GroundSolve Ltd
Consulting Geotechnical Engineers

JOINT ARCHIVE BUILDING – THEATRE CLWYD – PHASE I PRA AND PHASE II SI REPORT

GSL3455R01

VERSION 1

21 APRIL 2026

DRAFT

Prepared for: Wynne Construction Ltd

Prepared by: Alex Ridge

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This report has been prepared by GroundSolve Ltd with all reasonable care and diligence, within the best practice and guidance current at the time of issue within the proposed redline boundary and proposed Site end use as presented by the Client.

This report is confidential to the Client and GroundSolve Ltd accepts no responsibility whatsoever to third parties to whom this report is presented.

Version No.	Description of Issue / Revision	Date of Issue	Author	Reviewed By	Approved By
1	Draft for discussion	30/03/2026	Alex Ridge BSc (Hons) FGS	J Thorburn BSc FGS	Sam Fishburne BEng (Hons) MSc FGS CGeol RoGEP

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1 INTRODUCTION

GroundSolve Ltd (GSL) were commissioned by Wynne Construction to undertake a Land Contamination Risk Management (LCRM) Preliminary Risk Assessment and Site investigation for an area of land adjacent to the existing Theatre Clwyd, Mold (the “Site”).

This report has been devised to generally comply with the relevant principles and requirements of a range of guidance including:

- Part IIA of the Environment Protection Act, 1990
- National Planning Policy Framework
- BS5930:2015+A1:2020: “Code of practice for site investigations”
- BS10175: 2011 +A2:2017 “Investigation of Potentially Contaminated Sites - Code of Practice”
- The Building Regulations 2010. Part C (HM Government 2013)
- Environment Agency: Land Contamination Risk Management (LCRM), Version 3, October 2020;
- Environment Agency (2017) “The Environment Agency’s Approach to Groundwater Protection” November 2018 Version 1.2;

1.1 PROPOSED DEVELOPMENT

The proposed development of the site is understood to comprise:

- the removal from site or the treatment of any contaminated material encountered during ground investigation;
- the construction construct a steel frame building, which will be used as an archive facility.

The findings and conclusions of the risk assessments have been set out and recommendations given for the proposed light industrial units end use. If there is a subsequent change in the proposed land the risk assessments and conclusions should be reviewed to determine whether they are still applicable for the revised end use.

1.2 PREVIOUS REPORTS

No previous reports.

1.3 OBJECTIVES

Taking into account the proposed development of the Site, the objectives of this appraisal were:

1. To determine the historical and current land use.
2. To establish the environmental setting of the Site.
3. To evaluate whether past mining or other extractive industries could have an influence on the Site.
4. To review previous pertinent third party reports;

5. To determine likely ground and groundwater conditions.
6. To determine the potential risks to human health and the wider environment.
7. To determine potential risks posed to the Site from hazardous ground gases and / or vapours.
8. To derive a Preliminary Conceptual Site Model.

1.4 ASSUMPTIONS

The following assumptions are made in this report:

1. It is assumed that ground levels will not change significantly from those described in this report or a shown on proposed development drawings. If this is not the case, then amendments to the recommendations made in this report may be required.
2. Any references to observations of suspected asbestos-containing materials are for information only and should be verified by a suitably qualified asbestos specialist and/or confirmed by laboratory analysis.
3. The use of the term 'Topsoil' within this report is based on a visual identification only and that these materials have not necessarily been classified in accordance with BS3882:2015.
4. The comments and opinions presented in this report are based on the findings of the desk study performed by GroundSolve Ltd. There may be other conditions prevailing on the Site which have not been revealed by this investigation and which have not been taken into account by this report at this stage.
5. Responsibility cannot be accepted for any conditions not revealed by this investigation. Any diagram or opinion on the possible configuration of the findings is conjectural and given for guidance only. Confirmation of ground conditions should be undertaken if deemed necessary.
6. This report has been prepared for the sole use of the Client. No other third party may rely upon or reproduce the contents of this report without the written approval of GroundSolve Ltd. If any unauthorised third party comes into possession of this report, they rely on it entirely at their own risk.

2 SITE DETAILS AND DESCRIPTION

Table 2-1 – Current Site Overview

Site name	Joint Archive Building, Theatre Clwyd
Site Address	Theatr Clwyd, County Hall and Theatre Clwyd, Mold, Flintshire, CH7 1YA
National Grid Reference (NGR)	324192 365252
Approximate Site area	0.59
Site shape	Roughly rectangular
General topography and ground levels	The main part of the site is relatively flat with a fall from north (141.5m OD) to south (140.0m OD). There are relatively steeps slopes along the northern, eastern and southern boundaries. The northern boundary slopes from 141.5m OD to 138.25m OD to kerbside. The eastern boundary slopes from 141mOD to 137.5mOD. The southern boundary slopes from 138.2m OD to 136.2m OD.

A site investigation was undertaken on 2nd February 2026 to 10th February 2026. The locations of various features are detailed on Drawing No. DR001. Photographs of the site are presented in **Appendix B**.

Table 2-2 – Summary of Description of the Site and its Environs

Current Use:	The area is currently vacant land adjacent to the existing theatre building.
Access	Via asphalt roadway direct from the A5119 leads to the site.
Existing Buildings& Structures	There are no existing structures or buildings currently on the site.
Site Surface	The majority of the site surface comprises rough low vegetation. There is a small area of gravel surfacing at the NW corner of the site.
Vegetation	Comprises of 6No semi mature trees located at the southern end of the development area.
Storage Tanks	Below Ground Tanks: No evidence/none suspected. Above Ground Tanks: None present.
Services	A number of foul service covers were noted. BT cables are known to be located on the northern, eastern and southern boundaries. Utility survey indicates unknown service running on the western portion of the site.
Asbestos	No potential Asbestos Containing Materials (ACMs) noted in the buildings or on the ground surface.
Waste Disposal/ Materials Storage	No site material storage on the site.
Surrounding Area	The site is bounded immediately to the north by agricultural fields and bounded to the south and west by buildings associated with Theatre Clwyd. The site is bounded to the east by agricultural fields.
Local / Background Knowledge	The site has remained open land since circa 1872.

3 SITE HISTORY

3.1 SITE HISTORY REVIEW

Extracts of Ordnance Survey (OS) plans dated from 1872 were reviewed. These were obtained as part of the Groundsure Report for the Site, which is presented in **Appendix C**.

Table 3-1 below presents a summary of the main aspects of the Site relevant to the current and proposed future end uses. It is not the intention of this report to describe in detail all of the changes that have occurred on or adjacent to the Site, where these are not relevant to the land use.

Table 3-1 - Site History

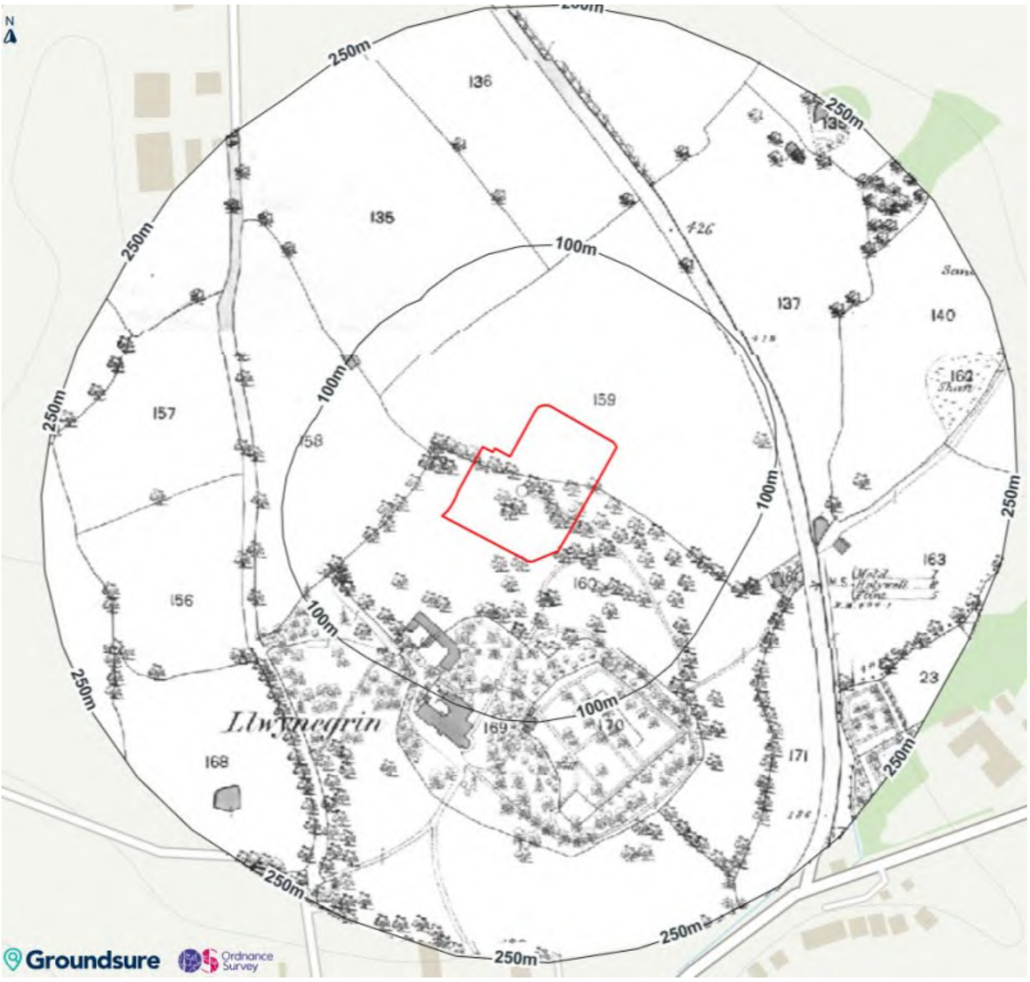
<table>
<tr><th>Time Period</th><th>On-Site features</th><th>Off-Site features</th></tr>
<tr><td rowspan="2">1872</td><td colspan="2">

Figure 3-1 - Historical OS Mapping (1872) 1:2,500</td></tr>
<tr><td>- The site is open agricultural land with a field boundary running west to east through the centre of the site. There is a small circular feature present in the centre of the site, which has an access track from SE boundary. The southern field</td><td>- Site is bounded to the north, east and west by open agricultural land
- Llwynegrin Hall comprising 2 No. buildings are present to the southwest. There are formal gardens present 100m to the south.</td></tr>
</table>

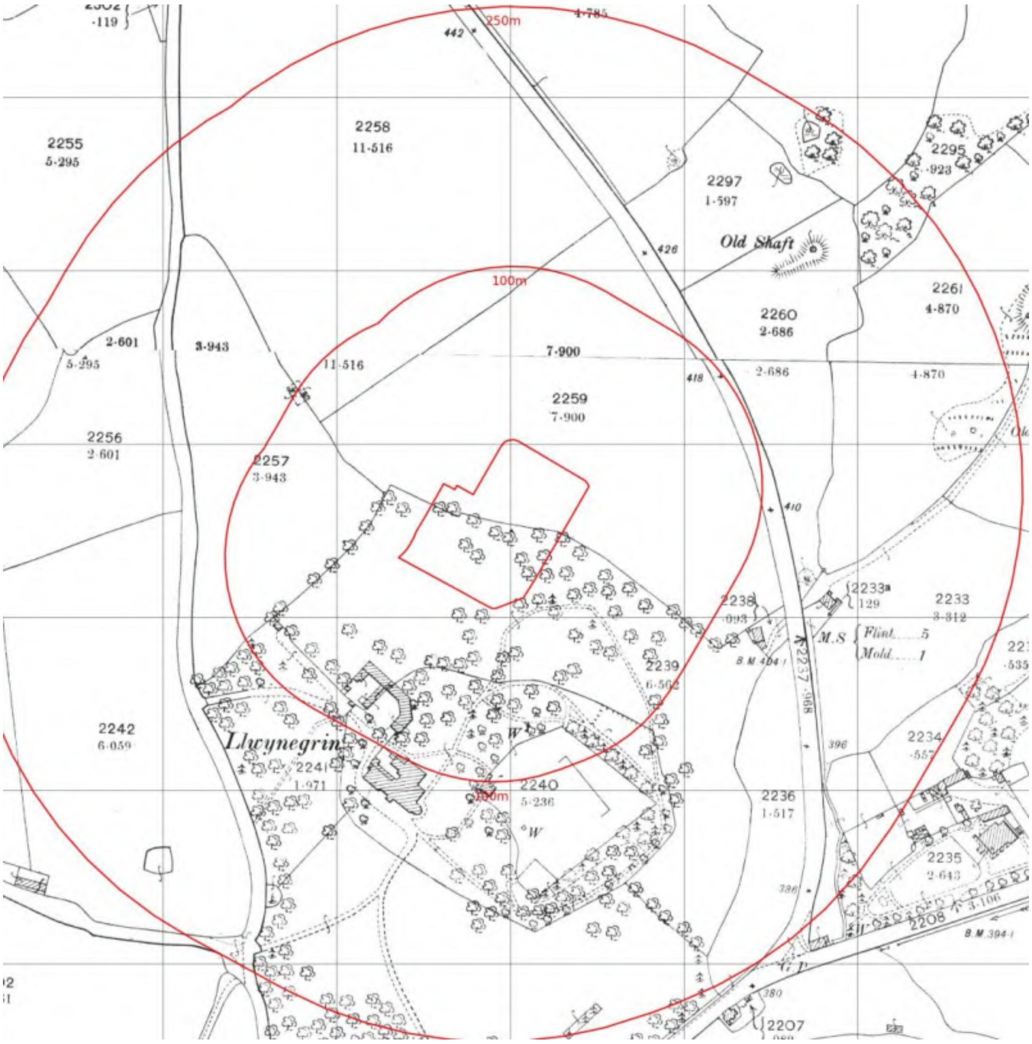
<table>
<tr><th>Time Period</th><th>On-Site features</th><th>Off-Site features</th></tr>
<tr><td></td><td>appears to have mature trees around the boundary and circular feature.</td><td>• A shaft is located 210m east of the site.</td></tr>
<tr><td>1898</td><td colspan="2">

Figure 3-2 - Historical OS Mapping (1898) 1:2,500</td></tr>
<tr><td></td><td>• The circular feature and access track are no longer present in the centre of the site. The remains agricultural land</td><td>• Shaft located 120m northeast is labelled as “Old Shafts”
• An additional well is labelled to the south of the site
• Tracks appear on mapping associated with the buildings to the south.</td></tr>
</table>

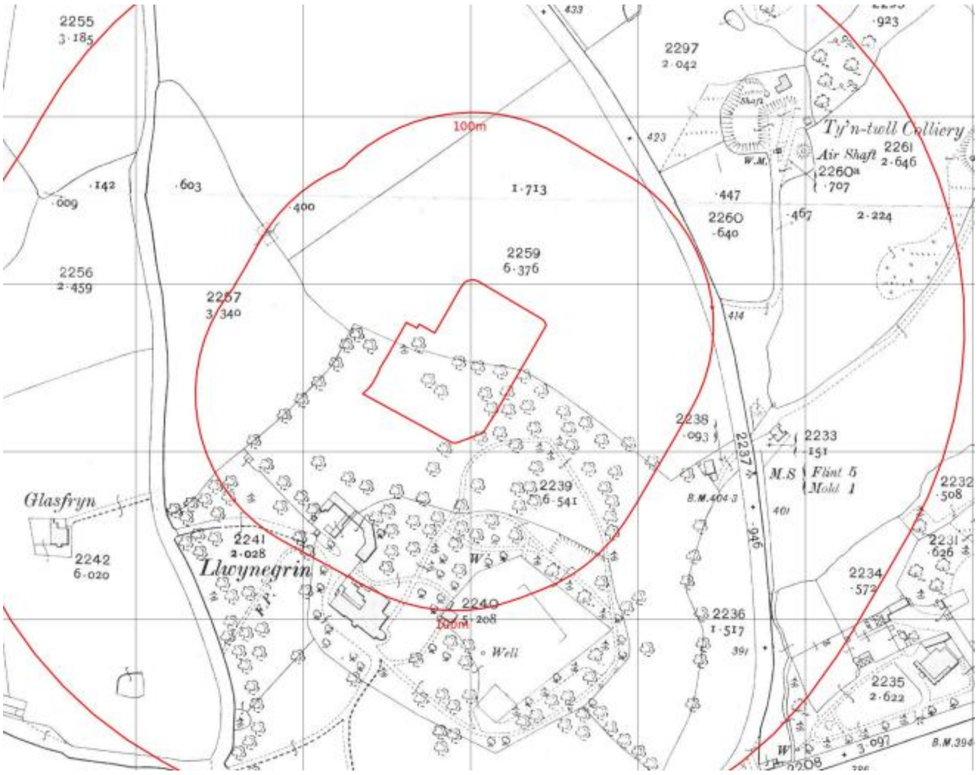
<table>
<tr><th>Time Period</th><th>On-Site features</th><th>Off-Site features</th></tr>
<tr><td rowspan="2">1912</td><td colspan="2">

Figure 3-3 – Historical OS Mapping (1912) 1:2,500</td></tr>
<tr><td>

- No significant changes

</td><td>

- Ty'n – Twll Coilliery is located 145m northwest of the site. The site comprises of 2 No. shafts and an air shaft.

