kg						
PCB 118	DETSC 3401#	0.01	mg/kg						
PCB 153	DETSC 3401#	0.01	mg/kg						
PCB 138	DETSC 3401#	0.01	mg/kg						
PCB 180	DETSC 3401#	0.01	mg/kg						
PCB 7 Total	DETSC 3401#	0.01	mg/kg						
Acid Herbicides									
Mecoprop	DETSC 3447	35	ug/kg						< 35
2,4-D	DETSC 3447	35	ug/kg						< 35
Bentazone	DETSC 3447	35	ug/kg						< 35
Picloram	DETSC 3447	35	ug/kg						< 35
MCPA	DETSC 3447	35	ug/kg						< 35
Clopyralid	DETSC 3447	35	ug/kg						< 35
Dicamba	DETSC 3447	35	ug/kg						< 35
2,3,6-TBA	DETSC 3447	35	ug/kg						< 35
Dichlorprop	DETSC 3447	35	ug/kg						< 35
Bromoxynil	DETSC 3447	35	ug/kg						< 35
Triclopyr	DETSC 3447	35	ug/kg						< 35
Fenoprop	DETSC 3447	35	ug/kg						< 35
MCPB	DETSC 3447*	35	ug/kg						< 35
2,4,5-T	DETSC 3447	35	ug/kg						< 35
Fluroxypyr	DETSC 3447	35	ug/kg						< 35
2,4-DB	DETSC 3447	35	ug/kg						< 35
Ioxynil	DETSC 3447	35	ug/kg						< 35
Benazolin	DETSC 3447	35	ug/kg						< 35
PCP	DETSC 3447*	35	ug/kg						< 35

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

	Lab No	2358842	2358843	2358844	2358845	2358846	2358847
	Sample ID ~	TP07	TP06	TP05	TP03	TP02	TP01
	Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Preparation							
Stones >10mm	DETSC 1003*	1	% m/m	4.0	7.0	6.0	1.0		8.0
Moisture Content	DETSC 1004	0.1	%	16	15	12	15		16
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	15	7.9	7.6	16		9.8
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	< 0.2	0.3	0.2	0.4		0.3
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.2	0.2	0.3		0.3
Chromium	DETSC 2301#	0.15	mg/kg	20	9.3	12	13		12
Chromium III	DETSC 2301*	0.15	mg/kg	20	9.3	12	13		12
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0		< 1.0
Copper	DETSC 2301#	0.2	mg/kg	27	16	18	27		21
Lead	DETSC 2301#	0.3	mg/kg	58	41	34	70		55
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg	0.26	0.07	0.07	0.14		0.06
Nickel	DETSC 2301#	1	mg/kg	11	6.4	6.4	10		9.0
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5		< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	25	15	19	24		22
Zinc	DETSC 2301#	1	mg/kg	58	48	48	67		53
Inorganics									
pH	DETSC 2008#		pH	5.0	6.7	5.5	6.1		5.6
Total Organic Carbon	DETSC 2084#	0.5	%	3.3	2.1	1.5	4.0		2.8
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l						
Petroleum Hydrocarbons									
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg						
EPH (C10-C12)	DETSC 3311	10	mg/kg						
EPH (C12-C16)	DETSC 3311	10	mg/kg						
EPH (C16-C21)	DETSC 3311	10	mg/kg						
EPH (C21-C35)	DETSC 3311	10	mg/kg						
EPH (C35-C40)	DETSC 3311	10	mg/kg						
EPH (C10-C40)	DETSC 3311#	10	mg/kg						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03		< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03		< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03		< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03		< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.05	< 0.03	0.04	0.03		0.08
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03		< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.10	0.08	0.07	0.07		0.16
Pyrene	DETSC 3303#	0.03	mg/kg	0.10	0.08	0.07	0.06		0.14
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.05	0.05	0.04	0.03		0.06

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

	Lab No	2358842	2358843	2358844	2358845	2358846	2358847
	Sample ID ~	TP07	TP06	TP05	TP03	TP02	TP01
	Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Chrysene	DETSC 3303	0.03	mg/kg	0.06	0.06	0.05	0.04		0.09
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.07	0.07	0.05	0.04		0.09
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03		0.04
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	< 0.03		0.06
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03		0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03		< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03		0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.46	0.33	0.31	0.21		0.71
PCBs									
PCB 28 + PCB 31	DETSC 3401#	0.01	mg/kg						
PCB 52	DETSC 3401#	0.01	mg/kg						
PCB 101	DETSC 3401#	0.01	mg/kg						
PCB 118	DETSC 3401#	0.01	mg/kg						
PCB 153	DETSC 3401#	0.01	mg/kg						
PCB 138	DETSC 3401#	0.01	mg/kg						
PCB 180	DETSC 3401#	0.01	mg/kg						
PCB 7 Total	DETSC 3401#	0.01	mg/kg						
Acid Herbicides									
Mecoprop	DETSC 3447	35	ug/kg					< 35	
2,4-D	DETSC 3447	35	ug/kg					< 35	
Bentazone	DETSC 3447	35	ug/kg					< 35	
Picloram	DETSC 3447	35	ug/kg					82	
MCPA	DETSC 3447	35	ug/kg					< 35	
Clopyralid	DETSC 3447	35	ug/kg					< 35	
Dicamba	DETSC 3447	35	ug/kg					< 35	
2,3,6-TBA	DETSC 3447	35	ug/kg					< 35	
Dichlorprop	DETSC 3447	35	ug/kg					< 35	
Bromoxynil	DETSC 3447	35	ug/kg					< 35	
Triclopyr	DETSC 3447	35	ug/kg					< 35	
Fenoprop	DETSC 3447	35	ug/kg					< 35	
MCPB	DETSC 3447*	35	ug/kg					< 35	
2,4,5-T	DETSC 3447	35	ug/kg					< 35	
Fluroxypyr	DETSC 3447	35	ug/kg					< 35	
2,4-DB	DETSC 3447	35	ug/kg					< 35	
Ioxynil	DETSC 3447	35	ug/kg					< 35	
Benazolin	DETSC 3447	35	ug/kg					< 35	
PCP	DETSC 3447*	35	ug/kg					< 35	

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

	Lab No	2358848	2358849	2358850	2358851	2358852	2358853
	Sample ID ~	TP01	TP02	TP04	TP05	TP07	TP08
	Depth ~	0.50	0.70	0.80	0.60	0.60	0.80
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m						
Moisture Content	DETSC 1004	0.1	%						
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg						
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg						
Cadmium	DETSC 2301#	0.1	mg/kg						
Chromium	DETSC 2301#	0.15	mg/kg						
Chromium III	DETSC 2301*	0.15	mg/kg						
Chromium, Hexavalent	DETSC 2204*	1	mg/kg						
Copper	DETSC 2301#	0.2	mg/kg						
Lead	DETSC 2301#	0.3	mg/kg						
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg						
Nickel	DETSC 2301#	1	mg/kg						
Selenium	DETSC 2301#	0.5	mg/kg						
Vanadium	DETSC 2301#	0.8	mg/kg						
Zinc	DETSC 2301#	1	mg/kg						
Inorganics									
pH	DETSC 2008#		pH	6.9	6.9	6.8	6.4	6.1	6.5
Total Organic Carbon	DETSC 2084#	0.5	%						
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	< 10	< 10	< 10	< 10	< 10	< 10
Petroleum Hydrocarbons									
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg						
EPH (C10-C12)	DETSC 3311	10	mg/kg						
EPH (C12-C16)	DETSC 3311	10	mg/kg						
EPH (C16-C21)	DETSC 3311	10	mg/kg						
EPH (C21-C35)	DETSC 3311	10	mg/kg						
EPH (C35-C40)	DETSC 3311	10	mg/kg						
EPH (C10-C40)	DETSC 3311#	10	mg/kg						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg						
Acenaphthylene	DETSC 3303#	0.03	mg/kg						
Acenaphthene	DETSC 3303#	0.03	mg/kg						
Fluorene	DETSC 3303	0.03	mg/kg						
Phenanthrene	DETSC 3303#	0.03	mg/kg						
Anthracene	DETSC 3303	0.03	mg/kg						
Fluoranthene	DETSC 3303#	0.03	mg/kg						
Pyrene	DETSC 3303#	0.03	mg/kg						
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg						

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

	Lab No	2358848	2358849	2358850	2358851	2358852	2358853
	Sample ID ~	TP01	TP02	TP04	TP05	TP07	TP08
	Depth ~	0.50	0.70	0.80	0.60	0.60	0.80
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024	26/06/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Chrysene	DETSC 3303	0.03	mg/kg						
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg						
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg						
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg						
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg						
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg						
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg						
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg						
PCBs									
PCB 28 + PCB 31	DETSC 3401#	0.01	mg/kg						
PCB 52	DETSC 3401#	0.01	mg/kg						
PCB 101	DETSC 3401#	0.01	mg/kg						
PCB 118	DETSC 3401#	0.01	mg/kg						
PCB 153	DETSC 3401#	0.01	mg/kg						
PCB 138	DETSC 3401#	0.01	mg/kg						
PCB 180	DETSC 3401#	0.01	mg/kg						
PCB 7 Total	DETSC 3401#	0.01	mg/kg						
Acid Herbicides									
Mecoprop	DETSC 3447	35	ug/kg						
2,4-D	DETSC 3447	35	ug/kg						
Bentazone	DETSC 3447	35	ug/kg						
Picloram	DETSC 3447	35	ug/kg						
MCPA	DETSC 3447	35	ug/kg						
Clopyralid	DETSC 3447	35	ug/kg						
Dicamba	DETSC 3447	35	ug/kg						
2,3,6-TBA	DETSC 3447	35	ug/kg						
Dichlorprop	DETSC 3447	35	ug/kg						
Bromoxynil	DETSC 3447	35	ug/kg						
Triclopyr	DETSC 3447	35	ug/kg						
Fenoprop	DETSC 3447	35	ug/kg						
MCPB	DETSC 3447*	35	ug/kg						
2,4,5-T	DETSC 3447	35	ug/kg						
Fluroxypyr	DETSC 3447	35	ug/kg						
2,4-DB	DETSC 3447	35	ug/kg						
Ioxynil	DETSC 3447	35	ug/kg						
Benazolin	DETSC 3447	35	ug/kg						
PCP	DETSC 3447*	35	ug/kg						

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

	Lab No	2358854	2358855	2358856	2358857	2358858	2358859
	Sample ID ~	TP09	TP10	TP12	TP15	TP16	TP17
	Depth ~	0.65	1.00	0.70	0.40	0.65	0.50
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/06/2024	26/06/2024	26/06/2024	27/06/2024	27/06/2024	27/06/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m						
Moisture Content	DETSC 1004	0.1	%						
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg						
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg						
Cadmium	DETSC 2301#	0.1	mg/kg						
Chromium	DETSC 2301#	0.15	mg/kg						
Chromium III	DETSC 2301*	0.15	mg/kg						
Chromium, Hexavalent	DETSC 2204*	1	mg/kg						
Copper	DETSC 2301#	0.2	mg/kg						
Lead	DETSC 2301#	0.3	mg/kg						
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg						
Nickel	DETSC 2301#	1	mg/kg						
Selenium	DETSC 2301#	0.5	mg/kg						
Vanadium	DETSC 2301#	0.8	mg/kg						
Zinc	DETSC 2301#	1	mg/kg						
Inorganics									
pH	DETSC 2008#		pH	6.7	6.2	6.3	6.4	5.6	6.0
Total Organic Carbon	DETSC 2084#	0.5	%						
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	< 10	< 10	< 10	< 10	< 10	< 10
Petroleum Hydrocarbons									
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg						
EPH (C10-C12)	DETSC 3311	10	mg/kg						
EPH (C12-C16)	DETSC 3311	10	mg/kg						
EPH (C16-C21)	DETSC 3311	10	mg/kg						
EPH (C21-C35)	DETSC 3311	10	mg/kg						
EPH (C35-C40)	DETSC 3311	10	mg/kg						
EPH (C10-C40)	DETSC 3311#	10	mg/kg						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg						
Acenaphthylene	DETSC 3303#	0.03	mg/kg						
Acenaphthene	DETSC 3303#	0.03	mg/kg						
Fluorene	DETSC 3303	0.03	mg/kg						
Phenanthrene	DETSC 3303#	0.03	mg/kg						
Anthracene	DETSC 3303	0.03	mg/kg						
Fluoranthene	DETSC 3303#	0.03	mg/kg						
Pyrene	DETSC 3303#	0.03	mg/kg						
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg						