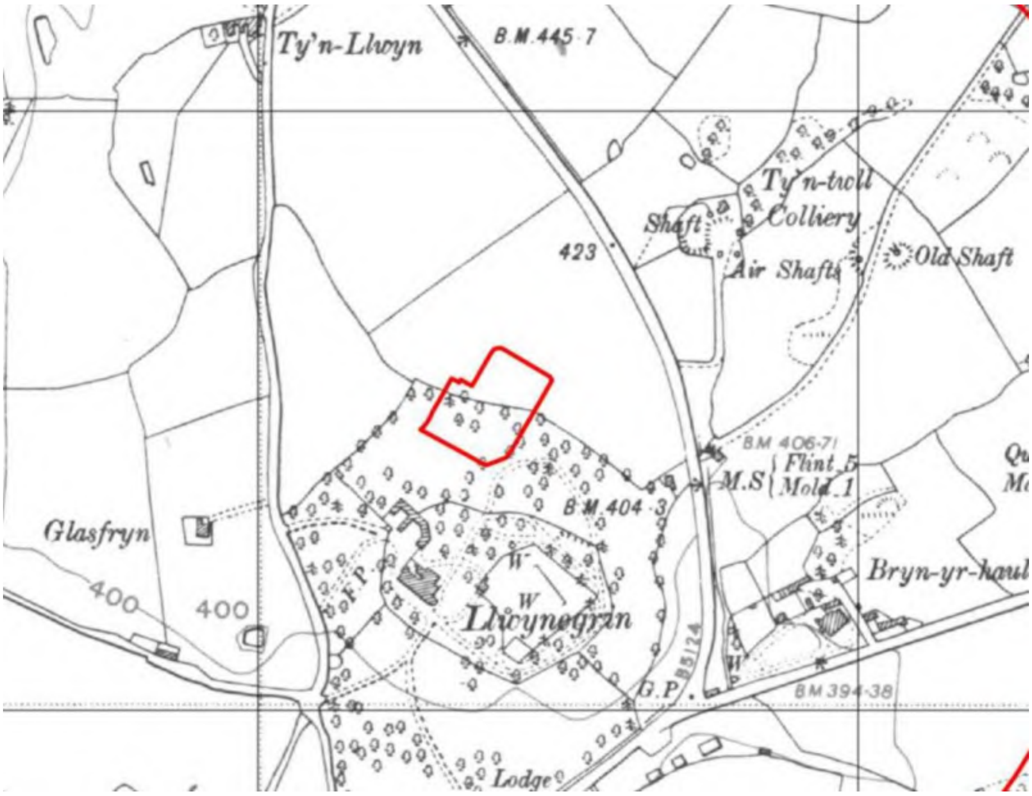
</td></tr>
<tr><td rowspan="2">1938</td><td colspan="2">

Figure 3-4 – Historical OS Mapping (1938) 1:10,560</td></tr>
<tr><td>

- No significant changes

</td><td>

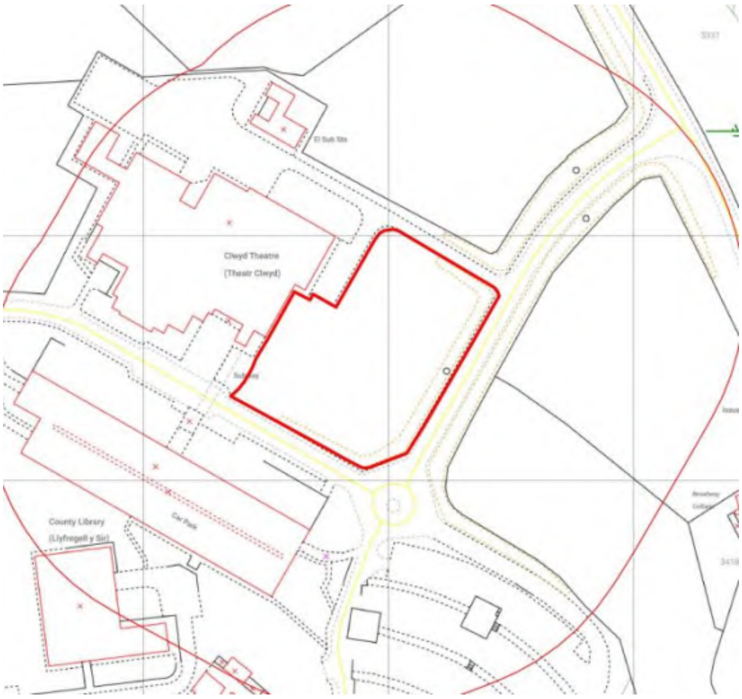
- No significant changes

</td></tr>
</table>

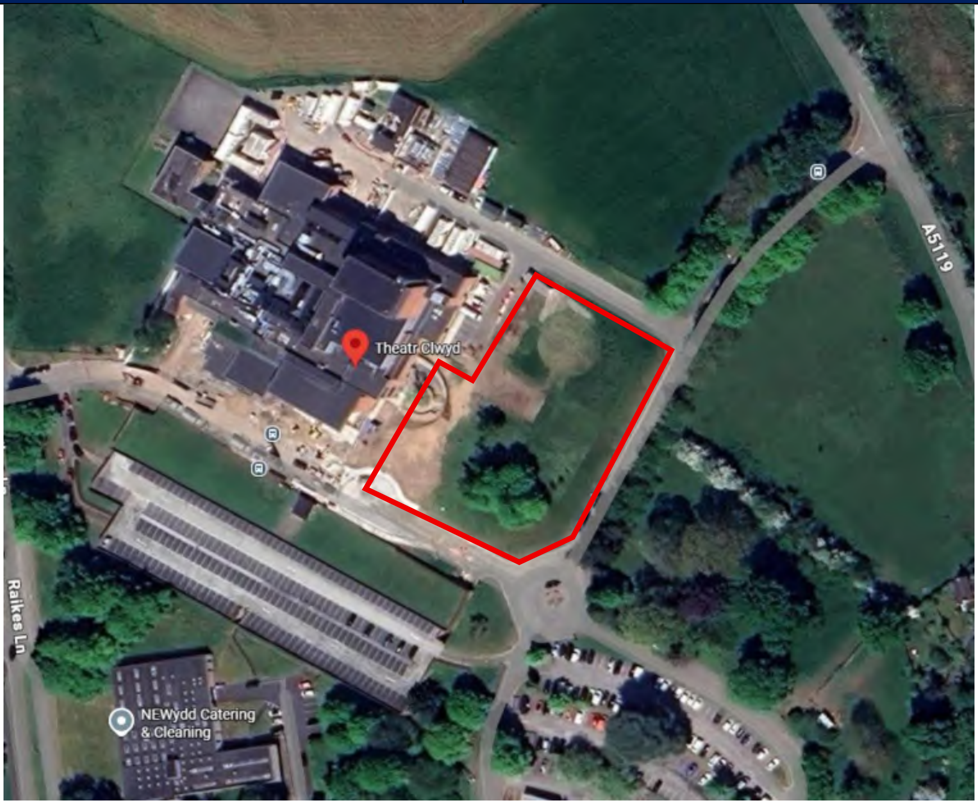
<table>
<tr><th>Time Period</th><th>On-Site features</th><th>Off-Site features</th></tr>
<tr><td rowspan="2">1959-1964</td><td colspan="2">

Figure 3-5 – Historical OS Mapping (1959-1964) 1:10,560</td></tr>
<tr><td>• No significant changes</td><td>• Additional buildings are now present within the Llwynegrin Hall to the southwest of the site.
• Residential dwellings constructed 280m south of the site.</td></tr>
</table>

Time Period	On-Site features	Off-Site features
1968-1973	 **Figure 3-6 – Historical OS Mapping (1968-1973) 1:2,500**	
	- No significant changes	- Development has occurred to the south west and south of the site with the establishment of the "Law Corris", "County Council Offices" and "County Library" as well as a large parking area to the south. - A spring is noted 142m east of the site.
1984	 **Figure 3-7 – Historical OS Mapping (1984-1989) 1:2,500**	

Time Period	**On-Site features**	**Off-Site features**
	- The site appears to have been cut to the NE, east and south during construction of an access road leading to a sloping profile to the north, east and south.	- Theatre Clwyd has been constructed to the west of the site with additional access roads constructed and a car park to the west.
1987-1992	 **Figure 3-8 – Historical OS Mapping (1988) 1:2,500**	
	- No significant changes	- A substation is located 52m northwest.
2003	 **Figure 3-9 – Historical OS Mapping (2003) 1:1,250**	

Time Period	On-Site features	Off-Site features
	- No significant changes.	- No significant changes.
2025	 Figure 3-10 – Aerial Photography 2025	

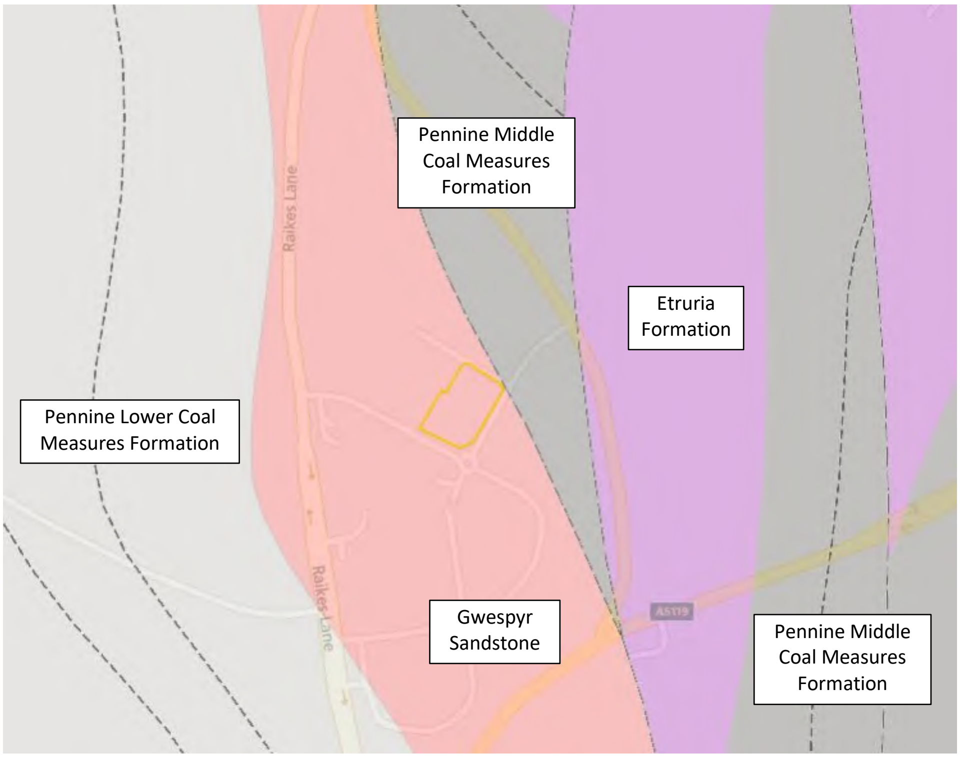
Time Period	On-Site features	Off-Site features
	 Figure 3-11 – Aerial Mapping 2026	
	The recent aerial photography shows that the site was used as a temporary Theatre space, while building work was carried out within the main Theatre building. It appears the structures were placed directly on top of the existing soft landscaping.	- No significant changes.

4 ENVIRONMENTAL SETTING

4.1 GEOLOGY

Table 4-1 - Geological Summary

Maps and publications referenced	BGS Geological Maps 1:50,000 series (sheet 108). BGS Geological Maps 1:10,000 series (sheet SJ26NW) Groundsure Report (GS-XOV-8BI-W33-WWC). Consultants Coal Mining Report (GS-C5W-ZU4-SEV-G3M).
Made ground / artificial ground	No made ground or artificial ground is mapped as being present on the site. Areas of made ground likely localised to the above ground circular feature shown in historical mapping, historical tracks and made ground localised around services.
Drift geology	Using publicly available information it is understood the site superficial deposits underlying the site comprise of Glaciofluvial Deposits.  Figure 4-1 – Drift Geology Mapping

Solid geology	BGS Geological mapping indicates the site to be underlain by Carboniferous Gwespyr Sandstone.  **Figure 4-2 – Solid Geology Mapping**
Faults	There is a fault located immediately to the northeast as shown on the 1:10,000 BGS geological mapping, and is mapped as being located offsite. The Coal Consultants Report, identifies a fault striking north – south through the centre of the site.
Coal seams	No coal seams are within 298m of the site.

4.2 BGS EXPLORATORY HOLE RECORDS

There is 1 No. BGS exploratory hole records within a relevant distance of the site (assumed as an approximate 50m radius).

A summary of the ground conditions is presented in Table 5-1 below.

Table 5-1 - Historical Borehole Records

Reference	Distance from site (m) and Direction	Depth Made Ground (m)	Depth Glacial Sand and Gravel Deposits (m)	Depth Glacial Till Deposits (m)	Depth Solid Geology (m)
BGS ID 148455	99m West	1.90m	7.50 Gravelly fine to medium SAND	14.70 Grey stoney CLAY	15.00m Buff SANDSTONE

4.3 MINING AND QUARRYING

Table 4-2 - Coal Mining Activities

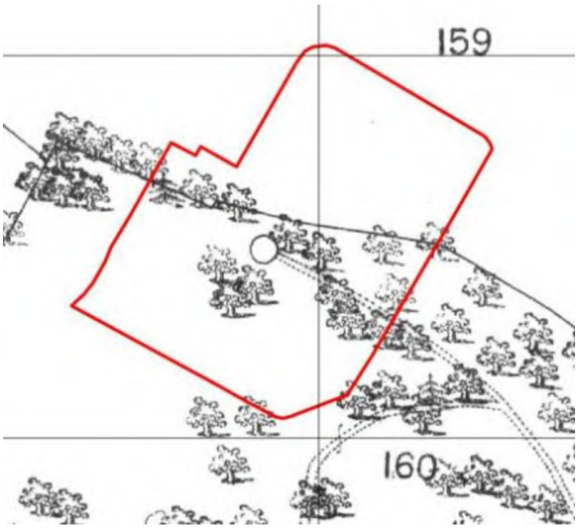
	Yes/No	Comments
Is the Site in an area of potential shallow coal workings?	Yes	The site lies within a Coal Mining Reporting Area. The Mining Remediation Authority Consultants Coal Mining Report has recorded no past mining records on the site. There are no probable unrecorded shallow workings and no coal outcrops on the site.
Is the Site in a high risk development area?	No	The site does not lie within a high-risk development area
Are there any known shafts, adits, tips, lagoons, or opencast workings likely to affect the Site?	No	There are no mine entries within 100m of the site. The closest shaft is located 186m NE of the site.   The historical mapping identified a circular feature in the centre of the site. The information held by the Mining Remediation Authority indicates that this is not a mining related feature.
Is exploratory work required to investigate the potential risk from shallow mining or quarrying?	No	The absence of mine entries within 100m, no past underground mining or related infrastructure and no outcrops recorded negate any risk from past shallow mining or quarrying.