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

	Lab No	2358854	2358855	2358856	2358857	2358858	2358859
	Sample ID ~	TP09	TP10	TP12	TP15	TP16	TP17
	Depth ~	0.65	1.00	0.70	0.40	0.65	0.50
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/06/2024	26/06/2024	26/06/2024	27/06/2024	27/06/2024	27/06/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Chrysene	DETSC 3303	0.03	mg/kg						
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg						
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg						
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg						
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg						
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg						
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg						
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg						
PCBs									
PCB 28 + PCB 31	DETSC 3401#	0.01	mg/kg				< 0.01		
PCB 52	DETSC 3401#	0.01	mg/kg				< 0.01		
PCB 101	DETSC 3401#	0.01	mg/kg				< 0.01		
PCB 118	DETSC 3401#	0.01	mg/kg				< 0.01		
PCB 153	DETSC 3401#	0.01	mg/kg				< 0.01		
PCB 138	DETSC 3401#	0.01	mg/kg				< 0.01		
PCB 180	DETSC 3401#	0.01	mg/kg				< 0.01		
PCB 7 Total	DETSC 3401#	0.01	mg/kg				< 0.01		
Acid Herbicides									
Mecoprop	DETSC 3447	35	ug/kg						
2,4-D	DETSC 3447	35	ug/kg						
Bentazone	DETSC 3447	35	ug/kg						
Picloram	DETSC 3447	35	ug/kg						
MCPA	DETSC 3447	35	ug/kg						
Clopyralid	DETSC 3447	35	ug/kg						
Dicamba	DETSC 3447	35	ug/kg						
2,3,6-TBA	DETSC 3447	35	ug/kg						
Dichlorprop	DETSC 3447	35	ug/kg						
Bromoxynil	DETSC 3447	35	ug/kg						
Triclopyr	DETSC 3447	35	ug/kg						
Fenoprop	DETSC 3447	35	ug/kg						
MCPB	DETSC 3447*	35	ug/kg						
2,4,5-T	DETSC 3447	35	ug/kg						
Fluroxypyr	DETSC 3447	35	ug/kg						
2,4-DB	DETSC 3447	35	ug/kg						
Ioxynil	DETSC 3447	35	ug/kg						
Benazolin	DETSC 3447	35	ug/kg						
PCP	DETSC 3447*	35	ug/kg						

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

	Lab No	2358860	2358861	2358876
	Sample ID ~	TP19	TP22	TP06
	Depth ~	1.00	1.20	0.60
	Other ID ~			
	Sample Type ~	SOIL	SOIL	SOIL
	Sampling Date ~	27/06/2024	27/06/2024	26/06/2024
	Sampling Time ~	n/s	n/s	n/s

Test	Method	LOD	Units			
Preparation						
Stones >10mm	DETSC 1003*	1	% m/m			12
Moisture Content	DETSC 1004	0.1	%			11
Metals						
Arsenic	DETSC 2301#	0.2	mg/kg			2.2
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg			< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg			< 0.1
Chromium	DETSC 2301#	0.15	mg/kg			10
Chromium III	DETSC 2301*	0.15	mg/kg			10
Chromium, Hexavalent	DETSC 2204*	1	mg/kg			< 1.0
Copper	DETSC 2301#	0.2	mg/kg			4.9
Lead	DETSC 2301#	0.3	mg/kg			8.3
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l			< 10
Mercury	DETSC 2325#	0.05	mg/kg			< 0.05
Nickel	DETSC 2301#	1	mg/kg			7.1
Selenium	DETSC 2301#	0.5	mg/kg			< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg			13
Zinc	DETSC 2301#	1	mg/kg			30
Inorganics						
pH	DETSC 2008#		pH	6.2	6.8	7.1
Total Organic Carbon	DETSC 2084#	0.5	%			< 0.5
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l			2.4
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l			5.2
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	< 10	< 10	< 10
Petroleum Hydrocarbons						
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg			< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg			< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg			< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg			< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg			< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg			< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg			< 10
PAHs						
Naphthalene	DETSC 3303#	0.03	mg/kg			< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg			< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg			< 0.03
Fluorene	DETSC 3303	0.03	mg/kg			< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg			< 0.03
Anthracene	DETSC 3303	0.03	mg/kg			< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg			< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg			< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg			< 0.03

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

			Lab No	2358860	2358861	2358876
			Sample ID ~	TP19	TP22	TP06
			Depth ~	1.00	1.20	0.60
			Other ID ~			
			Sample Type ~	SOIL	SOIL	SOIL
			Sampling Date ~	27/06/2024	27/06/2024	26/06/2024
			Sampling Time ~	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**			
Chrysene	DETSC 3303	0.03	mg/kg			< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg			< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg			< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg			< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg			< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg			< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg			< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg			< 0.10
PCBs						
PCB 28 + PCB 31	DETSC 3401#	0.01	mg/kg			
PCB 52	DETSC 3401#	0.01	mg/kg			
PCB 101	DETSC 3401#	0.01	mg/kg			
PCB 118	DETSC 3401#	0.01	mg/kg			
PCB 153	DETSC 3401#	0.01	mg/kg			
PCB 138	DETSC 3401#	0.01	mg/kg			
PCB 180	DETSC 3401#	0.01	mg/kg			
PCB 7 Total	DETSC 3401#	0.01	mg/kg			
Acid Herbicides						
Mecoprop	DETSC 3447	35	ug/kg			
2,4-D	DETSC 3447	35	ug/kg			
Bentazone	DETSC 3447	35	ug/kg			
Picloram	DETSC 3447	35	ug/kg			
MCPA	DETSC 3447	35	ug/kg			
Clopyralid	DETSC 3447	35	ug/kg			
Dicamba	DETSC 3447	35	ug/kg			
2,3,6-TBA	DETSC 3447	35	ug/kg			
Dichlorprop	DETSC 3447	35	ug/kg			
Bromoxynil	DETSC 3447	35	ug/kg			
Triclopyr	DETSC 3447	35	ug/kg			
Fenoprop	DETSC 3447	35	ug/kg			
MCPB	DETSC 3447*	35	ug/kg			
2,4,5-T	DETSC 3447	35	ug/kg			
Fluroxypyr	DETSC 3447	35	ug/kg			
2,4-DB	DETSC 3447	35	ug/kg			
Ioxynil	DETSC 3447	35	ug/kg			
Benazolin	DETSC 3447	35	ug/kg			
PCP	DETSC 3447*	35	ug/kg			

Summary of Asbestos Analysis
Soil Samples

Our Ref 24-13511
Client Ref ~ 5080
Contract Title ~ Roslyn Avenue, Netherton

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2358830	TP24 0.10	SOIL	NAD	none	Josh Best
2358831	TP22 0.10	SOIL	NAD	none	Josh Best
2358832	TP19 0.10	SOIL	NAD	none	Josh Best
2358834	TP17 0.10	SOIL	NAD	none	Josh Best
2358835	TP16 0.10	SOIL	NAD	none	Josh Best
2358836	TP15 0.10	SOIL	NAD	none	Josh Best
2358837	TP14 0.10	SOIL	NAD	none	Josh Best
2358838	TP12 0.10	SOIL	NAD	none	Josh Best
2358839	TP10 0.10	SOIL	NAD	none	Josh Best
2358840	TP09 0.10	SOIL	NAD	none	Josh Best
2358842	TP07 0.10	SOIL	NAD	none	Josh Best
2358843	TP06 0.10	SOIL	NAD	none	Josh Best
2358844	TP05 0.10	SOIL	NAD	none	Josh Best
2358845	TP03 0.10	SOIL	NAD	none	Josh Best
2358847	TP01 0.10	SOIL	NAD	none	Josh Best
2358876	TP06 0.60	SOIL	NAD	none	Josh Best

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 24-13511
Client Ref ~ 5080
Contract ~ Roslyn Avenue, Netherton

Containers Received & Deviating Samples

Lab No	Sample ID ~	Date Sampled ~	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2358830	TP24 0.10 SOIL	27/06/24	GJ 250ml, PT 1L		
2358831	TP22 0.10 SOIL	27/06/24	GJ 250ml, PT 1L		
2358832	TP19 0.10 SOIL	27/06/24	GJ 250ml, PT 1L		
2358833	TP18 0.10 SOIL	27/06/24	GJ 250ml, GJ 60ml, PT 1L		
2358834	TP17 0.10 SOIL	27/06/24	GJ 250ml, PT 1L		
2358835	TP16 0.10 SOIL	27/06/24	GJ 250ml, PT 1L		
2358836	TP15 0.10 SOIL	27/06/24	GJ 250ml, GJ 60ml, PT 1L		
2358837	TP14 0.10 SOIL	26/06/24	GJ 250ml, GJ 60ml, PT 1L		
2358838	TP12 0.10 SOIL	26/06/24	GJ 250ml, PT 1L		
2358839	TP10 0.10 SOIL	26/06/24	GJ 250ml, PT 1L		
2358840	TP09 0.10 SOIL	26/06/24	GJ 250ml, PT 1L		
2358841	TP08 0.10 SOIL	26/06/24	GJ 250ml, GJ 60ml, PT 1L		
2358842	TP07 0.10 SOIL	26/06/24	GJ 250ml, PT 1L		
2358843	TP06 0.10 SOIL	26/06/24	GJ 250ml, GJ 60ml, PT 1L		
2358844	TP05 0.10 SOIL	26/06/24	GJ 250ml, PT 1L		
2358845	TP03 0.10 SOIL	26/06/24	GJ 250ml, PT 1L		
2358846	TP02 0.10 SOIL	26/06/24	GJ 250ml, GJ 60ml, PT 1L		
2358847	TP01 0.10 SOIL	26/06/24	GJ 250ml, PT 1L		
2358848	TP01 0.50 SOIL	26/06/24	PT 1L		
2358849	TP02 0.70 SOIL	26/06/24	PT 1L		
2358850	TP04 0.80 SOIL	26/06/24	PT 1L		
2358851	TP05 0.60 SOIL	26/06/24	PT 1L		
2358852	TP07 0.60 SOIL	26/06/24	PT 1L		
2358853	TP08 0.80 SOIL	26/06/24	PT 1L		
2358854	TP09 0.65 SOIL	26/06/24	PT 1L		
2358855	TP10 1.00 SOIL	26/06/24	PT 1L		
2358856	TP12 0.70 SOIL	26/06/24	PT 1L		
2358857	TP15 0.40 SOIL	27/06/24	GJ 250ml, PT 1L		
2358858	TP16 0.65 SOIL	27/06/24	PT 1L		
2358859	TP17 0.50 SOIL	27/06/24	PT 1L		
2358860	TP19 1.00 SOIL	27/06/24	PT 1L		
2358861	TP22 1.20 SOIL	27/06/24	PT 1L		
2358876	TP06 0.60 SOIL	26/06/24	GJ 250ml, PT 1L		BTEX / C5-C10

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Information in Support of the Analytical Results

Our Ref 24-13511
Client Ref ~ 5080
Contract ~ Roslyn Avenue, Netherton

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.
Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.
The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Information in Support of the Analytical Results

Our Ref 24-13511
Client Ref ~ 5080
Contract ~ Roslyn Avenue, Netherton

Key:

~ Sample details are provided by the client and can affect the validity of the results
***** -not accredited.
# -MCERTS (accreditation only applies if report carries the MCERTS logo).
$ -subcontracted.
n/s -not supplied.
I/S -insufficient sample.
U/S -unsuitable sample.
t/f -to follow.
nd -not detected.

End of Report

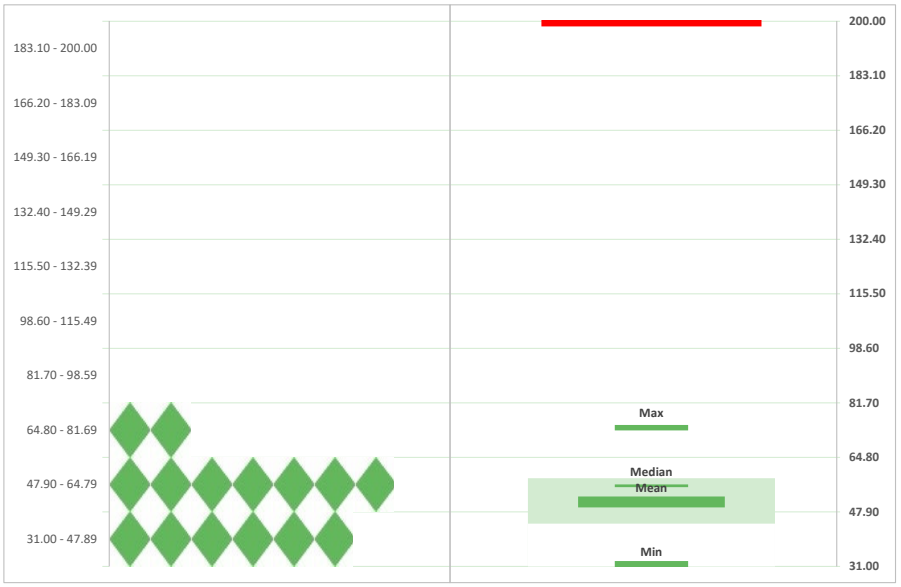
Roslyn Avenue, Netherton

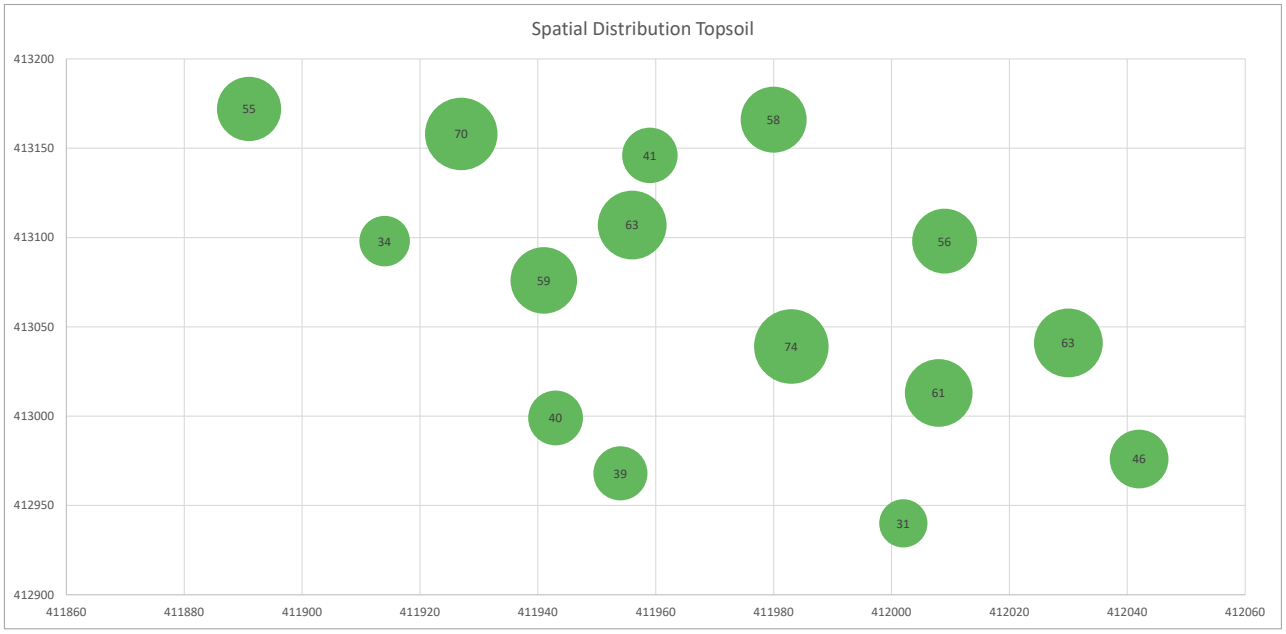
Job No: 5080
Engineer: LB
Date: 19 July 2024

Topsoil: Dataset for Pb - Dot & Box Plots and Summary Statistics

Determinant	Pb
Critical concentration	200.00
No. samples	15.00
Max	74.00
Mean	50.99
Min	31.00
Median	56.00
Standard Deviation	13.28
Standard Error	3.43
T value	2.14
Upper Confidence Level (95%)	58.35
Upper Confidence Level (80%)	55.61
Lower Confidence Level (5%)	44.27
Transform data	Normal

Upper Confidence Level for chart	95%





Spatial distribution can show sampling clusters based on ground type it **does not** identify areas of contamintion

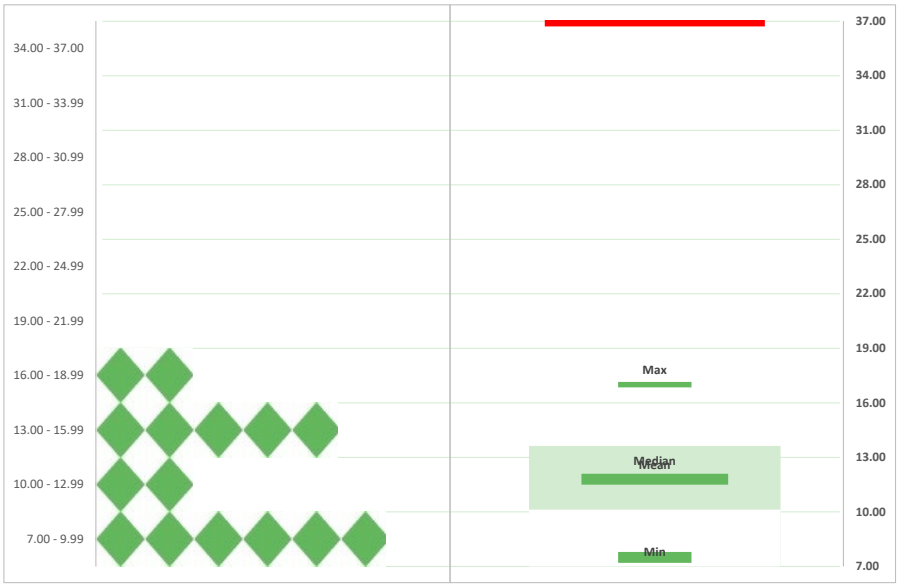
Roslyn Avenue, Netherton

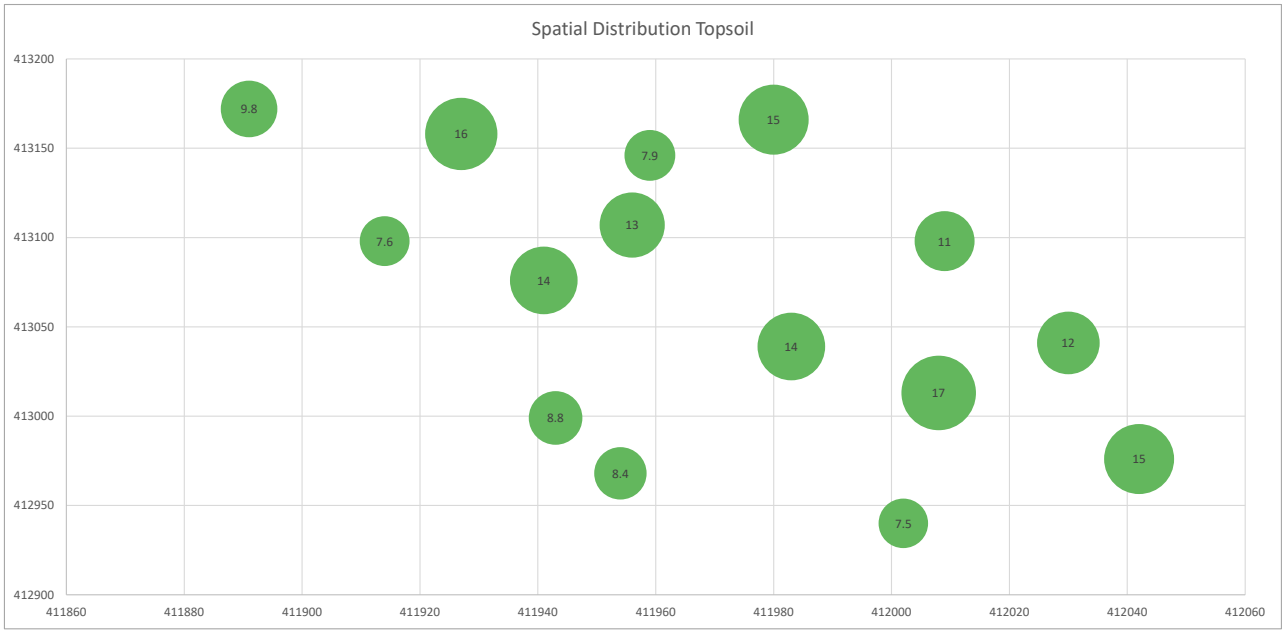
Job No: 5080
Engineer: LB
Date: 19 July 2024

Topsoil: Dataset for As - Dot & Box Plots and Summary Statistics

Determinant	As
Critical concentration	37.00
No. samples	15.00
Max	17.00
Mean	11.80
Min	7.50
Median	12.00
Standard Deviation	3.30
Standard Error	0.85
T value	2.14
Upper Confidence Level (95%)	13.63
Upper Confidence Level (80%)	12.95
Lower Confidence Level (5%)	10.13
Transform data	Normal

Upper Confidence Level for chart	95%





Spatial distribution can show sampling clusters based on ground type it **does not** identify areas of contamintion

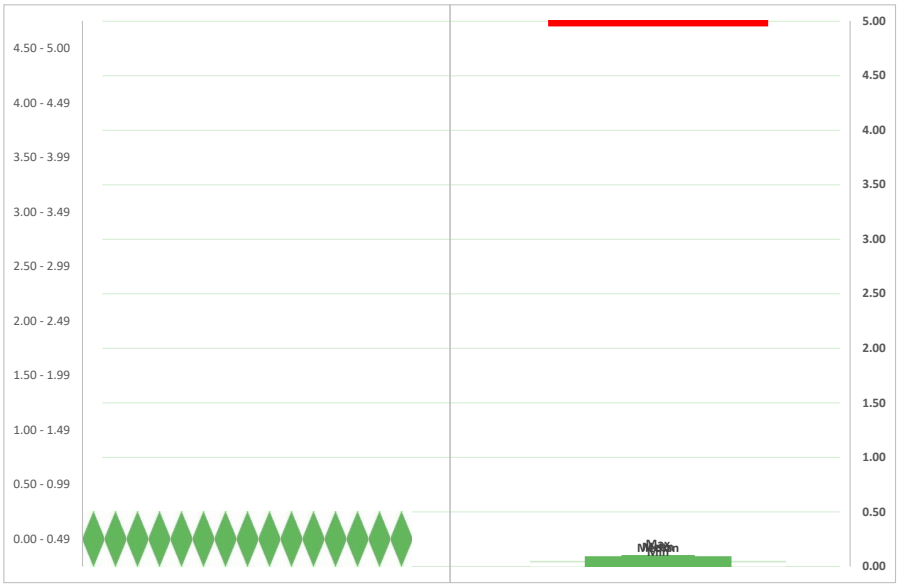
Roslyn Avenue, Netherton

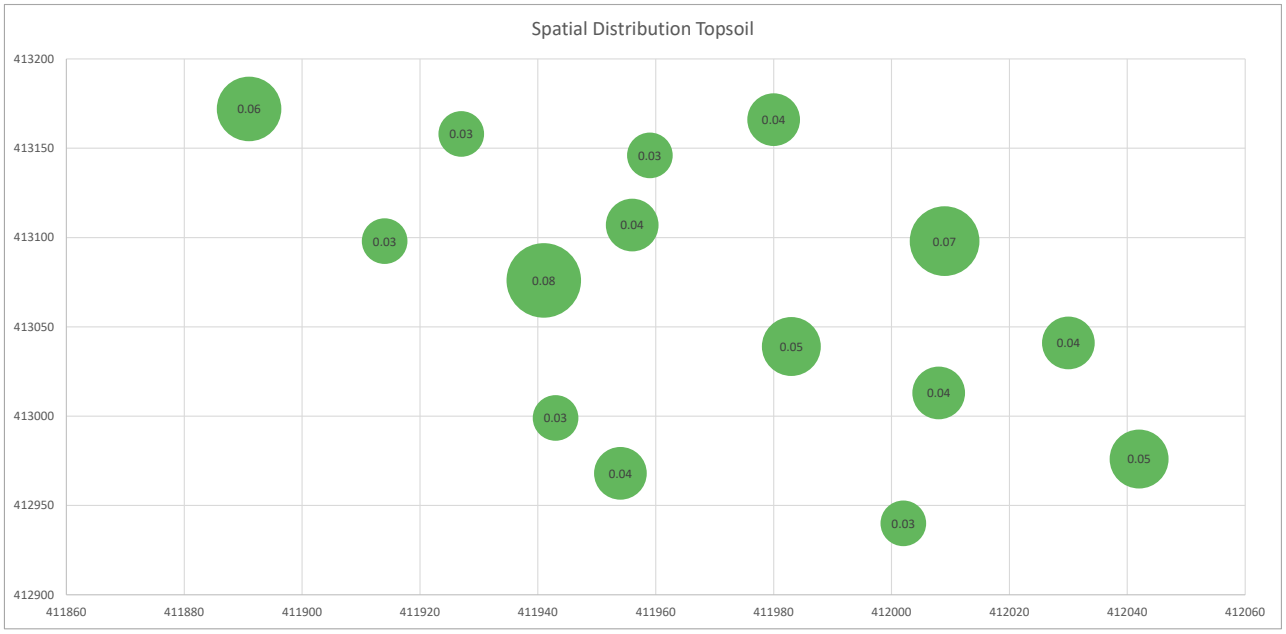
Job No: 5080
Engineer: LB
Date: 19 July 2024

Topsoil: Dataset for B(a)P - Dot & Box Plots and Summary Statistics

Determinant	B(a)P
Critical concentration	5.00
No. samples	15.00
Max	0.08
Mean	0.04
Min	0.03
Median	0.04
Standard Deviation	0.02
Standard Error	0.00
T value	2.14
Upper Confidence Level (95%)	0.05
Upper Confidence Level (80%)	0.05
Lower Confidence Level (5%)	0.04
Transform data	Normal

Upper Confidence Level for chart	95%





Spatial distribution can show sampling clusters based on ground type it **does not** identify areas of contamintion