Table 4-3 - Other Extractive Industries

	Yes/No	Comments
Superficial drift deposits		
Evidence of extraction on or within 250 m of the Site?	Yes	Unspecified Ground Workings (75m SE, 150m NE)
Action required?	Yes	Further ground gas risk assessment required.
Solid Strata		
Any evidence of mineral extraction on or within 250 m of the Site?	Yes	Shaft and Colliery located 200m northeast.
Action required?	No	The site is not within the zone of influence of the site.

4.4 HYDROGEOLOGY

Table 4-4 - Groundwater Occurrence and Abstraction

	Presence/location	Comments
Environment Agency aquifer designation – Superficial Deposits	Onsite	Secondary A Aquifer
Environment Agency aquifer designation – Bedrock	Onsite	Secondary A Aquifer
Anticipated groundwater depth(s)	Onsite/Offsite	Groundwater depths unknown.
Direction of flow	Onsite/Offsite	Unknown
Current licensed abstractions – potable	Onsite/Offsite	No potable extractions within 500m.
Source Protection Zones	Onsite/Offsite	No source protection zones within 500m.
Springs	Offsite	A spring is noted 142m east of the site.

NR - none recorded.

4.5 HYDROLOGY

Table 4-5 - Surface Water Features

	Presence/location	Comments
Nearest surface water feature	Offsite	135m E – Inland river influenced by normal tide action
Other surface water features	Onsite/Offsite	None within 250m.
Canals, ponds, lakes, etc.	Onsite/Offsite	None within 250m.
Water Framework Directive (WFD) Surface Water Bodies	Onsite	Alyn - Leadmill to Hope - GB111067052172 – Management catchment (River Dee)
Licensed surface water abstractions	Onsite/Offsite	None within 500m

Environment Agency GQA assessments: A = very good to E = poor

Information obtained from the Environment Agency (EA) Risk of Flooding from Rivers and the Sea (RoFRaS) database indicates that the risk of flooding across the site is very low risk from rivers and sea (0.1% chance per year), and high risk from surface water and small watercourses (>3.3%)

The British Geological Survey indicate there is a potential for groundwater flooding at the subject site, with a low to high risk rating.

No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

4.6 ENVIRONMENTAL DESIGNATIONS

Table 4-6 - Summary of Environmental Designations

	Presence/location	Comments
Sites of Special Scientific Interest (SSSI)	Onsite/Offsite	None within 250m
Conserved wetland sites (Ramsar sites)	Onsite/Offsite	None within 250m
Special Areas of Conservation (SAC)	Onsite/Offsite	None within 250m
Special Protection Areas (SPA)	Onsite/Offsite	None within 250m
National Nature Reserves (NNR)	Onsite/Offsite	None within 250m
Local Nature Reserves (LNR)	Onsite/Offsite	None within 250m
Designated Ancient Woodland	Offsite	204m SE, 246m SE – Semi Ancient Woodland
Biosphere Reserves	Onsite/Offsite	None within 250m

	Presence/location	Comments
Forest Parks	Onsite/Offsite	None within 250m
Marine Conservation Zones	Onsite/Offsite	None within 250m
Green Belt	Onsite/Offsite	None within 250m
Proposed Ramsar sites	Onsite/Offsite	None within 250m
Possible Special Areas of Conservation (pSAC)	Onsite/Offsite	None within 250m
Potential Special Protection Areas (pSPA)	Onsite/Offsite	None within 250m
Nitrate Sensitive Areas	Onsite/Offsite	None within 250m
Nitrate Vulnerable Zones	Onsite/Offsite	0m – Surface Water 44m W – Surface Water
SSSI Units	Onsite	No consideration required unless the development is for infrastructure, air pollution (livestock, poultry) or combustion related.

4.7 LANDFILL AND WASTE MANAGEMENT ACTIVITY

Table 4-7 - Waste Management Activities

	Presence/location	Comments
Active or recent landfill	Onsite/Offsite	None within 250m
Historical landfill (BGS records)	Onsite/Offsite	None within 250m
Historical landfill (LA/mapping records)	Onsite/Offsite	None within 250m
Historical landfill (EA/NRW records)	Onsite/Offsite	None within 250m
Historical waste sites	Offsite	125m NE - Tyn y Twll Landfill, Main Road, Sychdyn, Mold, Clwyd, CH7 6EA, WALES
Licensed waste sites	Onsite/Offsite	None within 250m
Waste exemptions	Offsite	237m S – Kier Construction
Evidence of other landfilling or potential infilling on or within 250m of Site	Offsite	Unspecified Ground Workings (75m SE, 150m NE)
Walkover evidence of fly-tipping on Site?	Onsite	Materials stored on the western boundary of the site however these appear to be inert (benches, fencing)
Is a landfill/ground gas risk assessment required?	Onsite	No. Landfill located 125m NE used for agricultural improvements and highway access improvements from the A5119.

4.8 LOCAL INDUSTRIAL LAND USES

Other potentially contaminative activities are shown in Table 4-8 below with those features considered pertinent to the conceptual site model highlighted in **bold**. The entries relate to activities within *circa* 250 m of the Site, with the exception of COMAH facilities where the assessment is extended to a distance of *circa* 500m from the Site.

Table 4-8 - Other Potentially Contaminative Processes in the Locality

	Location	Comments
Recent industrial land uses	Offsite	49m N – Substation 180m NE – Shaft (disused) 215m S – Chimney
Current or recent petrol stations	Onsite/Offsite	None within 500m
Current or Historical Storage Tanks	Onsite/Offsite	None within 500m
Electricity cables (High Voltage)	Onsite/Offsite	None within 500m
Gas pipelines ((High Pressure)	Onsite/Offsite	None within 500m
Sites determined as Contaminated Land	Onsite/Offsite	None within 500m
Control of Major Accident Hazards (COMAH)	Onsite/Offsite	None within 500m
Regulated explosive sites	Onsite/Offsite	None within 500m
Hazardous substance storage/usage	Onsite/Offsite	None within 500m
Historical licensed industrial activities (IPC)	Onsite/Offsite	None within 500m
Licensed industrial activities (Part A(1))	Onsite/Offsite	None within 500m
Licensed pollutant release (Part A(2)/B)	Onsite/Offsite	None within 500m
Radioactive Substance Authorisations	Onsite/Offsite	None within 500m
Licensed Discharges to controlled waters	Onsite/Offsite	None within 250m
Pollutant release to surface waters (Red List)	Onsite/Offsite	None within 500m
Pollutant release to public sewer	Onsite/Offsite	None within 500m
List 1 Dangerous Substances	Onsite/Offsite	None within 500m
List 2 Dangerous Substances	Onsite/Offsite	None within 500m
Pollution Incidents (EA/NRW)	Onsite/Offsite	None within 250m

	Location	Comments
Pollution inventory substances	Onsite/Offsite	None within 500m
Pollution inventory waste transfers	Onsite/Offsite	None within 500m
Pollution inventory radioactive waste	Onsite/Offsite	None within 500m

COMAH – Control of Major Accident Hazards (regulations); NIHHS – Notification of Installations Handling Hazardous Substances (regulations)

4.9 RADON RISK

Table 4-9 - Radon Risk Status

	Comments
Estimated properties affected	5-10% of properties affected.
Radon Protection Measures required?	Basic Radon Protective Measures are required.

5 PRELIMINARY GEOTECHNICAL ASSESSMENT

5.1 ANTICIPATED GROUND CONDITIONS

In addition to the environmental hazards, there are also geotechnical hazards associated with the stability of the ground (including load bearing capacity, slope stability and effects of ground (mining) cavities). Local Authorities follow NPPF (2018) which requires that "site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining." A summary of the geotechnical considerations is provided below:

Table 5-1 - Summary of Geotechnical Hazards

Geohazards:	
Highly Compressible Ground	Negligible
Collapsible Soils	Very low
Swelling Clay	Negligible
Running Sand	Very Low
Ground Dissolution	Negligible
Landslip	Very Low
Mining & Quarrying (see Section 3.3)	There is no evidence of mining or mineral extraction or quarrying at the site.
Geotechnical Design Considerations	
Site Clearance	In area of proposed development, trees to be removed and topsoil strip required. All green waste and deleterious material to be removed from site
Trees	Check whether there are any Tree Preservation Orders. Foundation design to take into account trees.
Existing Buildings / Obstructions	No previous permanent structures present on site.
Foundations	Anticipate that deep foundations will be required due to anticipated column loadings (2500kN)
Floor Slabs	Given the requirement for a piled foundation solution, cast in situ suspended floors are recommended to remove the risk of differential settlement.
Groundwater	Groundwater not encountered onsite.
Earthworks	Considered bulk earthworks will be required to excavate underground obstructions and strip topsoil.
Slopes	Slope stability considered to be a low/medium risk. The site sits approximately 4.00m higher at 141m AOD whilst the road level adjacent sits at approximately ~137m AOD. If a piled solution is undertaken and no additional load is applied post construction hence the risk is low, however consideration is needed during construction stage for plant and machinery.
Retaining Walls	Not considered to be relevant to the proposed development
Chemically aggressive ground conditions	Possibility for low pH and high sulphate concentrations which could be detrimental to below ground concrete.

6 PRELIMINARY CONCEPTUAL SITE MODEL

6.1 INTRODUCTION

Based on the information provided in the previous sections of this report a combined preliminary conceptual site model and conceptual exposure model has been developed for the proposed future land use. This summarises the understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors. In assessing the likely contaminants of concern present at the Site, reference has also been made to Defra and Environment Agency supporting documentation. A preliminary qualitative risk assessment has also been made of the likelihood of the linkage operating and its potential significance in accordance with CIRIA C552.

The preliminary conceptual model is presented in schematic form in section 6.9. The potential pollutant linkages identified and the qualitative risk assessment for these are presented in Conceptual Site Model.

The terms used in the preliminary qualitative risk assessment are defined in **Appendix F**.

The following sections discuss all the identified potential on and off-site sources, pathways, and receptors in the context of the proposed development and plausible pollutant linkages which may represent a risk to identified receptors such as human health and/or controlled waters from the data gained from the desk study. At this stage, the assessment is qualitative and aimed to determine all pollutant linkages, irrespective of significance or allowing for uncertainty.

Three impact potentials exist for any given site, these are:

- The site impacting upon itself;
- The site impacting on its surroundings; and
- The surroundings impacting on the site.

All three impacts need to be considered in a risk assessment.

- Sources; these are potential or known sources of contamination that may relate to a former land use or present site feature or process (e.g., Made Ground, infilled ground etc).
- Pathways; a pathway is defined as a mechanism or route by which a contaminant encounters, or otherwise affects a receptor. Pathways by which the identified receptors may be impacted upon in the context of the proposed development.
- Receptors; receptors are defined as people, living organisms, ecological systems, controlled waters, atmosphere, structures, and utilities that could be adversely affected by contaminant(s).

6.2 CONCEPTUAL SITE MODEL

Based on the data available the following Conceptual Site Model has been developed. The various components of the potential "source–pathway-receptor" pollutant linkages identified at the site.

6.3 HAZARDS IDENTIFIED WITH THE PROPOSED DEVELOPMENT

The hazard identification is based on the assumptions presented below:

- the site will be a commercial development.
- the previous structures and features onsite are a source of contamination.
- drinking water will be from mains supply.

6.4 POTENTIAL SOURCES OF CONTAMINATION

For the purpose of this assessment the potential contaminants of concern have been considered according to whether they are likely to have originated from on-site or off-site sources.

Potential On-site Sources of Contamination

From the information obtained, the following sources have been identified which may affect the redevelopment of the site for residential end use:

- Historical circular feature present on the site. No evidence to indicate it is a mining feature. The mapping doesn't indicate the feature as a pond or depression. The Groundsure Report has recorded the feature as a 'unspecified tank'. This is considered unlikely due to the age and location. This is likely an error in interpreting the historical mapping. The centre of a roundabout has also been interpreted as a tank, which is also incorrect. The feature could be an above ground e.g. bandstand. Depending on the origin, the feature may represent made ground, which could have elevated concentrations of Metals, PAHs, TPHs, Asbestos, Ground gas.

- Ground Gas: Radon

Potential Off-site Sources of Contamination

The following off-site sources have been identified which may affect the redevelopment of the site:

- Made ground: Historical structures and feature – unknown feature. Metals, PAHs, TPHs, Asbestos, Ground gas

- Substation: TPHs, PAHs – the age of the substation indicates that there is no risk from PCBs

- Historical Colliery – Metals, PAHs, TPHs, Ground Gas

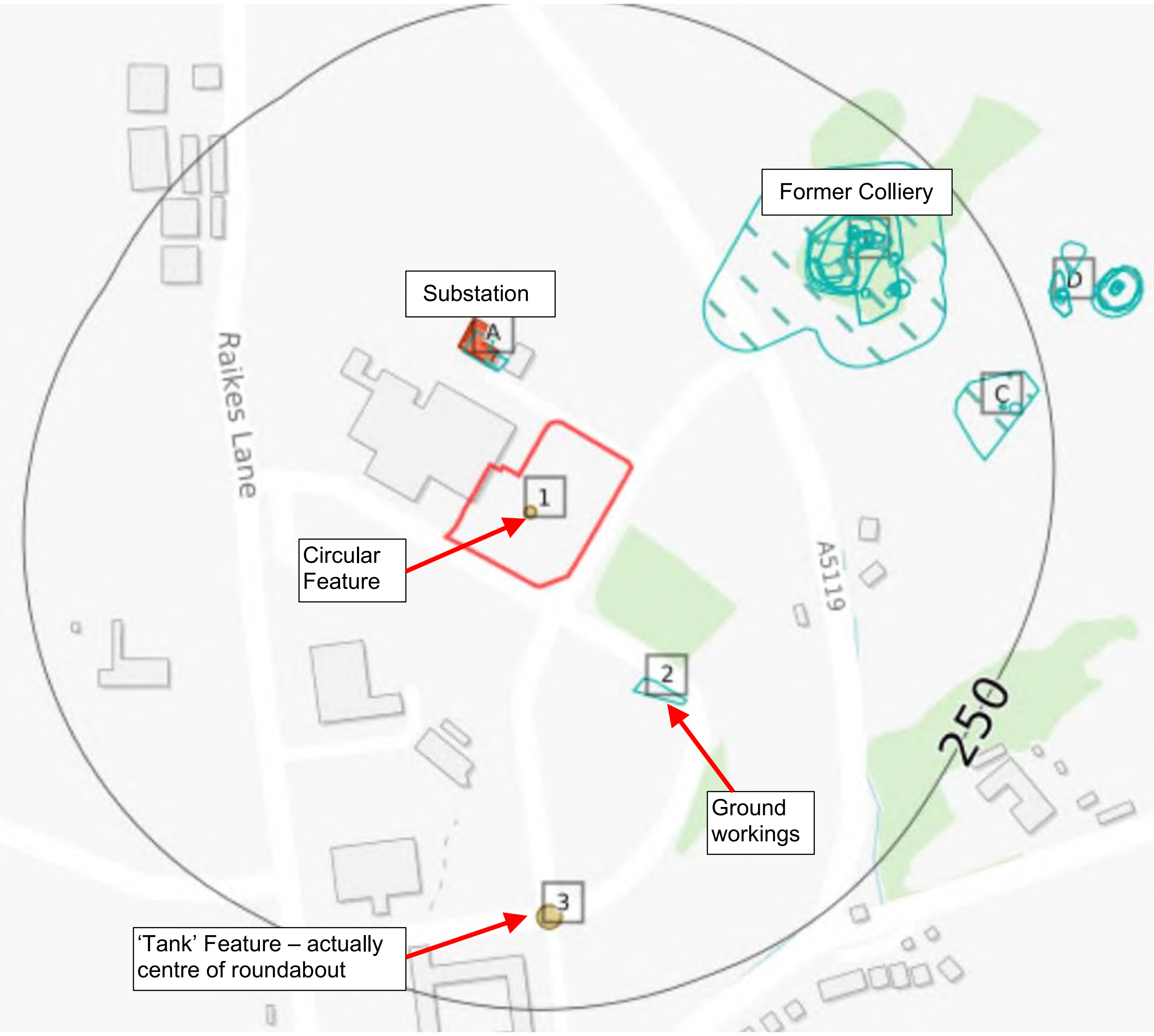


Figure 6-1 – Historical Industrial land uses

6.5 POTENTIAL RECEPTORS OF CONTAMINATION

Based on the data previously discussed, the following potential receptors to contamination have been identified:

Table 6-1 - Identified Potential Receptors

Sensitive Receptors	
A	Humans – Pre development completion, i.e. working on site during demolition and construction.
B	Humans living on the site post construction.
C	Controlled waters – Surface Waters (rivers and streams)
D	Groundwater in the secondary A aquifer.
E	Local flora and fauna during and post construction.
F	Building structure and services.

The possible contaminant linkages are discussed below. It should be noted not all may be formed between all sources and receptors.

The preliminary assessment of risks undertaken for the development considers potential risks to receptors A to F in **Table 6-1** above. The receptors A to F incorporate each of the receptors normally required by the Local Authority to be considered in their planning conditions relating to land contamination:

- Human Health (A & B)
- Property (including buildings, crops, livestock, pets, woodland, service lines) (E & F)
- Adjoining land (D & F)
- Groundwater and surface water (C & D)
- Ecological systems (E)
- Buildings and structures (F)

It should be noted that there are no archaeological sites or ancient monuments considered to be within the zone of influence of the site. They are therefore not considered in the risk assessment.

The closest of each of the above receptor categories to the site are considered to be:

On-site

- Human Health, Property, Buildings and Structures, Groundwater

Off-site

- Human Health, Buildings and Structures, Groundwater, and Surface water

The possible contaminant linkages are discussed below. It should be noted not all may be formed between all sources and receptors.

6.6 IDENTIFICATION OF PATHWAYS

Pathways to Human Health

There are various routes by which a potential contaminant may reach a receptor. For example, in areas where contaminated material is exposed, dermal contact with the material, inhalation or ingestion of dust may occur.

Inhalation or ingestion of dust and water could occur during the construction and development phase at the site. Pathways from dermal contact with soil and groundwater may also arise. It is considered that the risk of short-term exposure for ground workers and other construction workers is low unless there are asbestos fibres are encountered.

Post construction, the surface of the development area will be occupied with buildings and hard standing. This will effectively eliminate the persistence of potential pathways such as long-term direct contact and dust inhalation/ingestion as long as the soil in the garden areas has no significant concentrations of contaminants.

Ground Gas

The Site is located within an area where between 5% and 10% of properties are estimated to be affected by radon according to the UK Radon Potential dataset. As this exceeds the 3% threshold, basic radon protection measures are likely to be required for new residential and commercial development in accordance with BRE guidance.

There is the potential that ground gases may migrate from the offsite colliery and mine workings located 89m north due to the underlying glaciofluvial deposits with moderate gas permeability. Further site investigation is required to assess the risk from ground gases from this material.

Pathways to Controlled Waters

Groundwater levels at the site are anticipated to be at a depth of more than 5 m within the bedrock. However, there is the likelihood that perched groundwater will be present within / at the base of the glaciofluvial deposits. Lateral migration of potentially contaminated groundwater offsite (either via permeable made ground or the underlying aquifer) must be considered.

The vertical leaching of contaminants from any potential Made Ground into the groundwater is a potential pathway for contaminants to impact upon groundwater. The glaciofluvial deposits are anticipated to be underlain by Glacial Till (Clay) and therefore it is very unlikely for contaminates to make their way into the groundwater within the bedrock.
The site is not located within a groundwater source protection zone.

Surface run off from contaminated areas into surface watercourses must also be considered. Due to a lack of a hard standing site surface, this will be uncontrolled prior to and during the groundworks phase when this must be carefully managed.

Post construction the majority of the site and surface run-off will be limited and controlled through drains.
The nearest river source is 135m to the E. There is limited viable overland migration pathways for surface run off to reach this receptor.

Other Pathways

Other potential pathways that are possibly less significant to the site but still require consideration are: potential phytotoxic effects on sensitive landscaping plants; chemical attack on foundations and services and permeation of contaminants through domestic water pipes. The risk to buildings from ground gases has been discussed under human health above.

6.7 CONTAMINANT LINKAGES

For each contamination source there are potential contaminant linkages with all receptors. However, in the context of this site, not all of the contaminant linkages are plausible, particularly those of potential groundwater contamination and lateral groundwater migration.

6.8 UNCERTAINTIES

The following uncertainties exist in the preliminary conceptual model:

- The presence of any features unrecorded by the historic maps.
- Any unrecorded geological features.
- Any unrecorded pollution events during the Site’s history.

6.9 CONCEPTUAL SITE MODEL

In accordance with BS 10175, a schematic section has been developed for the site based on the previously presented data and contaminant linkage assessment:

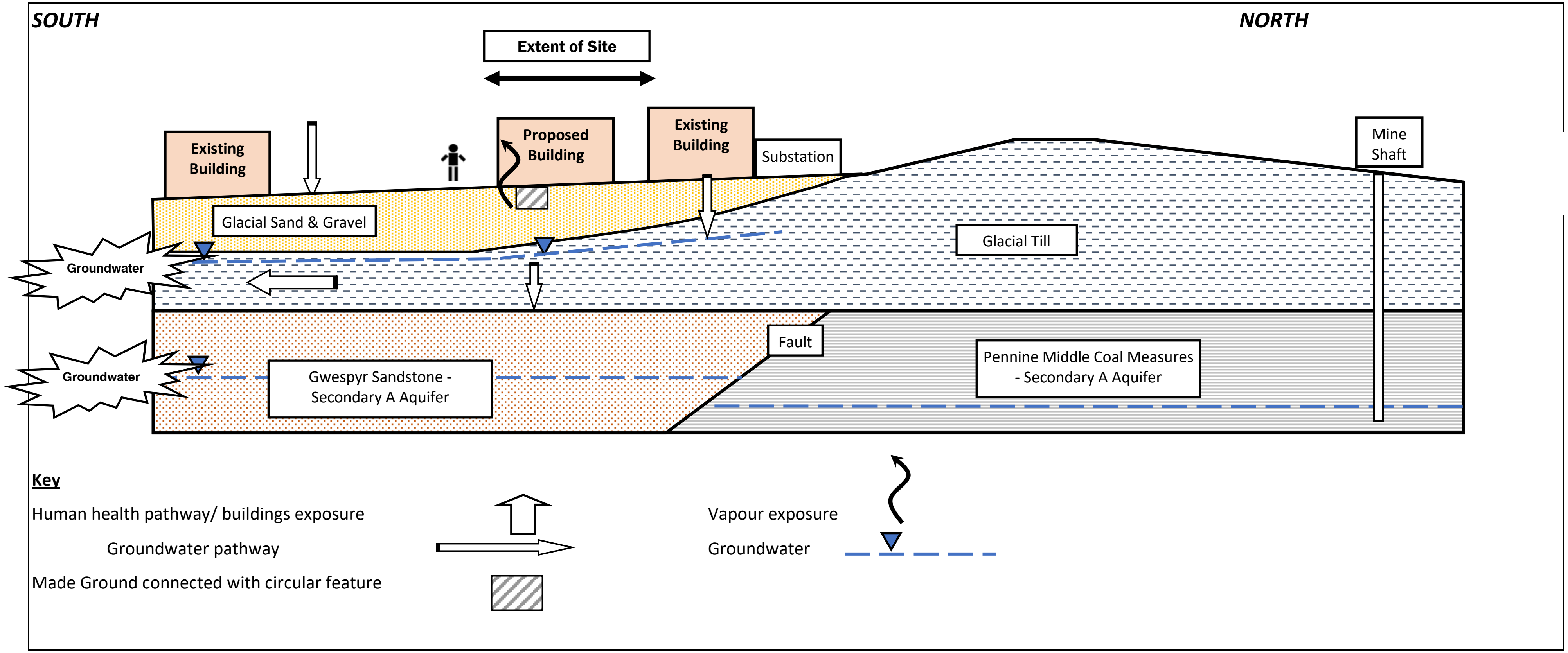


Figure 6-2 - Conceptual Site Model

The model shows the predicted geology and topography, the major on site potential contamination sources and vulnerable receptors.

The information presented above represents the preliminary conceptual ground model that may need to be revised based on information obtained as part of any future intrusive investigation. A number of sensitive receptors and potential pathways and sources (in association with a list of likely contaminants) have been identified.

The ground model and proposed end use described above should be considered broadly representative of the standard housing (with vegetable uptake) as defined in SR3 "Updated Technical Model to the CLEA Model" (SC050021/SR3, 2011) for the purpose of this report.

6.10 PRELIMINARY CONTAMINATION HAZARD ASSESSMENT

The preliminary hazard assessment is based on current available guidance published by a number of sources and is summarised in **Appendix E**. A preliminary conceptual site model for this site has been established using the desk study information and has been used as a basis for the preliminary hazard assessment. The significant and possible potential pathways are only considered for the hazard assessment.

The preliminary hazard assessment is a qualitative assessment of the risks posed by each viable pollution link identified. The hazard assessment leads to a recommended subsequent activity that could be:

- Action Required (AR) in the short term to break existing contaminant-pathway-receptor (CPR) link;
- Site Investigation Required (SIR) with objectives for risk estimation, or
- No Action Required (NAR) at this stage.

6.11 PRELIMINARY ASSESSMENT OF POTENTIAL POLLUTANT LINKAGES

Table 6-2 – Preliminary Conceptual Site Model

Human Health and Controlled Waters						
Potential Source	**Potential Pathway**	**Potential Receptor**	**Likelihood**	**Severity**	**Level of risk**	**Justification**
On site **Made ground** Metals, PAHs, asbestos	Root uptake, ingestion, direct contact, inhalation of dusts	End-users	Low likelihood	Mild	Low	Satellite imagery from 2023 shows that temporary structures were used on site while the existing Theatre building was renovated. It appears the temporary structure was placed directly on top of the grass soft landscaping. The structures have now been removed. . Historical mapping does not indicate any historical development, therefore sources of contamination on site is considered very low. The historical mapping (only identified on 1870 map) has identified a circular feature present on site. The origin of the feature is unknown, however has been ruled out as a mining feature. Made Ground may be present at this locality, therefore it is recommended ground investigation is carried out in this area. Given the commercial nature of the proposed development and the likely localised nature of any made ground, the likelihood of exposure to end users is considered to be low to moderate, and the overall risk is moderate to low at this stage. Further investigation and assessment will be required to confirm the risk.
On site **Made Ground** Metals and organic contamination	Migration into/chemical attack of water supply pipelines	Water Pipelines / End users	Low likelihood	Medium	Moderate/ Low	Contaminants within the soil/groundwater could potentially attack the clean potable water supply pipe, although made ground is likely to be localised. Nevertheless, contaminants should be assessed to determine the correct pipe material and level of precautions required.
On site **Made ground** Ground Gas (carbon dioxide and methane)	Migration into confined spaces, inhalation and asphyxiation/ explosion	End-users / property / structures	Unlikely	Medium to severe	Low	Made ground is unlikely to be present in any significant thickness and no significant infilled ground is situated within close proximity to the site. Made ground in this instance is likely to have a very low gas generation potential. CL:AIRE RB17 states that on sites where natural soils with low organic content and there is less than 1m of made ground that comprises general infill and car park construction materials, this is not considered to represent a significant ground gas source, and therefore gas monitoring is not required, and the site would fall into the definition of Characteristic Situation 1 (CS1), where no protection measures are required in construction.
Onsite **Radon**	Ingestion, direct contact, inhalation of dust/ vapours	End-users	Likely	Severe	Severe	The site straddles two risk categories for Radon, both 3-5% and 5-10%. Given the higher % of properties affected in the area being 5-10% radon protections measures are required, therefore basic protection measures are required.

Human Health and Controlled Waters						
Potential Source	**Potential Pathway**	**Potential Receptor**	**Likelihood**	**Severity**	**Level of risk**	**Justification**
Offsite **Electricity Substation** PCBs, TPHs	Ingestion, direct contact, inhalation of dusts	End-users	Unlikely	Medium	Low	Due to the age of the substation, which appears to have been constructed at some stage in 1989. This post-dates the ban on PCBs imposed in 1986, therefore this is not likely a potential source of PCBs. In addition, the substation appears to have been seated on a hard standing base which is likely to have contained any contaminants. The overall risk is considered to be low..
Offsite **Historical Colliery** PAHs, Metals, Ground gas, TPHs	Vertical and horizontal migration of ground gas	End Users	Likely	Medium	Moderate	An historical colliery is located 89m west of the site. Its understood that included within the infrastructure are shafts. It is understood 2/3 of the shafts on site have been treated, however it is not known if these have simply been infilled and as such could pose a risk of ground gas migration to the site. Despite glacial till present underlying the area of these shafts, which is a non-preferential pathway, a possible linkage exists where the shafts have been driven beyond superficial into bedrock geology to target the coal measures between the colliery and the site. As such, and given the fault running below the site, it is plausible that a viable pathway exists for ground gas and as such further investigation is required.
	Leaching of contaminants via groundwater/transport onto site		Unlikely	Medium	Low	Given the presence of the glacial till underlying the colliery, the distance contaminants would have to travel, and the topographic differences in elevation between the site and the historical colliery, it is unlikely there is a viable pathway to onsite receptors from the risk from metals, PAHs and TPHs associated with the historical colliery.
On site **Made ground** Metals, PAHs,	Overland flow, / migration through saturated zone	Unnamed water course (onsite) Kenwick Brook (135m SW) (Surface Waters)	Unlikely	Medium	Low	Due to the lack of historical development across the site, significant thickness or widespread made ground deposits are unlikely to be present but may be present in the vicinity of the northern part of the site. It is considered contaminants associated with the made ground are unlikely to impact the river given the distance for contaminants to migrate and degradation is likely to occur over this distance. Therefore the risk is considered to be low.

Human Health and Controlled Waters						
Potential Source	**Potential Pathway**	**Potential Receptor**	**Likelihood**	**Severity**	**Level of risk**	**Justification**
	Overland flow, leaching through unsaturated zone / migration through saturated zone	Secondary (A) Aquifer (Groundwater)r	Unlikely	Medium	Low	The site is not within a Source Protection Zone. There are no potable groundwater abstraction licences located within 2000m of the site. As detailed above, any made ground is considered unlikely to be substantial in thickness. In addition, the development of the site will likely result in a reduction in surface water infiltration with the installation of a new surface water drainage system, which will reduce any contaminant leaching and contribute to an overall betterment of groundwater quality. The overall risk is therefore considered to be low. If substantial thicknesses of made ground or gross contamination is encountered during intrusive investigations, the risk assessment will need to be revised.
	Leaching through unsaturated zone / Migration through saturated zone	Secondary (A) Aquifer (Groundwater)	Unlikely	Medium	Low	The site is not within a Source Protection Zone . There are no potable groundwater abstraction licences located within 2000m of the site. Made ground is considered unlikely to be substantial in thickness. If substantial thicknesses of made ground or gross contamination is encountered during intrusive investigations, the risk assessment will need to be revised.

7 FIELDWORK

7.1 INTRODUCTION

The fieldwork was carried out on the 7th – 10th February 2026. GroundSolve personnel were present to supervise all work, describe the ground encountered, and take samples. Fieldwork procedures were undertaken in accordance with the relevant sections of:

- BS5930:2015 + A1:2020 "Code of Practice for Site Investigations;"
- BS10175:2011 + A2:2017 "Investigation of Potentially Contaminated Sites – Code of Practice."