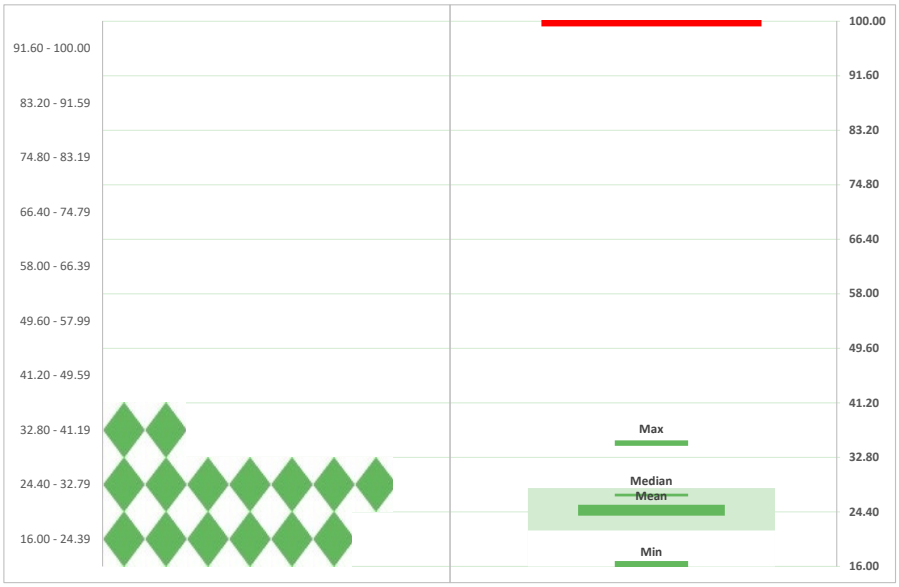
Roslyn Avenue, Netherton

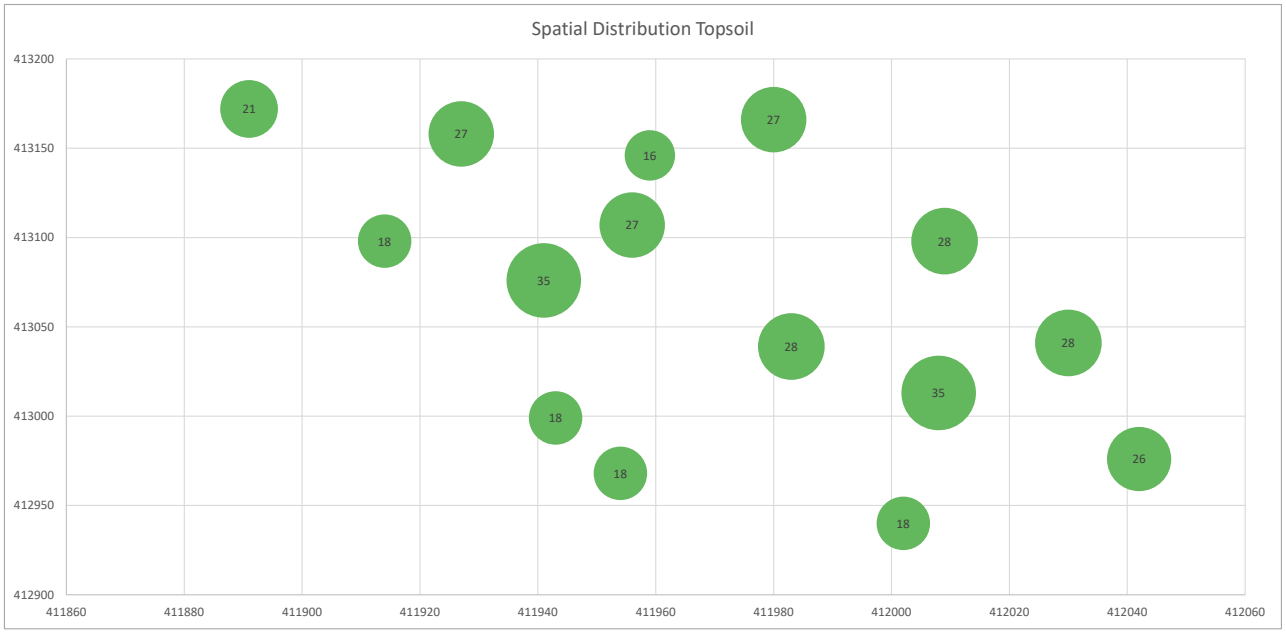
Job No: 5080
Engineer: LB
Date: 19 July 2024

Topsoil: Dataset for Cu - Dot & Box Plots and Summary Statistics

Determinant	Cu
Critical concentration	100.00
No. samples	15.00
Max	35.00
Mean	24.67
Min	16.00
Median	27.00
Standard Deviation	6.16
Standard Error	1.59
T value	2.14
Upper Confidence Level (95%)	28.08
Upper Confidence Level (80%)	26.81
Lower Confidence Level (5%)	21.55
Transform data	Normal

Upper Confidence Level for chart	95%





Spatial distribution can show sampling clusters based on ground type it **does not** identify areas of contamintion

Appendix I

Contaminated land assessment for selection of water supply pipes

The Risk assessment (RA)

Section 1: Development Details	
Development Name *(if it has one)*	Roslyn Avenue, Netherton
Development Address	Roslyn Avenue, Netherton, HD4 7EW
OS Grid Reference *(mid point)*	411979 413057
Developers Name	KCS Developments Ltd
Water Company reference number *(for UU use only)*	
Please provide details below of the current and historical use of the site and adjacent sites. *If your supporting information has details of the current and historical site use, please reference below the relevant sections of your report.*	
The site comprises a single parcel of agricultural land, consisting of tall grass used for silage. It has remained essentially undeveloped throughout history, with agriculture the only recorded use. See section 3 of report 5080/1.	

Section 2: Preliminary Risk Assessment	
Has your desk study and site walkover identified any land potentially affected by contamination?	☐ Yes ☒ No
If the site is potentially affected by contamination but you have not completed any intrusive site investigation please provide details below of the rationale behind the intended pipe selection. *If your supporting information has details of the rationale behind the intended pipe selection, please reference below the relevant sections of your report.*	
N/A	

Section 3: Intrusive Site Investigation	
Have you completed any intrusive site investigation?	☒ Yes ☐ No
Date(s) when the site investigation(s) undertaken	26th to 28th June 2024
At what level has groundwater been encountered?	☒ Not encountered
Table 1 (Pipeline Selection Risk Assessment Summary (PSRAS)) below classifies testing required where the preliminary risk assessment has identified land potentially affected by contamination. Please provide details below of any test groups which have not been tested and the rationale for not testing. *If your supporting information has details of the rationale behind not testing any particular test groups, please reference below the relevant sections of your report.*	
Preliminary Conceptual Site Model shows no plausible sources of contaminants in the PSRAS test group. Therefore, no testing for the majority of these contaminants has been undertaken.	

If the intrusive site investigation has identified concentrations above the PE threshold (see PSRAS) and your intended pipe selection is PE please provide details below of the rationale behind the intended pipe selection. *If your supporting information has details of the rationale behind the intended pipe selection, please reference below the relevant sections of your report.*
None identified above the PE threshold (PSRAS).

Section 4: Site Remediation	
Please provide details below of any site remediation (which may include a change in site levels) already completed. *If your supporting information has details of the site remediation already completed, please reference below the relevant sections of your report.*	
No significant changes in site levels anticipated at this stage.	
Has the PSRAS (Table 1) been completed using appropriate data after remediation?	☐ *Yes* ☐ *No* ☒ *N/A*
Please provide details below of any proposed site remediation and an analysis of whether this will affect your intended pipe selection. *If your supporting information has details of any proposed site remediation and whether this will affect your intended pipe selection, please reference below the relevant sections of your report.*	
No remediation anticipated. See section 11 of Report 5080/1 dated July 2024.	

Section 5: Final Use of Site	
Please provide details below of any chemicals (including fuel) to be stored on site and any other future contamination risks which may affect your intended pipe selection. *If your supporting information has details of potential contamination risks which may affect your intended pipe selection, please reference below the relevant sections of your report.*	
Not known at this stage, possible fuel storage within development compound.	
What water pipe materials are intended to be used on site?	☒ *PE* ☐ *PE Barrier Pipe Type A* ☐ *PE Barrier Pipe Type B* *Other (please specify):*

Section 6: Additional Information

Please use the section below to provide any additional details to support your intended pipe selection. *If your supporting information has additional information to support your intended pipe selection, please reference below the relevant sections of your report.*
Site is greenfield, with no significant made ground or elevated concentrations of contaminants identified.

Section 7: Risk Assessor	
Name and relevant qualifications of person directing the risk assessment for water pipes	L Barton (BSc, MGeol)
Name and address of risk assessor's company	Lithos Consulting, Wetherby, LS22 5DZ
Date risk assessment performed	24/07/2024

Section 8: Declaration			
I confirm I have completed this form and provided supporting information in accordance with 'UKWIR Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' and water company's Supplementary Guidance. I also confirm that if any further site investigation is needed and carried out, I will be required to submit an additional Risk Assessment for Water Pipes with the relevant supporting information. I understand that failure to supply any of the required information may delay my application being processed.			
Name	L Barton	Company	Lithos Consulting
Phone Number	01937 545 332	Date	24/07/2024

Table 1 - Pipe Selection Risk Assessment Summary (PSRAS)	
1) *Testing must be undertaken on the materials within which the pipes are to be laid, whether that be existing ground materials, remediated materials or imported capping materials. Please use the appropriate testing data to complete Table 1 below.* 2) *If more than one pipe selection is being made, for example, for pipes in different areas of a large site, a completed PSRAS is required for each selection.*	
What materials have been tested to populate Table 1 below?	☒ Existing ground materials ☐ Remediated materials ☐ Imported capping materials
At the time of investigation, the proposed route(s), and total length, of pipeline were unknown. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance was not undertaken. Sampling within 15m of proposed water supply pipes could be undertaken, once site preparatory works and infrastructure design have been completed. However, given the site's history and the relatively consistent ground conditions reported, the use of 'standard' polyethylene water supply pipes should be acceptable.	

All concentrations in mg/kg								
Test Group	**Testing Required?**	**PE threshold**	**Metal Pipes/ Barrier Pipe**	**Laboratory Detection Limit**	**Testing UKAS accredited Y/N**	**Maximum concentration at proposed pipeline depth** See Note [2]	**Maximum site concentration** See Note [3]	**Locations and depths where concentrations exceed proposed pipeline threshold**
Total VOCs	Where Preliminary Risk Assessment (PRA) has identified land potentially affected by contamination	0.5	Pass					
Total BTEX & MTBE		0.1	Pass					
Total SVOCs (excluding PAHs and those substances marked with an *)		2	Pass					
EC5-EC10 aliphatic and aromatic hydrocarbons		2	Pass					
EC10-EC16 aliphatic and aromatic hydrocarbons		10	Pass					
EC16-EC40 aliphatic and aromatic hydrocarbons		500	Pass					
Phenols* (from SVOC analysis)		2	Pass					
Cresols and chlorinated phenols* (from SVOC analysis)		2	Pass					
Ethers*	Only where identified	0.5	Pass					
Nitrobenzene*		0.5	Pass					
Ketones*		0.5	Pass					
Aldehydes*		0.5	Pass					
Amines		Fail	Pass					
Corrosive	Conductivity, Redox and pH	Pass	See Note [1]					

Note [1] Threshold: For wrapped steel, corrosive if pH<7 and conductivity > 400µS/cm. For wrapped ductile iron corrosive if pH<5, Eh not neutral and conductivity > 400µS/cm. For copper, corrosive if pH<5 or >8 and Eh positive.

Note [2] Water pipes are normally laid at 0.75-1.35m below finished ground level.

Note [3] Also state if liquid free product is present in soil or groundwater.

Appendix J

Geotechnical Test Results

LABORATORY REPORT

Contract Number: PSL24/4762

Report Date:	18 July 2024
Client's Reference:	5080
Client Name:	Lithos Consulting Parkhill Walton Road Wetherby North Yorkshire LS22 5DZ
For the attention of:	**Liam Barton**
Contract Title:	Roslyn Avenue
Date Received:	4/7/2024
Date Commenced:	4/7/2024
Date Completed:	18/7/2024
Notes:	**Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins (Managing Director)	R Berriman (Associate Director)	S Royle (Laboratory Manager)
L Knight (Assistant Laboratory Manager)	D Nicholson (Senior Technician)	T Watkins (Senior Technician)

5 – 7 Hexthorpe Road,
Hexthorpe,
Doncaster,
DN4 0AR
Tel: 01302 768098
Email: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP03	3	B	0.70		Brown very sandy silty GRAVEL.
TP03	2	B	0.20		Brown gravelly very silty SAND.
TP09	2	B	0.20		Brown gravelly very silty SAND.
TP16	2	B	0.20		Brown very gravelly very clayey SAND.
TP08	2	D	0.70		Brown gravelly SAND.
TP09	4	D	0.80		Brown gravelly SAND.
TP10	2	D	0.90		Brown gravelly SAND.
TP12	2	D	0.60		Brown gravelly SAND.
TP13	2	D	0.80		Brown gravelly SAND.
TP18	2	D	0.80		Brown gravelly SAND.
TP11	2	D&B	0.80		Brown very gravelly slightly silty SAND.
TP14	2	D&B	0.60		Brown very sandy clayey GRAVEL.
TP15	3	D&B	0.60		Brown clayey SAND and GRAVEL.
TP20	1	D&B	0.60		Brown very sandy very silty GRAVEL.
TP23	2	D&B	0.70		Brown very sandy silty very clayey GRAVEL.