The investigation included:

- 4 No. windowless sample boreholes to a maximum depth of 5.45m bgl.
- 3 No. cable percussion boreholes to maximum depth of 14.05m bgl.
- 1 No. hand pit to 0.70m bgl.
- Sampling for chemical and geotechnical testing of soils.
- 6 Ground gas and groundwater monitoring visits.
- Falling head permeability testing.
- Description of the ground encountered in accordance with BS5930:2015 + A1:2020, Code of Practice for Site Investigations.

7.2 DYNAMIC (WINDOW) SAMPLE BOREHOLES

4 windowless sampling boreholes (WS) were completed using a tracked windowless sample rig. The exploratory hole logs are presented in **Appendix F**.

7.3 CABLE PERCUSSION BOREHOLES

3 No. cable percussion boreholes were completed using a Dando drilling rig. The exploratory hole logs are presented in **Appendix F**.

7.4 HAND EXCAVATED PIT

1 No. inspection pit was undertaken at CP103B. A concrete obstruction was encountered at 0.70m bgl and the location was terminated and repositioned. The exploratory hole log is presented in **Appendix H.**

7.5 CBR VALUES FROM DYNAMIC CONE PENETRATION TESTS

Dynamic Cone Penetration Tests were carried out within the area of the proposed access road and parking, from surface to a maximum depth of 0.74m. The results are presented in **Table 7-1** below, and **Appendix I**.

Table 7-1: CBR values derived from DCP testing

Location:	Depth (mm):	Estimated CBR value (%):
DCP01	0 – 265	8
	265 – 740	15
DCP02	0 – 300	5
	300 – 340	20
	340 - 580	20

7.6 SAMPLES AND SAMPLE CONTAINERS

Soil samples for chemical analysis each comprised a pair of samples: a plastic tub for metals and inorganics and an amber glass jar for organics.

Soil samples were stored in cool boxes with ice packs and dispatched directly to the testing laboratory, for all phases of the investigation.

Samples for physical testing comprised of undisturbed samples, bulk disturbed samples and small disturbed samples and were dispatched to the professional soils laboratory.

8 LABORATORY TESTING

8.1 CHEMICAL LABORATORY TESTING

Chemical samples were submitted to a UKAS accredited laboratory in accordance with ISO17025 and are also MCERTS accredited for soil analysis in accordance with the Environment Agency’s scheme. The laboratory carries out Quality Assurance and Quality Control in accordance with BS ISO 17025 and participate in external laboratory comparison and quality control schemes. Details of the accreditation and the methods of analysis are provided on the relevant test reports.

The selection of samples for laboratory testing and analytes to be determined were made based on the preliminary CSM and relevant observations during the investigations. The sample selection rationale is as follows:

- To gain a good coverage across the Site of the various material types and strata encountered.
- To investigate the specific locations of previous potentially contaminative land uses as identified within the Phase 1 desk study and subsequent CSM;
- To fully characterise the potential made ground materials within the identified higher-risk areas.

The selected soil samples were tested for a range of typical contamination indicators including specific tests for contaminants suspected as being present from the desk study, CSM, and observations made on-site. Tests were also performed which were used to support the modelling of contaminant transport and impacts (e.g. TOC) and for waste classification purposes.

Each of the soil samples were analysed for the ‘total’ concentration of a suite of potential contaminants.

The results of the laboratory analysis are presented in Appendix E. The various suites of analysis for the soil are presented in Table 8-1 below:

Table 8-1: Suites of Analysis for Environmental Soil Samples

Determinand	Soil Suite 3
Number of Samples	6
Index Tests	
Asbestos Screen / Quantification	✓
pH	✓
Metals	
As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn (all totals)	✓
Inorganics	
Acid Soluble Sulphate	✓
Cyanide - Total	✓
Sulphate (2:1 extract on soil samples)	✓
Organics	
Phenols - Total (monohydric)	✓
Total Organic Carbon (TOC)	✓
PAH (Speciated USEPA 16)	✓
Speciated TPH (C5-C35)	✓
Benzene, Toluene, Ethyl Benzene, Xylenes (BTEX);	✓

8.2 PHYSICAL LABORATORY TESTING

Samples were submitted to Professional Soils Laboratory (PSL) who are UKAS accredited in accordance with ISO17025. The following geotechnical testing was undertaken with the results of this testing presented in are presented in Appendix G. The various suites of analysis for the soil are presented in **Table 8-2** below:

Table 8-2: Summary of Physical Testing

Determinant	Samples Used in Testing
Index Tests	
pH	**5**
Sulphate (2:1 extract on soil samples)	**5**
Atterberg	**3**
Moisture Content	**3**
PSD (Particle Size Distribution	**6**
BRE SD-1 Suite B	**2**
Compaction Test	**2**

9 GROUND CONDITIONS

9.1 GENERAL

The site investigations have allowed the site-specific ground conditions to be described, and this information was used to provide an improved conceptual ground model. The geology encountered during the site investigations was generally consistent with existing publicly available information online on the British Geological Survey (BGS) GeoIndex (onshore) viewer. A summary of the general strata encountered across the site is provided in the following sub sections.

9.2 GROUND SURFACE / TOPSOIL

The ground surface across the site typically comprises a thin layer (approx. 0.20–0.40m) of soft brown clay. This clay is generally slightly sandy and slightly gravelly, with subrounded gravels of mudstone and shale. The topsoil is relatively uniform across locations.

9.3 ANTHROPOGENIC MATERIALS

Made Ground is locally present and variable in thickness (generally up to approx. 1.40m in WS104). It comprises heterogeneous materials including gravelly clay, sandy gravel, and occasional cobbles, often containing anthropogenic inclusions such as brick and concrete fragments. In CP103b, a concrete slab was encountered near surface. The deposits are typically dense to very dense where gravel-dominated but also included softer clayey layers. No visual or olfactory evidence of contamination was noted during the fieldwork.

9.4 NATURAL DEPOSITS

Underlying the Made Ground Fluvioglacial deposits were recorded throughout the site extending to between 10.20m bgl and 11.00m bgl. These deposits consisted of predominantly of sands (fine to medium) that are variably gravelly and range from loose to dense with localised gravelly strata identified in CP103 at 8.10m to 11.00m and overlying sand and clay within shallower window sample locations (WS105 & WS102), indicating a prevalence of gravel on the northwestern section of the site. Interbedded layers of clay are present. Gravels are commonly subangular to subrounded and composed of sandstone, siltstone, and occasional coal fragments (shallow).

Underlying the Fluvioglacial deposits, Glacial till was recorded at the base of the three cable percussive boreholes, to a maximum drilled depth of 14.05m bgl. The Till was encountered as stiff to very stiff, brown, sandy, slightly gravelly clay, occasionally thinly laminated.

9.5 BEDROCK

Bedrock was not proven during this investigation, however all three cable percussion boreholes refused.

9.6 GROUNDWATER

No groundwater was encountered within any of the exploratory hole locations.

Groundwater was recorded within the monitoring wells and this is discussed further in **Section 12**.

10 GENERIC QUANTITATIVE RISK ASSESSMENT

10.1 ASSESSMENT FOR THE PROTECTION OF HUMAN HEALTH

The results of the soil analyses are presented below, where they have been compared to suitable generic assessment criteria (GACs), in order to allow a generic quantitative risk assessment (GQRA) to be carried out for the site and the proposed development.

The Category 4 Screening Levels (C4SLs) published by DEFRA (2014) have been adopted in the first instance, which have been published for six substances to date. Where a C4SL is unavailable, the “Suitable 4 Use Levels” (S4ULs) published by LQM/CIEH (2015) have been adopted.

These criteria have been derived using the CLEA model for a range of standard end-use scenarios and a range of soil organic matter (SOM) contents. It should be noted that the C4SL values are derived on the basis of a “low level of toxicological concern”, while the S4UL values are based on a “tolerable” or “minimal” level of risk. As such, the S4ULs describe a lower level of risk than the C4SLs, and are equivalent to the former Soil Guideline Values (SGVs, published by the Environment Agency) and the previous editions of the LQM/CIEH GAC values.

The GQRA is based on a soil with a Soil Organic Matter of 2.5%, for a commercial end use.

A full summary of the chemical test results is presented in **Appendix E.**

10.2 RESTRICTIONS

No restrictions were present on site that impacted the works. CP103b encountered a concrete slab at 0.70m bgl and was consequently repositioned.

10.3 RESULTS

Metals

Of the 7 No. samples submitted for metals analysis, no exceedances were recorded above the GACs protective of human health for the proposed commercial end land use. GroundSolve conclude that the site does not pose a risk to site end users with respect to metals.

Table 10.1: Metals Suite

Metals	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Arsenic	4.6	11	8.27	7	640	C4SL	0
Chromium	8.8	20.6	14.56	7	8600	S4UL	0
Copper	8.8	17.6	14.29	7	68000	S4UL	0

Metals	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Lead	10.5	159	68.29	7	2300	C4SL	0
Mercury	1.3	1.3	0.79	7	58	S4UL	0
Nickel	7.1	25.9	13.86	7	980	S4UL	0
Selenium	<3.0	<3.0	3.00	7	12000	S4UL	0
Zinc	25.2	114	75.14	7	730000	S4UL	0

PAHs

Of the 7 No. samples submitted for PAH analysis, no exceedances were recorded above the GACs protective of human health for the proposed commercial end land use. GroundSolve conclude that the site does not pose a risk to site end users with respect to PAHs.

Table 10.2: Polyaromatic Hydrocarbons

Polyaromatic Hydrocarbons (PAH)	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Acenaphthene	< 0.001	< 0.001	0.00	7	98	C4SL	0
Acenaphthylene	< 0.001	< 0.001	0.00	7	180000	S4UL	0
Anthracene	< 0.001	< 0.001	0.00	7	27000	S4UL	0
Benzo(a)anthracene	< 0.002	< 0.002	0.00	7	30000	S4UL	0
Benzo(a)pyrene	< 0.10	< 0.10	0.10	7	12000	S4UL	0
Benzo(b)fluoranthene	< 0.10	< 0.10	0.10	7	40000	S4UL	0
Benzo(g,h,i)perylene	< 0.10	< 0.10	0.10	7	11000	S4UL	0
Benzo(k)fluoranthene	< 1.0	< 1.0	1.00	7	47000	S4UL	0
Chrysene	0.5	0.6	0.53	7	90000	S4UL	0
Dibenzo(a,h)anthracene	0.7	9.8	4.54	7	1800000	S4UL	0
Fluoranthene	0.7	0.7	0.53	7	1800000	S4UL	0
Fluorene	< 0.010	< 0.010	0.01	7	86000	S4UL	0
Indeno(1,2,3-cd)pyrene	< 0.010	< 0.010	0.01	7	180000	S4UL	0
Naphthalene	< 0.010	< 0.010	0.01	7	17000	S4UL	0
Phenanthrene	1.9	2.6	2.20	7	34000	S4UL	0
Pyrene	4.9	7.1	5.86	7	38000	S4UL	0

Petroleum Hydrocarbons (TPH)

No hydrocarbon impacted material was encountered during the fieldwork. Of the 7 No. samples submitted for TPH analysis, no exceedances were recorded above the GACs protective of human health for the proposed commercial end land use. GroundSolve conclude that the site does not pose a risk to site end users with respect to TPH.

Table 10.3: Petroleum Hydrocarbons

Petroleum Hydrocarbons	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Aliphatic C5-C6	< 0.001	< 0.001	0.00	7	98	C4SL	0
Aliphatic C6-C8	< 0.001	< 0.001	0.00	7	180000	S4UL	0
Aliphatic C8-C10	< 0.001	< 0.001	0.00	7	27000	S4UL	0
Aliphatic C10-C12	< 0.002	< 0.002	0.00	7	30000	S4UL	0
Aliphatic C12-C16	< 0.10	< 0.10	0.10	7	12000	S4UL	0
Aliphatic C16-EC35	< 0.10	< 0.10	0.10	7	40000	S4UL	0
Aliphatic C35-C40	< 0.10	< 0.10	0.10	7	11000	S4UL	0
Aromatic C5-C7	< 1.0	< 1.0	1.00	7	47000	S4UL	0
Aromatic C7-C8	0.5	0.6	0.53	7	90000	S4UL	0
Aromatic C8-C10	0.7	9.8	4.54	7	1800000	S4UL	0
Aromatic C10-C12	0.7	0.7	0.53	7	1800000	S4UL	0
Aromatic C12-C16	< 0.010	< 0.010	0.01	7	86000	S4UL	0
Aromatic >C16-C21	< 0.010	< 0.010	0.01	7	180000	S4UL	0
Aromatic >C21-C35	< 0.010	< 0.010	0.01	7	17000	S4UL	0
Aromatic >C35-EC40	1.9	2.6	2.20	7	34000	S4UL	0

Asbestos

Asbestos can be present in soil as fragments of bulk Asbestos Containing Materials (ACMs) (e.g., asbestos cement sheeting) and also as discrete asbestos fibres within the soil matrix. This investigation has carried out assessments to determine whether both bulk fragments of asbestos and discrete fibres are present in the soil at the site. The asbestos assessment commenced on site with inspection of the Made Ground by our site staff for the presence of bulk ACMs. During the fieldwork no suspected ACMs were identified.

Laboratory assessments were carried out in order to confirm the site assessment that ACMs were absent, and no asbestos was detected in any of the samples retrieved from site.

10.4 ASSESSMENT FOR THE PROTECTION OF CONTROLLED WATERS

The total concentrations detected within soil samples recorded no exceedances above the respective GACs protective of human health for the proposed commercial end land use, and do not indicate particularly high concentrations which would be indicative of a significant source of groundwater contamination. Overall, it is assessed that there is a low possibility of a contaminant linkage between Made Ground and the underlying controlled waters environment.

- GroundSolve believes that the site does not pose a significant risk to Controlled Water because:
- No exceedances have been found in the area of the proposed development
- No groundwater abstractions are within 500m of the site.

10.5

10.5 PERMANENT GROUND GASES

Measured Gas Concentrations

A regime of 6 No. gas monitoring have been carried out by GroundSolve in the 3 No. gas monitoring wells. The highest flow rates, methane, and carbon dioxide concentrations to date, together with the lowest oxygen levels (i.e: a combination of the worst-case temporal conditions recorded) from the monitoring visits are summarised in the table below:

Table 10.4: Summary of Ground Gas Monitoring

Borehole	Response Zone m bgl	No. of monitoring occasions	Steady State Flow (l/hr)	Methane (%v/v)	Carbon Dioxide (%v/v)	Oxygen (% v/v)	Water Level m bgl	Atmospheric pressure readings mbar
WS102	1.00 – 4.00	6	0.2	0.2	5.1	16.9	4.70-4.72	993-1011
WS103	1.00 – 5.00	6	0.4	0.3	3.6	17.3	4.80-4.82	993-1011
WS104	1.00 – 5.00	6	-6.5	0.3	10.3	3.4	1.10-1.58	993-1011

* limit of detection on gas monitor

Ground Gas Assessment

Background information relating to the origin and production of landfill and ground gases are presented in **Appendix I**, together with current guidance on the assessment of ground gases. In accordance with this approach and the above measured ground gas levels, it is considered that the worst-case temporal conditions may not have been measured during the monitoring period. However, it is anticipated that the worst-case temporal conditions will not be significantly worse than those presented in above . From of CIRIA C665 the worst-case Characteristic Situation for the site are as follows:

Table 10.5: Characteristic Gas Situations

Borehole Number	Steady State Flow	CH_4			CO_2		
	l/h	% v/v	GSV (l/hr)	Characteristic Situation	% v/v	GSV (l/hr)	Characteristic Situation
WS102	0.2	0.2	0.0004	1	5.2	0.0104	1
WS103	0.4	0.3	0.0016	1	3.6	0.0144	1
WS104	-6.5	0.3	0.013	1	10.3	0.67	2*

** Negative flow concentrations have been converted to positive, which is considered a conservative approach.*

Low methane concentrations have been recorded. Based on the Ground Gas Assessment it can be seen that the carbon dioxide conditions at the site are the main risk driver regarding the gas conditions and are found to predominately effect the north of the site where WS104 is located. Based on the results of the gas monitoring and that carbon dioxide has been routinely recorded above 5%v/v, the site has been classified as **Characteristic Situation 2 – Low Risk Scenario for which ground gas protection measures are required.**

The Site is situated where the majority of the site is located in an area where between 3%-5% of the properties are above the radon action level, with the northeast located in in an area where between 5%-10% of properties are located above the radon action level. As such, basic radon protection measures will be required across the whole of the new development.