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
TP03	3	B	0.70		9.3				NP			
TP08	2	D	0.70		14				NP			
TP09	4	D	0.80		8.5				NP			
TP10	2	D	0.90		11				NP			
TP12	2	D	0.60		12				NP			
TP13	2	D	0.80		8.1				NP			
TP18	2	D	0.80		12				NP			
TP11	2	D&B	0.80		10				NP			
TP14	2	D&B	0.60		9.2				NP			
TP15	3	D&B	0.60		14				NP			
TP20	1	D&B	0.60		16				NP			
TP23	2	D&B	0.70		15			30	19	11	71	Low Plasticity CL

SYMBOLS : NP : Non Plastic *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

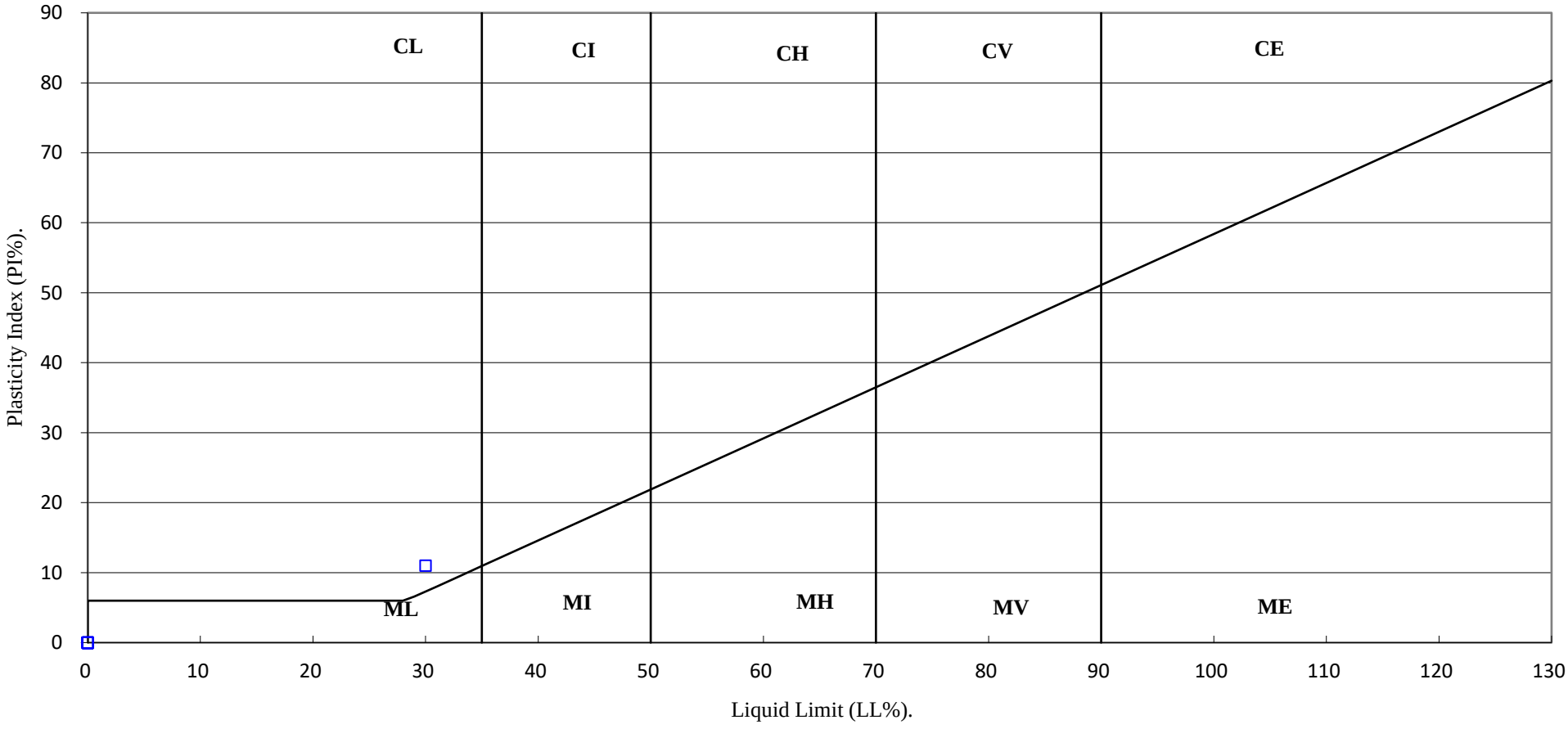
Contract No:

PSL24/4762

Client Ref:

5080

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043 / PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY	**Roslyn Avenue**	**Contract No:** **PSL24/4762** **Client Ref:** **5080**

PARTICLE SIZE DISTRIBUTION TEST

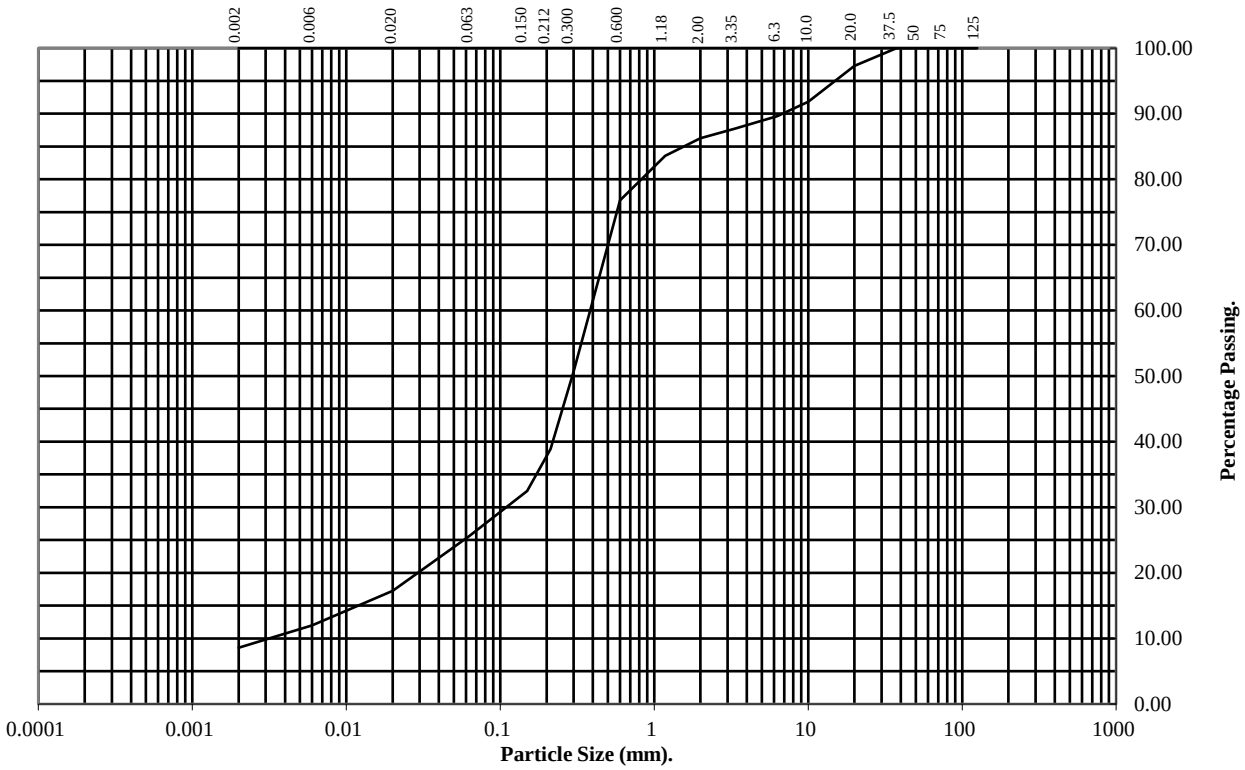
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: TP03 **Top Depth (m):** 0.20

Sample Number: 2 **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	100
20	97
10	92
6.3	90
3.35	88
2	86
1.18	84
0.6	77
0.3	51
0.212	39
0.15	32
0.063	26

Particle Diameter	Percentage Passing
0.02	17
0.006	12
0.002	9

Soil Fraction	Total Percentage
Cobbles	0
Gravel	14
Sand	60
Silt	17
Clay	9

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

Contract No: PSL24/4762

Client Ref: 5080

PARTICLE SIZE DISTRIBUTION TEST

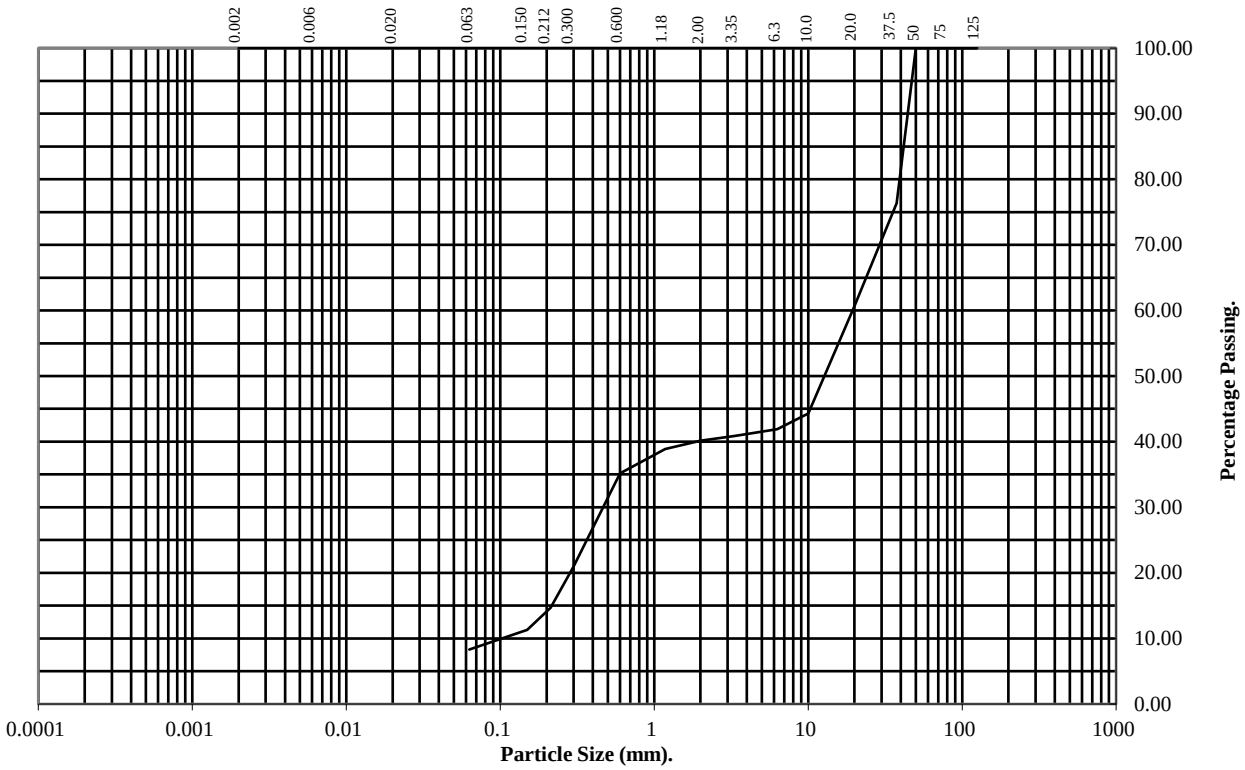
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP03** **Top Depth (m):** **0.70**

Sample Number: **3** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	76
20	61
10	44
6.3	42
3.35	41
2	40
1.18	39
0.6	35
0.3	21
0.212	15
0.15	11
0.063	8

Soil Fraction	Total Percentage
Cobbles	0
Gravel	60
Sand	32
Silt/Clay	8

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

Contract No: **PSL24/4762**

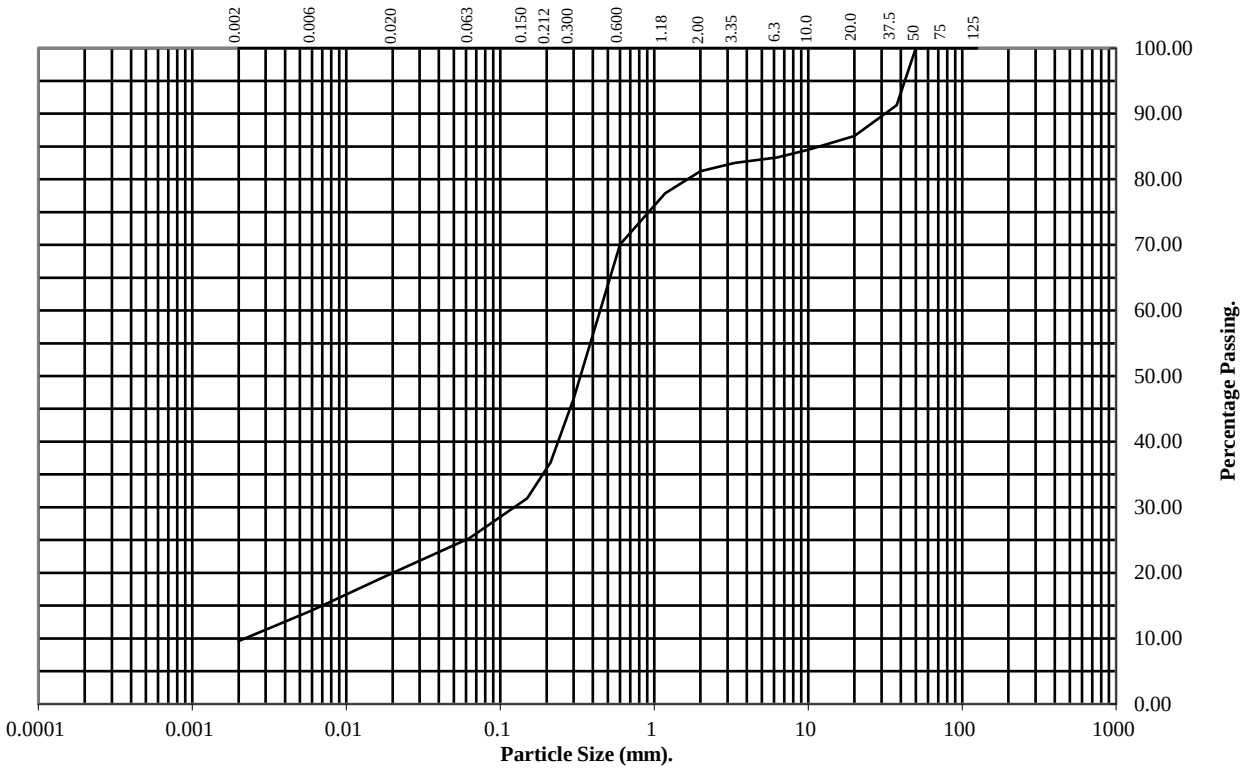
Client Ref: **5080**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number:	**TP09**	**Top Depth (m):**	**0.20**
Sample Number:	**2**	**Base Depth(m):**	
Sample Type:	**B**		