10.6 RISKS TO HUMAN HEALTH (CONSTRUCTION PHASE)

During the construction works there will be a risk from dust to on-site workers and people occupying adjacent properties. Appropriate risk assessments should be carried out by the contractor to allow appropriate controls for the mitigation of risk to health of construction workers to be put in place. This risk can be controlled to within acceptable limits by:

- Method statement for site activities including control of dust generation.
- Having adequate site hygiene facilities allowing staff to keep a good level of personal hygiene.
- The method statement shall have a contingency plan which should be implemented if the presence of contamination is suspected in groundworks.
- Only permitting smoking or eating on site in appropriate pre-designated areas.

Given the proximity of receptors in the environs of the site and construction workers, control of fugitive dust will be a priority. As a minimum it is anticipated the works will be undertaken in accordance with BRE best practise guidance, and that the following measures will be introduced to assist with control of dust generation during the groundworks phase of the works:

- Access roads and any stockpiles created during groundworks should be regularly damped down with water.
- Vehicles used to transport materials/wastes and aggregates should be enclosed or tarpaulined.
- Vehicle movements and speed should be kept to a minimum within the site.
- Dust generating equipment (e.g., mobile crushing and screening equipment) should be located to minimise potential nuisance impacts to receptors as far as practicable.
- Minimising drop heights of all loading and unloading activities that involve the transfer of soils and demolition materials.

10.7 CONCEPTUAL SITE MODEL

The proposed development comprises of a steel frame building which will be used as an archive facility in an existing soft landscaped area adjacent to Theatre Clwyd.

The conceptual site model has been updated since the Phase 1 Preliminary Risk Assessment, as the findings of the Phase 2 site investigation revealed the following general downward succession:

- **Site surface:** topsoil.
- **Made Ground:** Encountered at two isolated locations. Dense grey silty slightly sandy cobbly gravel of sandstone and concrete, deeper made ground encountered in WS104 comprised of grey sandy gravelly clay. CP103B was terminated at 0.7m on a concrete obstruction.
- **Fluvioglacial deposits:** Encountered in all areas, comprising fine to medium sand with gravels
- **Glacial Till:** Stiff brown sandy slightly gravelly clay.

The potential contamination at the site has been assessed using the contaminant-pathway-receptor linkage approach. Following the site investigation, the plausible contaminant sources have been updated or confirmed as:

- Ground Gas
- Radon

The results of site investigation and laboratory analysis of the submitted samples show that although measured concentrations were recorded, none exceed the relevant generic assessment criteria protective of human health for the proposed commercial end land use. GroundSolve conclude that the measured concentrations do not pose a significant risk to the human health on site.

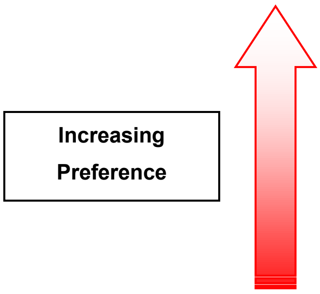
Gas Situation 2 and Basic Radon protection measures are required within the proposed development.

As with any project on a brownfield site there is the possibility of encountering unexpected contamination. If this occurs then the procedures set out in Appendix M should be implemented

11 WASTE ASSESSMENT

11.1 WASTE HIERARCHY

In accordance with government guidance, it is required that the production and disposal of waste is managed in accordance with the following hierarchy of preference:



AVOIDANCE

REDUCTION

RE- USE

RECOVER (including RECYCLING)

DISPOSAL (the final option)

11.2 WASTE CHARACTERISATION AND CLASSIFICATION

If there is a portion of excess soil this will then have to be sent to a suitable landfill site. A two-phase approach is required comprising:

Waste Characterisation; and

Waste Classification (Waste Acceptance Criteria).

Waste Characterisation

The results of the total concentrations from the chemical testing on soil samples have been assessed to determine whether or not they are hazardous in terms of waste characterisation. The results of this assessment indicate that the materials encountered during the investigation can be classified as non hazardous.

Waste Classification

In order to determine whether soils can be sent to a licensed landfill for disposal further testing is required comprising landfill Waste Acceptance Criteria (WAC) analysis for both total concentrations for certain chemicals and for leachate analysis. No WAC testing was carried out as part of this investigation. WAC testing will have to be carried out to confirm the landfill waste classification and if any pre-treatment is required. This is best carried out once all material to be disposed of is stockpiled, and volumes can be accurately assessed. It should be noted that natural clay can be classified as Inert Waste 17 05 04: Soil and stones only (excluding topsoil, peat, soil and stones).

Testing Frequency

There are also set requirements for the required sampling and testing frequencies for materials being sent for disposal at landfills. The required testing frequencies for each different waste type are summarised in **Table 11.1** below.

Table 11-1: Laboratory Sampling Testing Frequencies

Testing Level	Quantity of Waste	Number of Samples	
		Homogeneous	Heterogeneous & New Wastes
Level 1 Characterisation (Description, Total Concentrations & Leaching)	<100T	2	5
	<500T	3	8
	<1000T	5	14
	10,000 T	11	22
	Per additional 10,000T	+5 pro rata	+10 pro rata
Level 2 Compliance For Regularly Generated Wastes (Total Concentrations & Leaching)		1 per defined waste sub-population per year	3 per defined waste sub-population per year
Level 3 Verification Delivery document & visual check Chemical testing as per Level 2 suite		Visual – Each Load	Visual – Each Load
		1 per year per waste stream	3 per year per waste stream

12 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

12.1 FIELDWORK AND LABORATORY DATA REVIEW

The proposed development includes the construction of a steel framed commercial building.

The main part of the site is relatively flat with a fall from north (141.5m OD) to south (140.0m OD). There are relatively steeps slopes along the northern, eastern and southern boundaries. The northern boundary slopes from 141.5m OD to 138.25m OD to kerbside. The eastern boundary slopes from 141mOD to 137.5mOD. The southern boundary slopes from 138.2m OD to 136.2m OD. The proposed floor levels are not finalised at the time of this report.

It's understood column loads are anticipated to be in the region of 2500kN.

The shallow ground conditions predominantly comprise of sands (fine to medium) that are variably gravelly and range from loose to dense. Clay is present underlying the sand and is typically sandy and becoming stiff to very stiff with depth. Gravels are commonly subangular to subrounded and composed of sandstone, siltstone, and occasional coal fragments. The sand deposits should prove suitable for conventional spread foundations (pads/strips) however due to anticipated loads, pads/strips are unlikely to prove suitable. Foundations are likely to be required to extend deeper to achieve suitable capacity for anticipated loads.

Soil classification tests were carried out on the superficial deposits which when plotted against the A-Line, **Figure 12-1** indicated clays show low plasticity with liquid limits ranging between 18 and 21, plastic limits ranging between 12% and 13% (CP102 at 12.00m was recorded as non-plastic), plasticity indexes ranging between 6 and 8% and moisture contents between 8% and 20%.

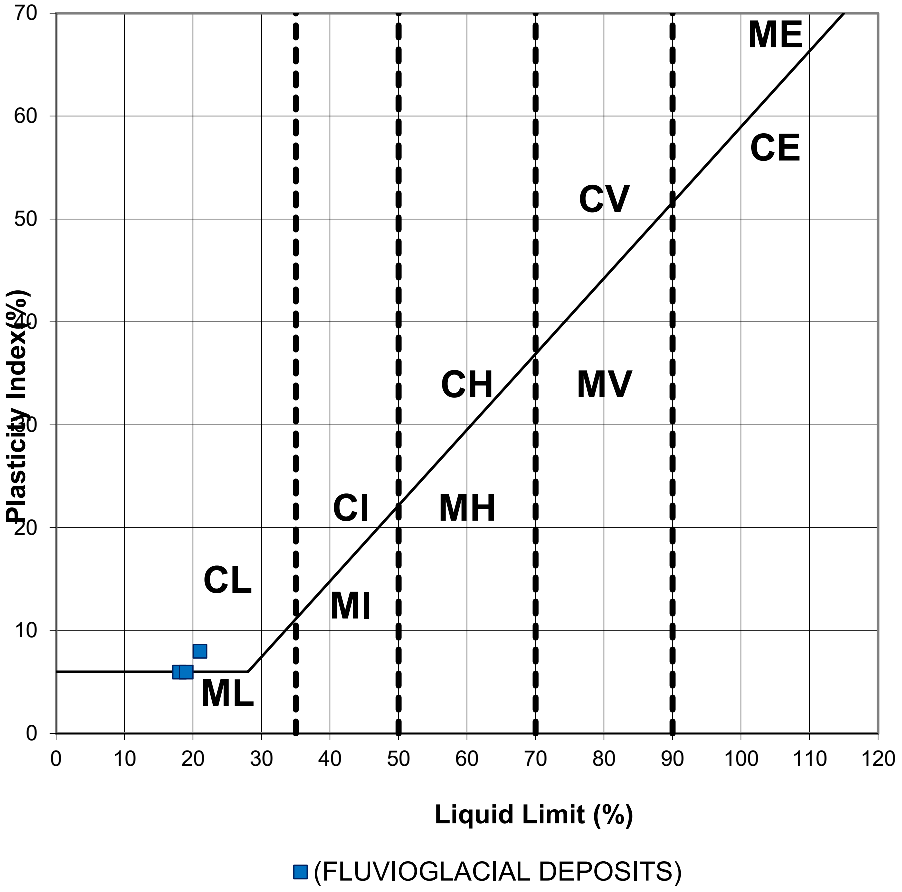


Figure 12-1 - A Line Plot

Table 9.1 Summary of Classification Testing

Hole	Depth (m)	Moisture Content (%)	% passing 425um sieve	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Modified Plasticity Index	Plasticity	Volume Change Potential
CP101	9.00	8.7	48	18	12	6	2.88	Low	Low
CP101	12.00	12.9	82	19	13	6	5	Low	Low
CP102	12.00	20.2			NP				
CP103	4.00	11.4	93	21	13	8	7	Low	Low
Minimum		8.7	48	18	12	6	3		
Average		13.3	74	19	13	7	5		
Maximum		20.2	93	21	13	8	7		

Standard Penetration Tests (SPT)

The SPT N values vary within the sand from 5 to 24 with an average of 11, between 9 and 16 and an average of 11 in the gravel and between 8 and 50 with an average of 22 within the clay. The SPT values indicate an undrained shear strength typically in the range of 40 and >250 kN/m2 (medium to high strength). When plotted against depth, see **Figure 12-2** there is a clear increase in density and stiffness with depth.

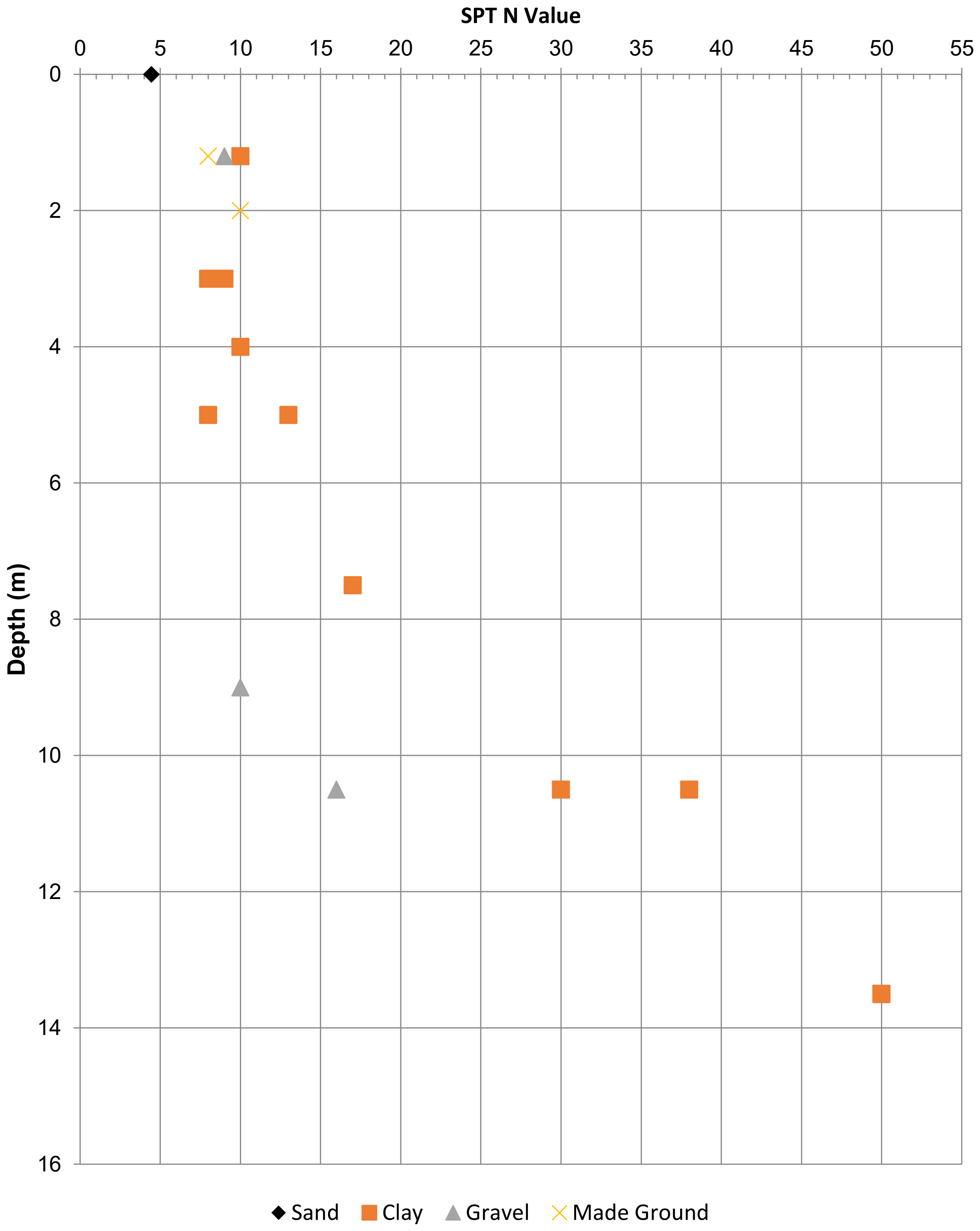


Figure 12-2 – SPT N Value with Depth plotted by strata type

Stroud, 1975 was used to derive undrained shear strength for the superficial deposits utilising an f1 value of 5. Strength Vs depth plots for cohesive materials show deposits ranging between 40 to >250kPa (medium to very high strength) Quick Undrained Triaxial testing was also undertaken on undisturbed samples recovered from glaciofluvial deposits, results of which are broadly consistent with derived values and can be found below in **Figure 12-3.**

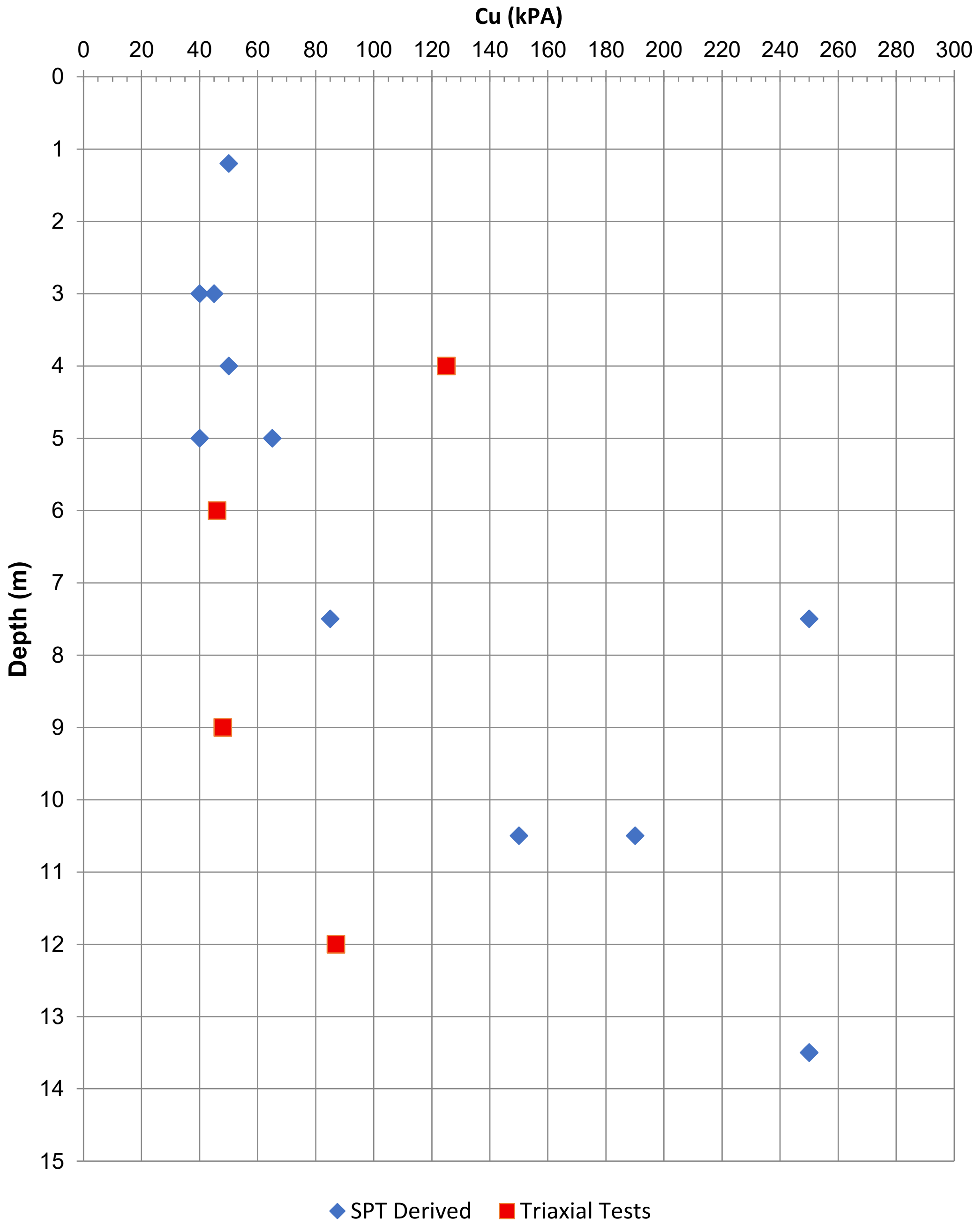


Figure 12-3 – Undrained Shear Strength vs Depth

A total of seven Particle Size Distribution (PSD) tests were carried out on bulk samples the results of which are summarised in **Figure 12-4** below. The results confirm the engineers' descriptions of predominantly granular deposits, with these summarised in **Table 12-1**.

Table 12-1 – PSD Soil Fractions Summary Table

Borehole	Depth (m)	Sample Type	Cobbles (%)	Gravel (%)	Sand (%)	Silt/Clay (%)
CP101	2.00	B	0	13	80	7
CP102	1.20	B	0	18	21	61
CP102	7.50	B	0	34	53	13
CP103	9.00	B	0	52	38	10
WS101	3.00	B	0	0	38	62
WS102	0.80	B	0	52	21	27
WS105	1.40	B	0	51	20	29

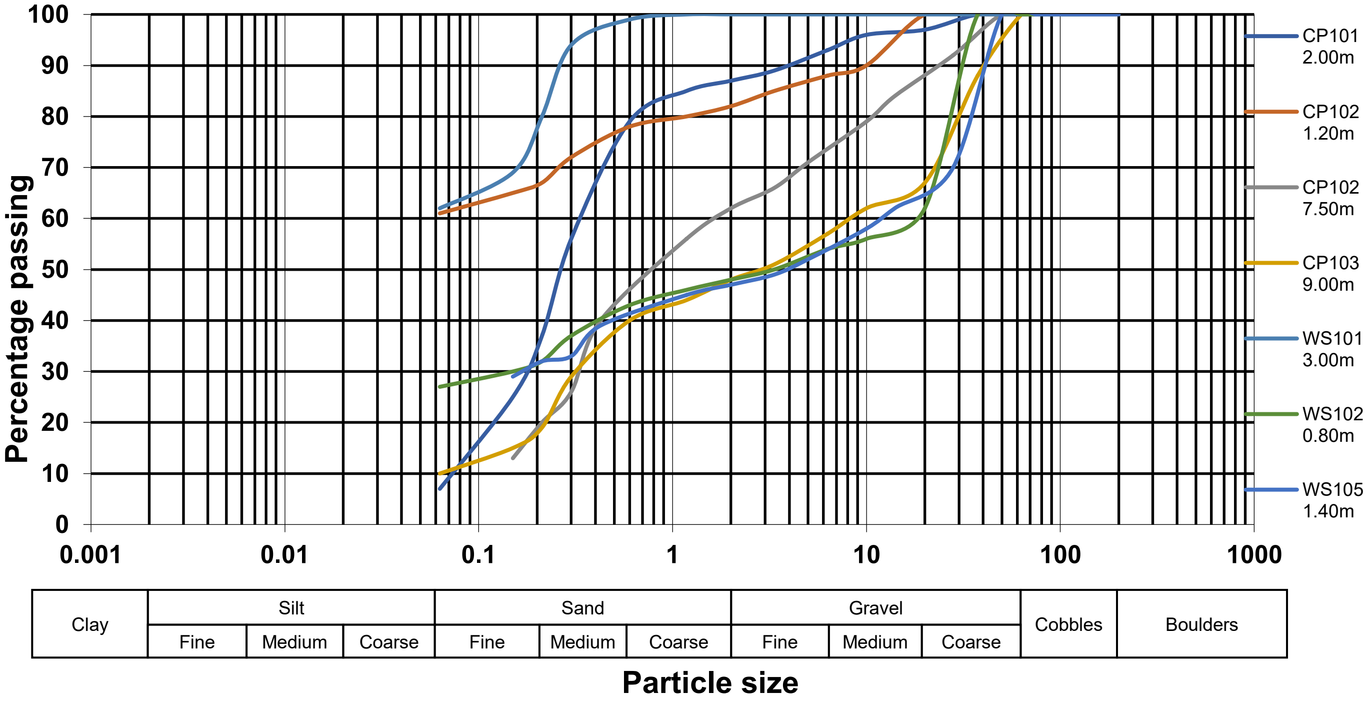


Figure 12-4 – PSD Grading Curve

12.2 Trees

A number of mature trees and bushes are located on or adjacent to the site boundaries. A comprehensive tree survey of those trees within the site boundary, and up to 20m beyond the site boundary (assuming mature high water demand trees are not present along the boundary) will be required to determine the effect of existing trees to proposed properties and also to assess the condition of trees which are to remain.

Any proposed felling or removal of trees or hedgerows should be agreed with the Local Authority as part of the pre-planning discussions for development and should be carried out outside the bird nesting season (it may be possible that tree felling can be carried out during the bird nesting season under the direction of an ecologist).

Care must be taken to ensure that any existing trees scheduled for retention are not adversely affected by construction operations. Further guidance on this aspect of site works is given in the British Standards "Guidance for Trees in Relation to Constructions", BS5837.

12.3 FOUNDATION RECOMMENDATIONS

For the purpose of this assessment, it is assumed the site will not be subject to extensive reprofiling.

The presence of loose silty sand across the majority of the site extending to a depth of up to 5.45m bgl in some areas (WS102) and anticipated column loads up to 2500kN means the adoption of conventional spread foundations such as ground bearing strips or pads is unfeasible and as such some form of deep foundation or ground treatment will be required. It is therefore anticipated that a piled foundation solution will be required.

When determining pile type and their locations the following will need to be considered.

- The presence of existing services and structures in close proximity
- Loose sands resulting in collapse of boreholes during drilling, particularly for CFA or bored piles.
- Socket length into competent underlying material (stiff clay)

Given the above we would suggest the optimum solution would be the installation of cased bored piles taken through the loose sand (Fluvioglacial deposits) and into the underlying stiff to very stiff clay (Glacial Till). We have not been instructed to undertake a detailed pile design however an indicative pile safe working load of 2666.7kN (unfactored) for a 600mm bored pile at a length of 11.50m has been calculated. For the office building where maximum column loads are anticipated to be 1000kN, an indicative safe working load of 1280kN (unfactored) for a 450mm diameter pile to 10.00m has been calculated.

When footings have been initially sized then full design of these should be carried out in accordance with BS EN 1997-1: 2004 +A1 2013: Eurocode 7 – Geotechnical Design – Part 1: General rules (including UK National Annex of November 2007) and BS8004: 2015 : Code of practice for foundations.

Vibro stone columns may be considered in principle; however, given the thickness of loose granular deposits and the magnitude of the proposed column loads (up to 2500kN), this solution is considered marginal and potentially uneconomical for primary structural support. As such, vibro improvement is not considered a preferred solution for heavily loaded elements but may be suitable for lightly loaded areas subject to further specialist design.

Any piling works undertaken from existing ground levels will require a suitable piling mat/platform constructed in accordance with BRE Report 470 (2004). A geotextile may be incorporated into the platform to reduce the required thickness and the platform could be designed as part of the engineering fill required for any earthworks to alter final site levels. Groundsolve can assist in the design if required once the VSC/piling rig types are known.

12.4 REUSE OF MATERIALS

The glacial deposits are considered suitable as structural fill material subject to placement and compaction with an approved earthworks specification.

12.5 GROUNDWATER CONDITIONS

4 No. rounds of groundwater monitoring have been carried out to date by GroundSolve in the groundwater monitoring well installations. Groundwater level varies between 1.10m bgl and 4.82m bgl.

12.6 GROUNDWATER & EXCAVATIONS

It is not expected that significant groundwater will be encountered in any excavations at this site. It is anticipated that any groundwater in excavations can be controlled by sump pumping. If inflows are relatively localised, this may cause softening of the ground and require localised excavation support in order to prevent instability of the sides of excavations.

Due to the granular nature of the shallow soils, it is anticipated that soils will gradually collapse into excavations, leading to instability of the sides of excavations. All excavations should be carried out in accordance with CIRIA Report 97 “Trenching Practice” and BS6031: 2009: Code of Practice for Earthworks. Further guidance on this aspect of site works is given in the British Standards for “Workmanship on Building Sites”, BS 8000, Parts 1 and 14, and in the Construction Industry Training Board’s Site Safety Note 10.

Excavation depths should generally be readily achieved using conventional hydraulic plant (e.g. wheeled JCB or similar) although larger plant will have higher excavation rates.

12.7 BURIED CONCRETE AND PIPEWORK

The results of laboratory pH and sulphate content indicate that ACEC Class AC-1 conditions prevail in accordance with BRE Special Digest 1, 2005 (the Design Concrete Class). Therefore, special precautions are not required at the site for the design of concrete in terms of the durability and structural performance.

12.8 SOAKAWAYS

Variable head permeability in-situ tests were carried out within the fieldwork in 2 No. borehole locations (WS013 and WS104). WS103 recorded a permeability of 8.05×10^{-6} m/s and was carried out within the Glacial sand deposits. It is anticipated that the value is conservative as the test was completed within 2mins due to fast drainage.

WS104 recorded a permeability of 7.24×10^{-8}m/s, and was carried out within the cohesive Made Ground.

Soakaway drainage can be considered, however should target the glacial sand deposits. The soakaway testing result are presented in **Appendix G**.

12.9 ROAD DESIGN

The performance of any hard standing will be determined by the weaker areas, therefore based upon the nature of the ground conditions encountered during the site investigations undertaken, it is recommended that a lower bound CBR value of 5% is adopted for design purposes. All exposed formations should be proof rolled and any soft spots revealed should be excavated and replaced with suitable compacted granular fill.

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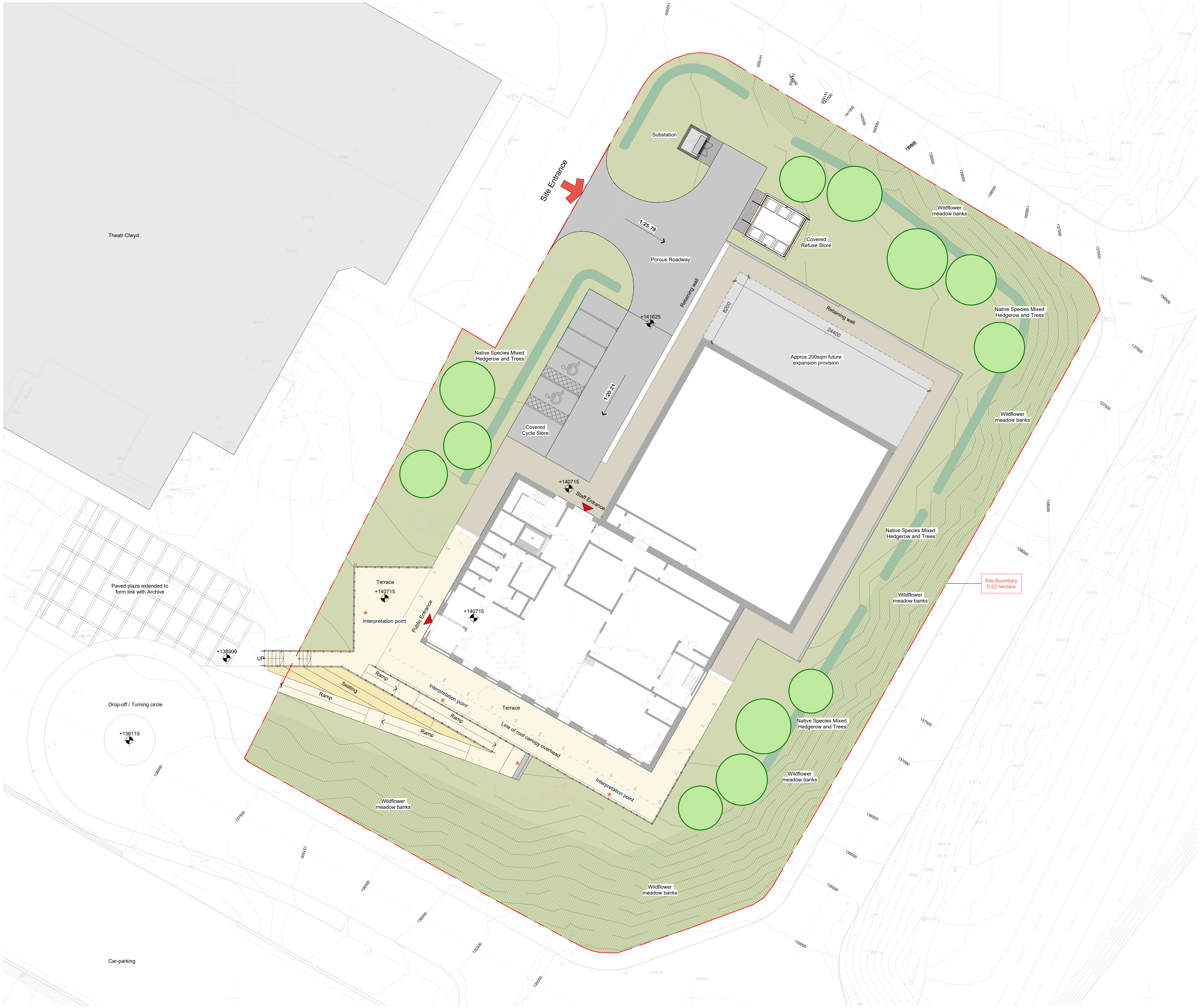
BGS Geology of Britain Viewer http://mapapps.bgs.ac.uk/geologyofbritain/home.html