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	91
20	87
10	85
6.3	83
3.35	82
2	81
1.18	78
0.6	70
0.3	47
0.212	37
0.15	31
0.063	25

Particle Diameter	Percentage Passing
0.02	20
0.006	14
0.002	10

Soil Fraction	Total Percentage
Cobbles	0
Gravel	19
Sand	56
Silt	15
Clay	10

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

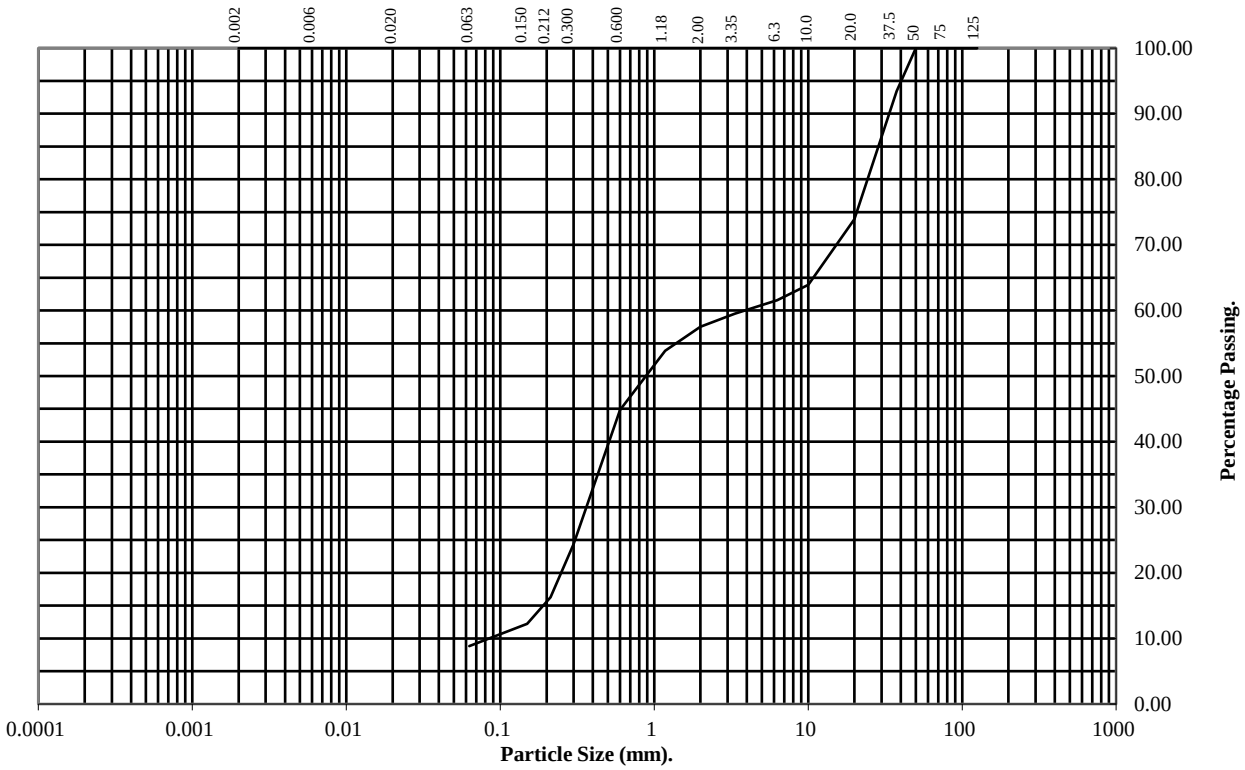
Contract No:
PSL24/4762
Client Ref:
5080

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**TP11**	**Top Depth (m):**	**0.80**
Sample Number:	**2**	**Base Depth(m):**	
Sample Type:	**D&B**		



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	93
20	74
10	64
6.3	62
3.35	60
2	58
1.18	54
0.6	45
0.3	24
0.212	16
0.15	12
0.063	9

Soil Fraction	Total Percentage
Cobbles	0
Gravel	42
Sand	49
Silt/Clay	9

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

Contract No:
PSL24/4762
Client Ref:
5080

PARTICLE SIZE DISTRIBUTION TEST

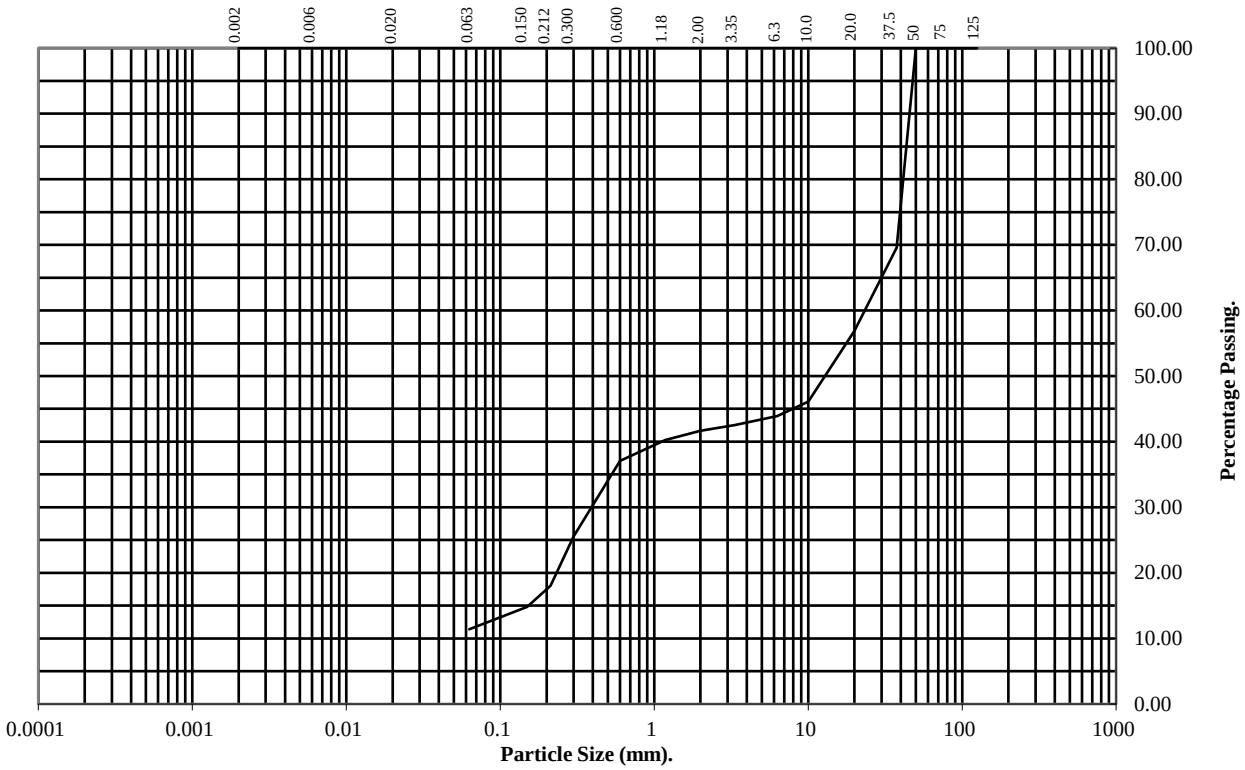
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP14** **Top Depth (m):** **0.60**

Sample Number: **2** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	70
20	57
10	46
6.3	44
3.35	43
2	42
1.18	40
0.6	37
0.3	26
0.212	18
0.15	15
0.063	11

Soil Fraction	Total Percentage
Cobbles	0
Gravel	58
Sand	31
Silt/Clay	11

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

Contract No: **PSL24/4762**

Client Ref: **5080**

PARTICLE SIZE DISTRIBUTION TEST

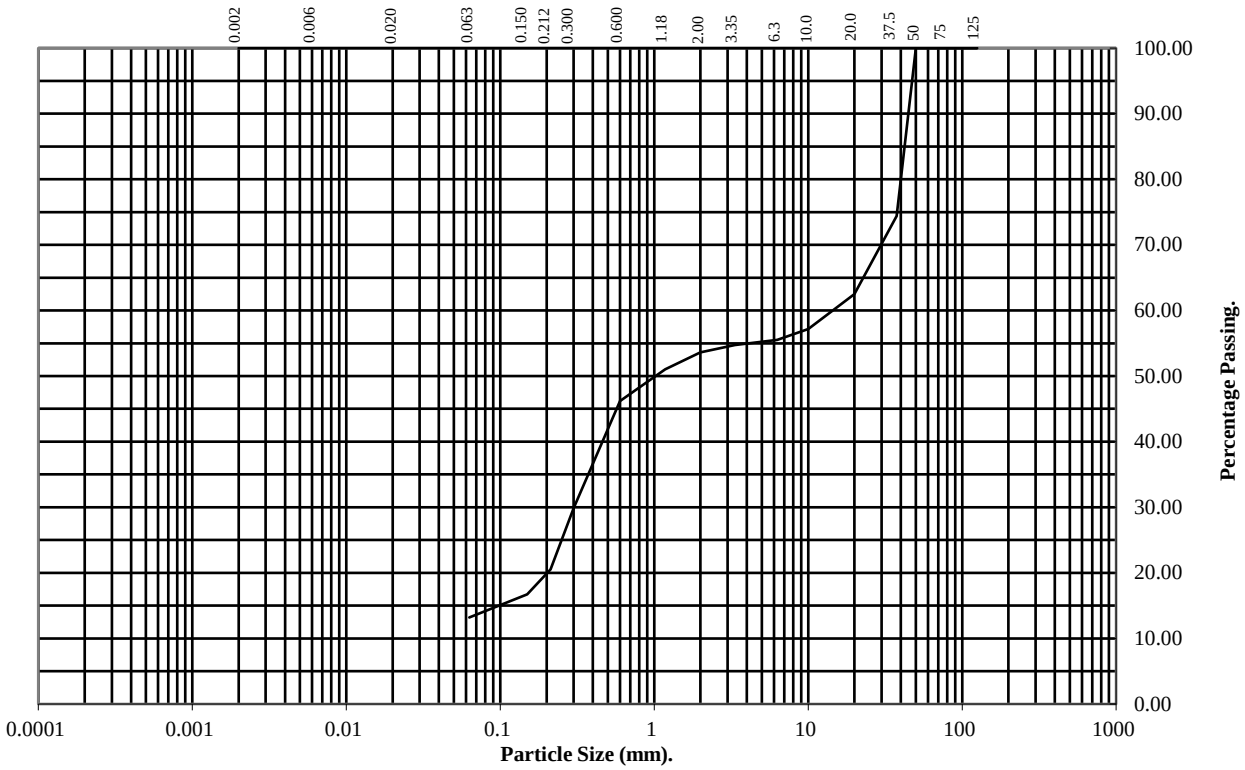
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP15** **Top Depth (m):** **0.60**

Sample Number: **3** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	74
20	62
10	57
6.3	55
3.35	55
2	54
1.18	51
0.6	46
0.3	30
0.212	21
0.15	17
0.063	13

Soil Fraction	Total Percentage
Cobbles	0
Gravel	46
Sand	41
Silt/Clay	13

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

Contract No: **PSL24/4762**

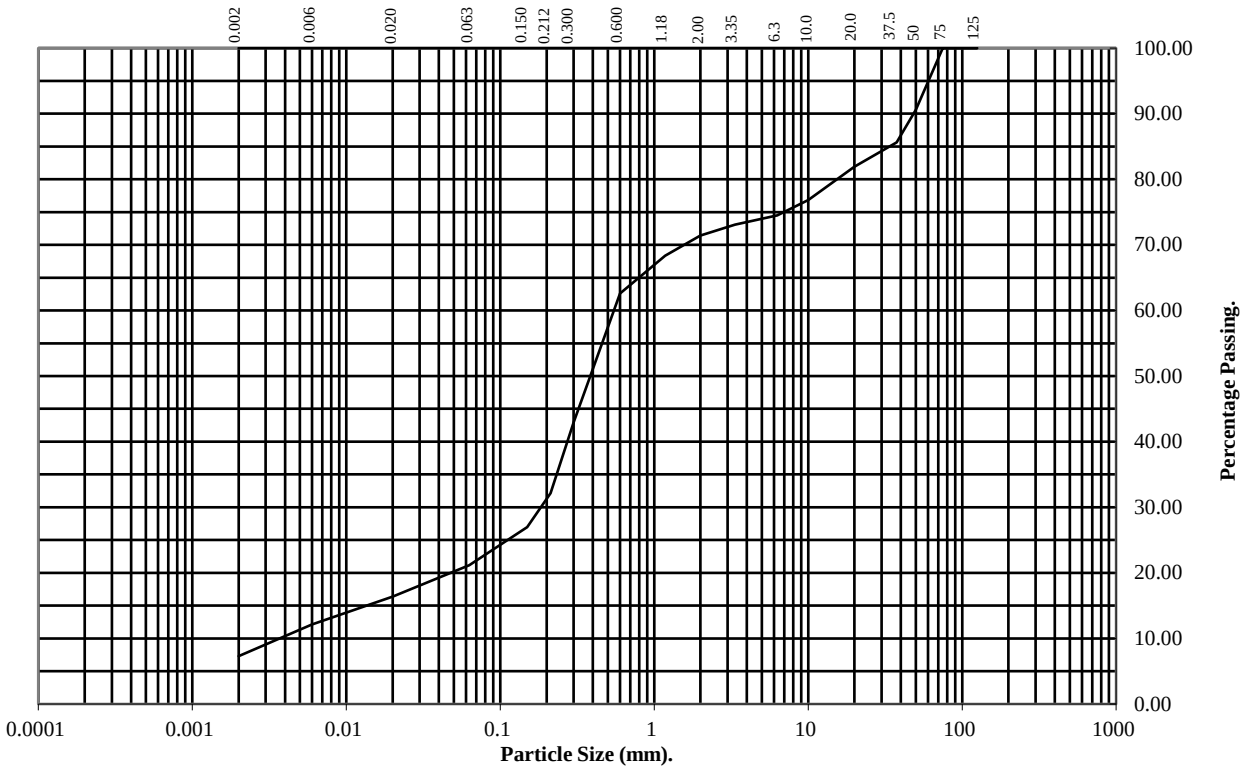
Client Ref: **5080**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number:	**TP16**	**Top Depth (m):**	**0.20**
Sample Number:	**2**	**Base Depth(m):**	
Sample Type:	**B**		



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	91
37.5	86
20	82
10	77
6.3	74
3.35	73
2	71
1.18	68
0.6	63
0.3	43
0.212	32
0.15	27
0.063	21

Particle Diameter	Percentage Passing
0.02	16
0.006	12
0.002	7

Soil Fraction	Total Percentage
Cobbles	9
Gravel	20
Sand	50
Silt	14
Clay	7

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

Contract No:
PSL24/4762
Client Ref:
5080

PARTICLE SIZE DISTRIBUTION TEST

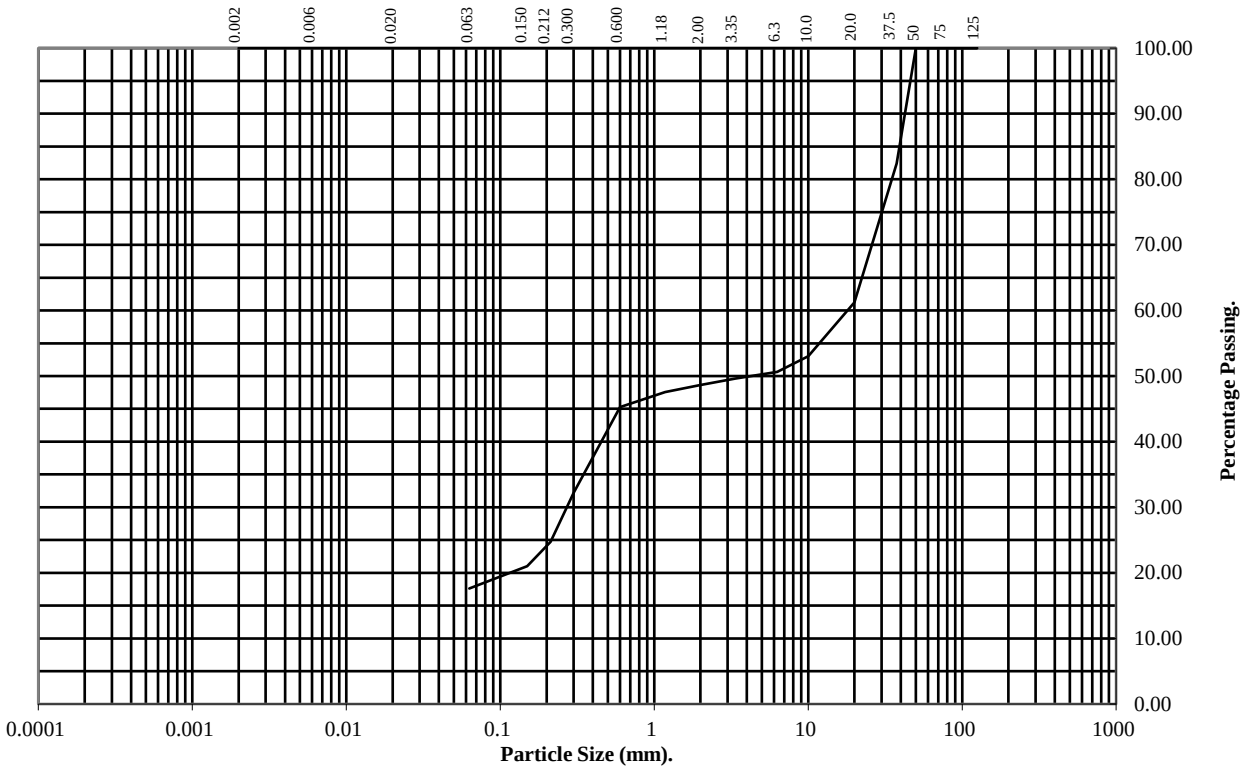
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP20** **Top Depth (m):** **0.60**

Sample Number: **1** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	82
20	61
10	53
6.3	51
3.35	50
2	49
1.18	48
0.6	45
0.3	32
0.212	25
0.15	21
0.063	18

Soil Fraction	Total Percentage
Cobbles	0
Gravel	51
Sand	31
Silt/Clay	18

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

Contract No: **PSL24/4762**

Client Ref: **5080**

PARTICLE SIZE DISTRIBUTION TEST

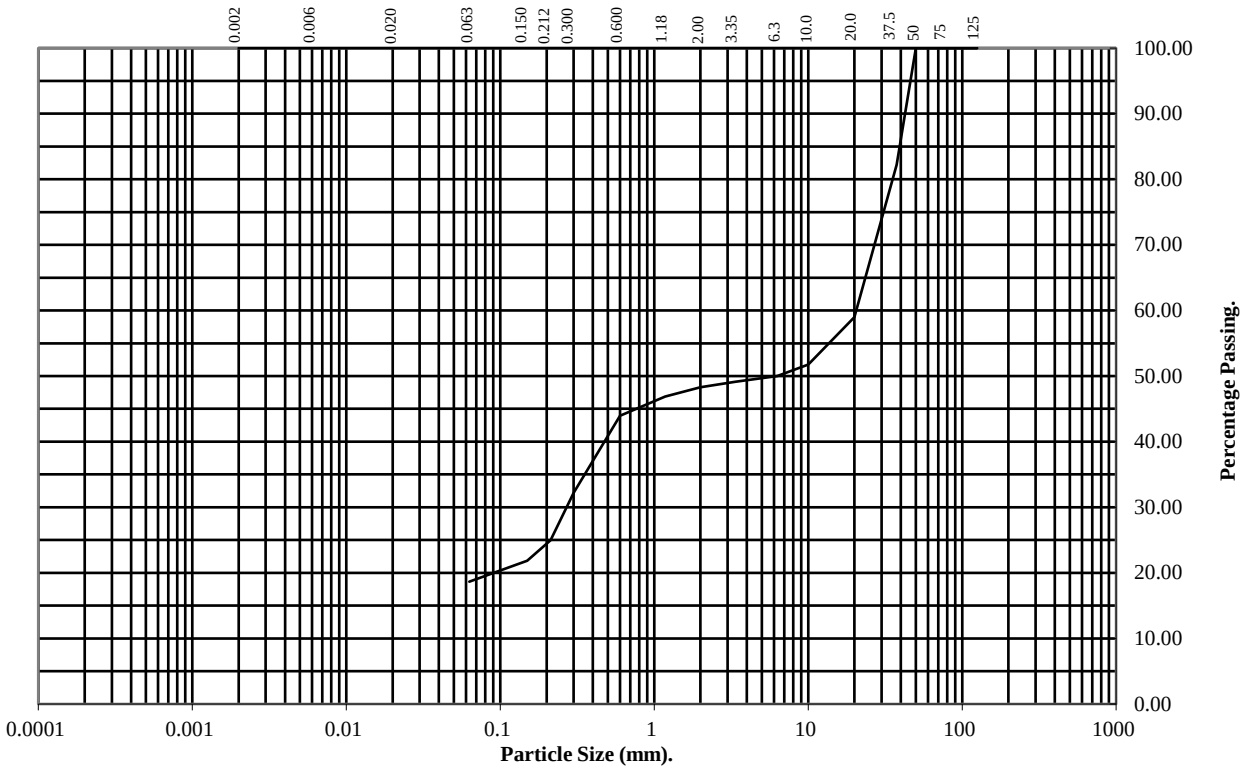
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP23 **Top Depth (m):** 0.70

Sample Number: 2 **Base Depth(m):**

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	82
20	59
10	52
6.3	50
3.35	49
2	48
1.18	47
0.6	44
0.3	32
0.212	25
0.15	22
0.063	19

Soil Fraction	Total Percentage
Cobbles	0
Gravel	52
Sand	29
Silt/Clay	19

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Roslyn Avenue

Contract No: PSL24/4762

Client Ref: 5080

Appendix K
Gas Monitoring Results

Visit 1											
Job Title:										**Job No:**	
Roslyn Avenue, Netherton										**5080**	
Client:										**Sheet :**	
KCS Developments Ltd										1 of 1	
Date:		**Arrival Time:**		**Depart Time:**		**Operator:**					
15/07/2024		12:00		13:30		Erin Waddilove					

Gas Monitoring Results:

Ambient Concentration (% Volume):	**CH_4:**	ND	**CO_2:**	ND	**O_2:**	20.4

Monitoring Point	**Groundwater level**	**Concentrations**					**Gas Flow Rates**			**Bottom of well**	**Remarks**
		Initial / Highest		**Steady concentrations**		**Lowest concn**	**Initial / Maximum**	**Steady**	**Time to fall from highest to steady**		
		CH_4	**CO_2**	**CH_4**	**CO_2**	**O_2**					
	(m) bgl	**% v/v**	**(%)**	**% v/v**	**(%)**	**(%)**	**litre/hr**	**litre/hr**	**secs**	**m**	
WS01	ND	ND	2.3	ND	2.3	17.8	ND	ND	30.0	0.80	
WS02	ND	ND	2.5	ND	2.5	17.7	ND	ND	30.0	1.22	
WS03	ND	ND	2.0	ND	2.0	17.2	ND	ND	30.0	1.54	
WS04	ND	ND	2.5	ND	2.5	18.1	ND	ND	30.0	1.18	
WS05	ND	ND	2.1	ND	2.1	17.6	ND	ND	30.0	1.03	
WS06	ND	ND	1.5	ND	1.5	18.5	ND	ND	30.0	1.71	
WS07	ND	ND	2.3	ND	2.3	17.4	ND	ND	30.0	1.23	
WS08	ND	ND	2.1	ND	2.1	18.0	ND	ND	30.0	1.38	
WS09	ND	ND	2.1	ND	2.1	18.2	2.8	ND	180.0	1.08	
WS10	ND	ND	4.3	ND	4.3	**15.0**	0.4	ND	90.0	1.23	

Equipment Used:	**Next Calibration Date**
Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	27/03/2025

Key

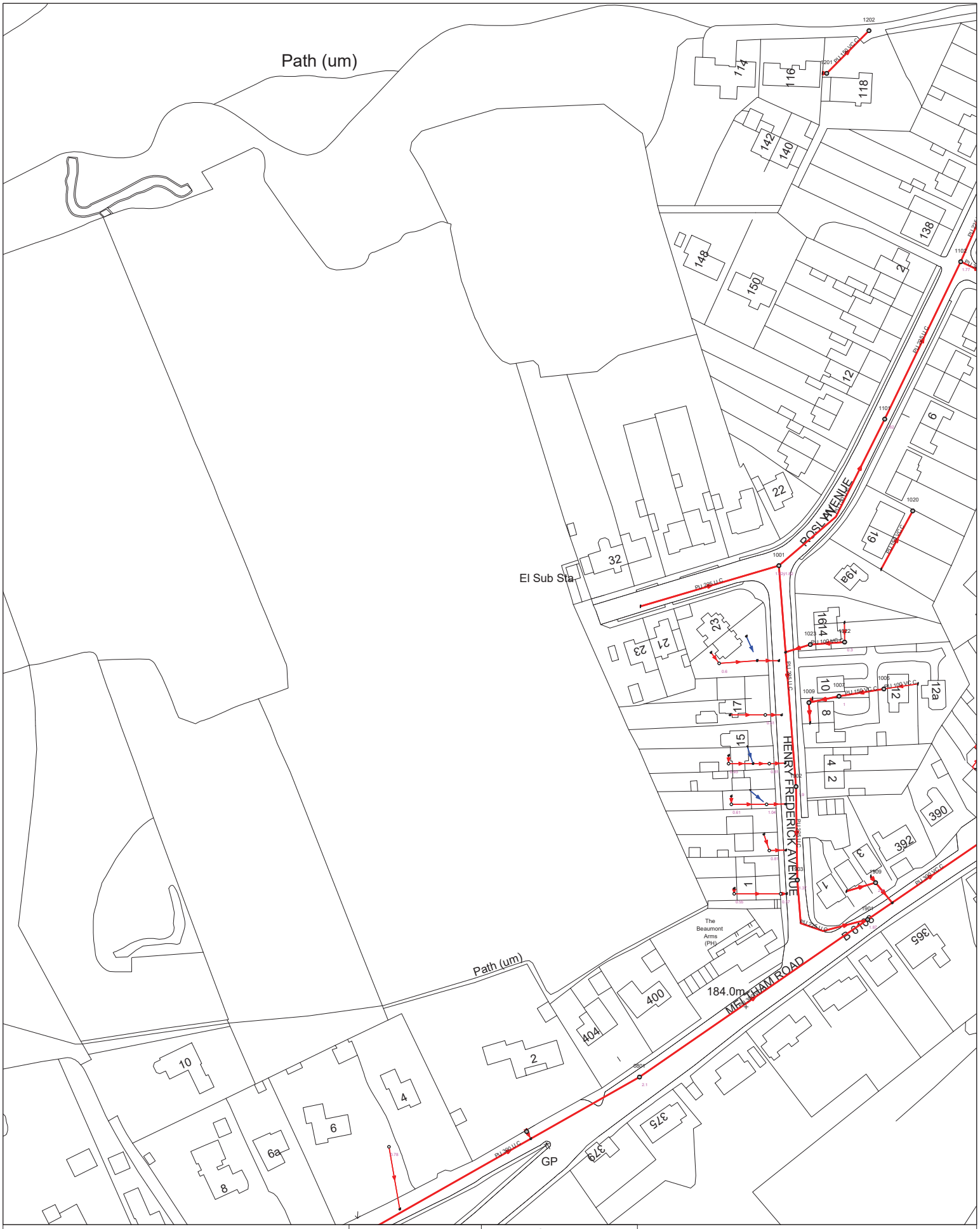
ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

	Site Data:			**Weather Station Data (Slaithwaite Station)**							**CH_4**	**CO_2**	**O_2**
	Temp (°C):	19 to 21		**Barometric Pressure Trend:**			Falling						
Time:	12:00	12:45	13:30	01:02	10:02	12:00	12:45	13:30	15:30	Trigger level 1	1.0	5.0	16.0
Pressure (mb):	985	984	981	1011	1009	1008	1008	1008	1007	Trigger level 2	5.0	10.0	10.0

Weather Conditions:	Sunny, warm, still, light cloud	
Surface Ground Conditions:	Dry	

Remarks:	Slaithwaite weather station located approxmately 3 miles west from the site (Roslyn Avenue, Netherton).

APPENDIX C



411889 : 412895	Map Name : SE1112NE	Title
Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : YorMap Advisor C ROBERTS Contact Tel : 87 2582		Notes
		Partial Key Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS
		This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.
		Date Req : 12/09/2023, 10:03:25 Date Gen : 12/09/2023, 10:03:42
		Source : Sewer Network Enquiry

UPN: Undefined Originator: C ROBERTS, YorMap, 87 2582

APPENDIX D

Notes

1. Do not scale from this drawing. All dimensions must be checked on site prior to the commencement of any fabrication or building works. Where applicable, dimensions and details are to be read in conjunction with specialist consultants' drawings and/or other specifications; any disparity is to be brought to the attention of the office & clarification sought before proceeding.

2. Any dimensions shown on this drawing are in (millimetres/metres)

Schedule of Accommodation

Roslyn Avenue, Netherton — 22.01.25

S106 Affordable Housing (20%)

Ref	Sq.ft	Bed	Storey	Number
T37	564	1	2	4
T37	652	1	2	4
T4	782	2	2	3
T7	983	3	2	3
T4	1119	4	2	2
Total				16

Open Market Housing

Ref	Sq.ft	Bed	Storey	Number
T37	564	1	2	3
T37	652	1	2	3
T4	782	2	2	3
T5	822	2	1	1
T10	1142	2	2.5	10
T8	970	3	2	9
T7	983	3	2	8
T14	1278	4	2	4
T16	1489	4	2	11
T19	1762	5	2	5
T21	2139	5	2	8
T22	2275	5	2	1
Total				66

Overall total	82

PLANNING LAYOUT KEY:

- SITE BOUNDARY
- 0.45m KNEE HIGH RAIL
- 0.9m METAL RAILINGS
- 1.8m TIMBER FENCE
- 1.8m TIMBER GATE
- 1.8m SCREEN WALL
- BIN STORAGE
- BIN COLLECTION POINT
- SHED POINT
- AFFORDABLE RENT
- AFFORDABLE INTERMEDIATE
- TARMAC PRIVATE DRIVE
- BLOCK PAVING - HIGHWAY
- BLOCK PAVING - DRIVES
- POS
- EXISTING TREES AND HEDGING

ALL PLOTS TO BE FITTED WITH AN ELECTRIC VEHICLE CHARGING POINT IN ACCORDANCE WITH PART S OF THE BUILDING REGULATIONS

REFER TO LANDT10APE MASTERPLAN FOR DETAILS OF PROPOSED LANDT10APING.

0 5 10 25 50m

1:500

Revisions

Harron Homes Limited
Unit 1 Cliffe Park
Bruntcliffe RT14d
Morley
Leeds
LS27 ORY

Tel: 0113 204 4670
Fax: 0113 204 4677
Web: www.harronhomes.co.uk

Status: Planning

Project:Roslyn Avenue, Netherton

Title: Site Layout

Drawn: KW/JFE Date:28.01.25

Checked:- Scale @ A1:1.500

Job no:652 Drg No:PL01 Rev:#

APPENDIX E

General Notes

1. Do not scale this drawing.
2. All dimensions are in millimeters unless stated otherwise.
3. This drawing is to be read in conjunction with all other relevant drawings & specifications.
4. All proprietary items to be installed in strict compliance with manufacturers instructions and recommendations.
5. No works shall commence on site until approval has been obtained from all relevant Agencies / Authorities.
6. All dimensions referred to in this drawing must be verified.

Key

- Site Boundary
- Section 104 - Sewer Easement
- Section 104 - Surface Water Sewer
- Section 104 - Surface Water Manhole
- Section 104 - Foul Water Sewer
- Section 104 - Foul Water Manhole
- Section 104 - Combined Water Sewer
- Section 104 - Combined Water Manhole
- Yorkshire Water Combined Water Sewer
- Yorkshire Water Combined Water Manhole

New combined water drainage to discharge to Yorkshire Water combined water sewer.

Hydrobrake flow control chamber restricting surface water runoff to a peak rate of **5.0l/s** for all storm events up to and including 1 in 100 year + 45% climate change storm event.

Attenuation storage within the piped network and attenuation tank to be between 1612m³ and 2387m³ for all storms up to and including 1 in 100 year + 45% climate change events.

rev	description	drawn	date
P03	Site layout plan updated. Foul and surface water drainage layout updated to suit.	SG	22.07.25
P02	Foul and surface water drainage layouts updated.	SG	24.02.25
P01	First Issue	SG	18.02.25

Status

ELSTON ENGINEERING

1 Chapel Farm Close, Elston, Newark, Nottinghamshire, NG23 5PW
W: www.elstonengineering.com
E: enquiries@elstonengineering.com
T: 07931 391372

client: HARRON HOMES

project: Land off Roslyn Avenue, Netherton, Huddersfield

drawing title: Foul and Surface Water Drainage Layout Plan

Drawing Number:		Drawn by:	Checked by:
EE100008-100		SG	SG
Project ref:	scale:	date:	original paper size:
EE100008	1:500	18.02.2025	A1

APPENDIX F

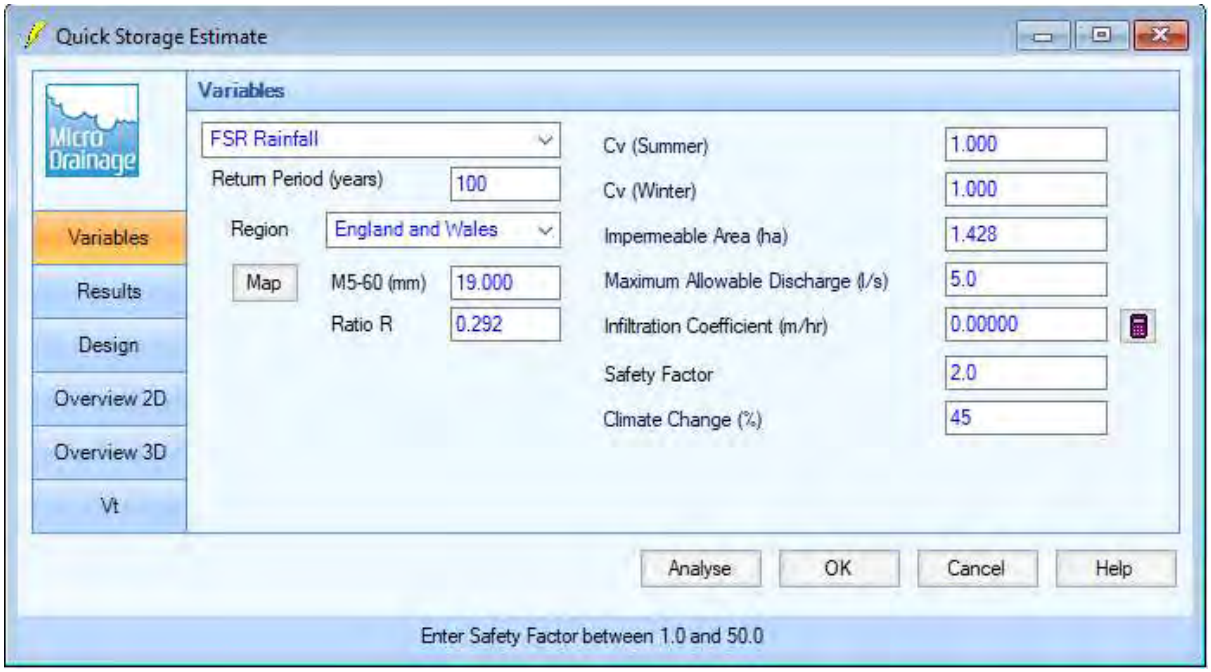


Figure 4 - XP Solutions Quick Storage Estimate – Input

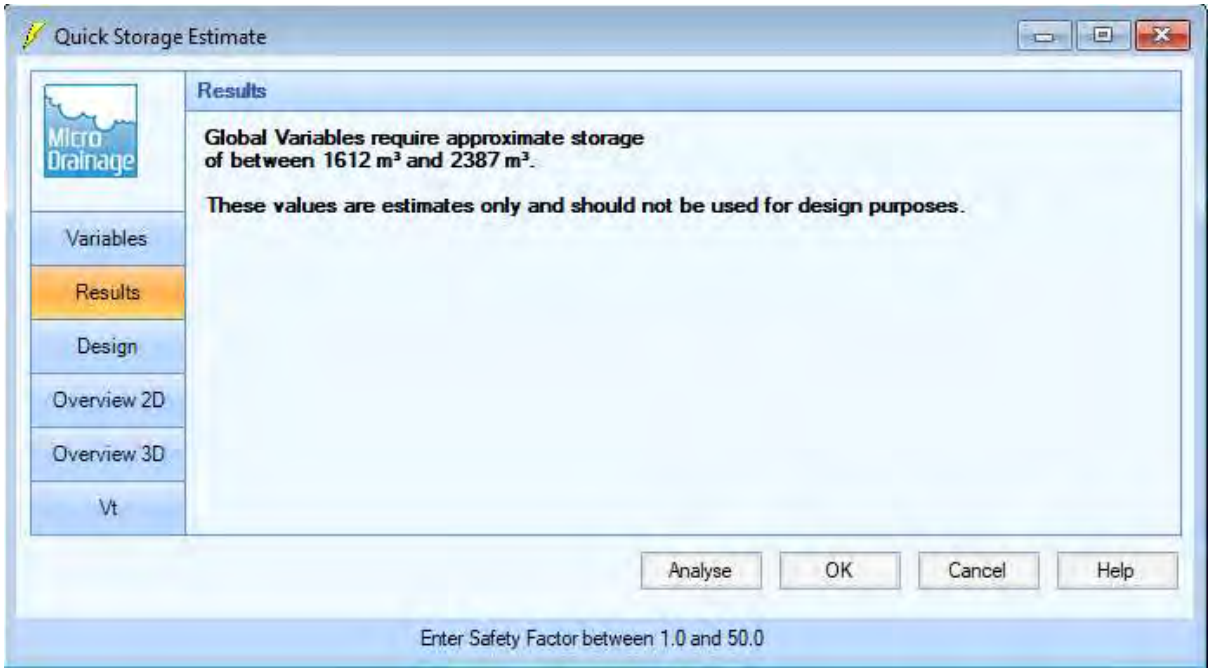


Figure 5 - XP Solutions Quick Storage Estimate - Output

APPENDIX G

Operation and Maintenance Requirements for Piped Drainage Network		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular	Inspection of manholes for debris and sediment build-up	Annually (and following poor performance)
	Cleaning of manhole chambers and removing any debris and sediment build-up.	Annually (and following poor performance)
Occasional Maintenance	Jetting of pipes between manholes to flush any debris and sediment build-up down the pipes. Debris and sediment build-up to be collected at the downstream manhole and removed from the piped network.	Three monthly (or as required)
Monitoring	Survey pipes for any signs of root ingress, cracking or collapse and undertake remedial work to replace pipe runs as necessary.	Every 5 years or as required following poor performance.

Operation and Maintenance Requirements for Trees		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets and outlets	Quarterly
Occasional Maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
	Water	As required (in periods of drought)
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

Operation and Maintenance Requirements for Attenuation Storage Tanks		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance).	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockages by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays.	Annually, or as required.
Remedial Actions	Repair/rehabilitate inlets, outlets, overflows and vents.	As required.
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of tank for sediment build-up and remove if necessary.	Every 5 years or as required.

Operation and Maintenance Requirements for Proprietary Treatment System (Gullies)		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Routine Maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation.	Six monthly
	Remove sediment, oil, grease and floatables.	As necessary - indicated by system inspections or immediately following significant spill.
Remedial Actions	Replace malfunctioning parts or structures.	As required.
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies.	Monthly during first half of operation, then six months.