APPENDIX A: DRAWINGS



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Notes:

- Figured dimensions are to be used in all case.
- Dimensions should not be scaled from drawing.
- All existing dimensions should be checked on site before commencement of the works.
- Any discrepancies in dimensions should be clarified with the Architect prior to commencement of the works.
- No deviation from this drawing will be permitted without the prior written consent of the Architect.
- This drawing is to be read in conjunction with all other relevant LMA drawings, and the drawings and information produced by other professionals / consultants involved in the project
- Please note that the use of any quantification data is done so at the users own risk.
- This drawing is the copyright of **Lovelock Mitchell Architects** and to be returned to the Architect on completion of the contract. The drawing should not be reproduced without the written permission of **Lovelock Mitchell Architects.**

This drawing must be printed in colour to be read correctly

N

P1	25-10-03	First Issue of Drawing	ST	PAF
Rev.	**Date**	**Revision Description**	**Drawn**	**Checked**

MLD | LMA | 01 | XX | DR | A

1140 | P1

[SITE]

Site_Plan_Proposed

North East Wales Archives
Mold

Status: S2 | Information

Project Number: 2518

LOVELOCK MITCHELL
ARCHITECTS

3 Stanley Street Chester CH1 2LS
01244 404321
www.lovelockmitchell.com

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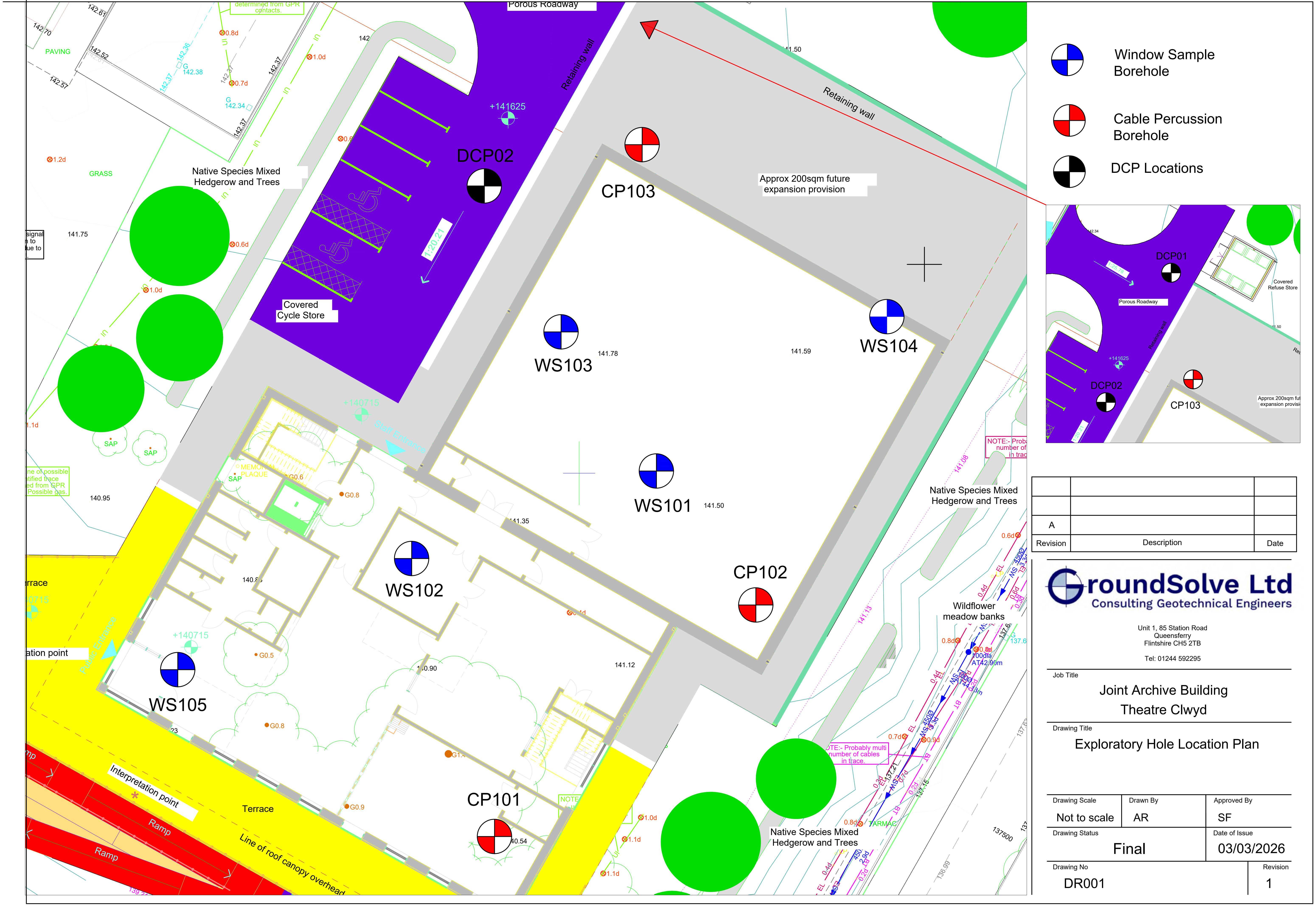


A		
Revision	Description	Date

GroundSolve Ltd
Consulting Geotechnical Engineers

Unit 1, 85 Station Road
Queensferry
Flintshire CH5 2TB

Tel: 01244 592295

Job Title
Joint Archive Building
Theatre Clwyd

Drawing Title
Exploratory Hole Location Plan

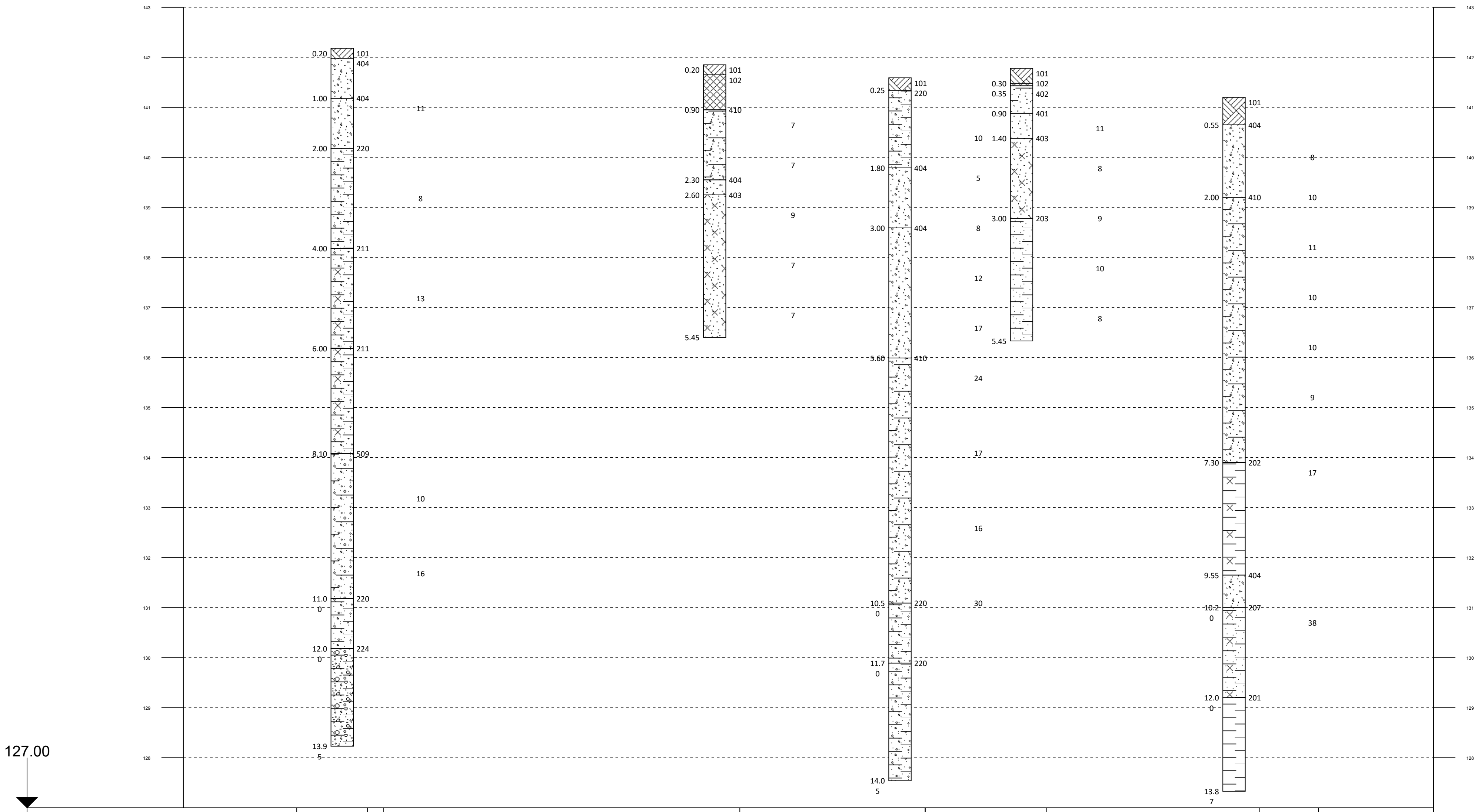
Drawing Scale	Drawn By	Approved By
Not to scale	AR	SF

Drawing Status: Final
Date of Issue: 03/03/2026

Drawing No: DR001
Revision: 1

Project Id: 3455
Project Title: Joint Archive Building - Theatre Clywd, Mold
Location: Raikes Ln, Mold CH7 1YA
Client: Wynne Construction

Title: Section Line
Vertical Scale: 1:112
Horizontal Scale: 1:372
Engineer:



Chainage (m)	0.00	4.69	5.78	29.43	41.74	49.81	63.92	67.85
Elevation (mAOD)		142.18	142.10	141.85	141.59	141.78	141.20	
Offset (m)		1.33	5.67	9.89	2.91	8.01	1.54	

APPENDIX B: SITE PHOTOGRAPHS

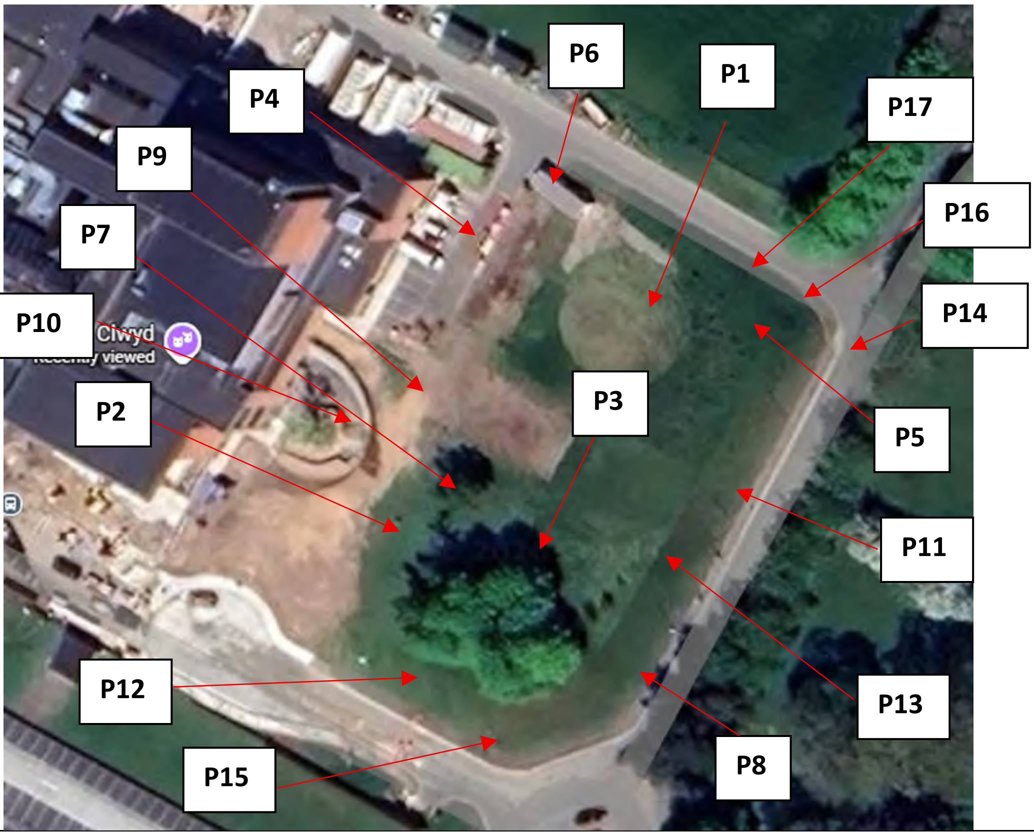

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Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

Photo 16

Photo 17

APPENDIX C: GROUNDSURE REPORT

Groundsure
LOCATION INTELLIGENCE

Enviro+Geo
Insight

THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA

Order Details

Date:	30/01/2026
Your ref:	3455 / PO002971
Our Ref:	GS-XOV-8BI-W33-WWC

Site Details

Location:	324192 365252
Area:	0.59 ha
Authority:	Sir y Fflint - Flintshire County Council ↗

Summary of findings p. 2 >

OS MasterMap site plan p.14 >

Aerial image p. 9 >

Insight User Guide ↗

Contact us with any questions at:
info@groundsure.com ↗
01273 257 755

Summary of findings

Page	Section	Past land use >	On site	0-50m	50-250m	250-500m	500-2000m
15 >	1.1 >	Historical industrial land uses >	0	1	24	22	-
17 >	1.2 >	Historical tanks >	1	0	1	1	-
18 >	1.3 >	Historical energy features >	0	1	1	0	-
18	1.4	Historical petrol stations	0	0	0	0	-
19	1.5	Historical garages	0	0	0	0	-
19	1.6	Historical military land	0	0	0	0	-

Page	Section	Past land use - un-grouped >	On site	0-50m	50-250m	250-500m	500-2000m
20 >	2.1 >	Historical industrial land uses >	0	1	31	26	-
23 >	2.2 >	Historical tanks >	1	0	1	1	-
23 >	2.3 >	Historical energy features >	0	3	1	0	-
23	2.4	Historical petrol stations	0	0	0	0	-
24	2.5	Historical garages	0	0	0	0	-

Page	Section	Waste and landfill >	On site	0-50m	50-250m	250-500m	500-2000m
25	3.1	Active or recent landfill	0	0	0	0	-
25	3.2	Historical landfill (BGS records)	0	0	0	0	-
26	3.3	Historical landfill (LA/mapping records)	0	0	0	0	-
26	3.4	Historical landfill (EA/NRW records)	0	0	0	0	-
26 >	3.5 >	Historical waste sites >	0	0	1	0	-
26	3.6	Licensed waste sites	0	0	0	0	-
27 >	3.7 >	Waste exemptions >	0	0	1	0	-

Page	Section	Current industrial land use >	On site	0-50m	50-250m	250-500m	500-2000m
28 >	4.1 >	Recent industrial land uses >	0	1	2	-	-
29	4.2	National Geographic Database (NGD) - Current or recent tanks	0	0	0	-	-
29	4.3	Current or recent petrol stations	0	0	0	0	-
29	4.4	Electricity cables	0	0	0	0	-
29	4.5	Gas pipelines	0	0	0	0	-

29	4.6	Sites determined as Contaminated Land	0	0	0	0	-
30	4.7	Control of Major Accident Hazards (COMAH)	0	0	0	0	-
30	4.8	Regulated explosive sites	0	0	0	0	-
30	4.9	Hazardous substance storage/usage	0	0	0	0	-
30	4.10	Historical licensed industrial activities (IPC)	0	0	0	0	-
30	4.11	Licensed industrial activities (Part A(1))	0	0	0	0	-
31	4.12	Licensed pollutant release (Part A(2)/B)	0	0	0	0	-
31	4.13	Radioactive Substance Authorisations	0	0	0	0	-
31 >	**4.14** >	**Licensed Discharges to controlled waters** >	0	0	0	1	-
31	4.15	Pollutant release to surface waters (Red List)	0	0	0	0	-
32	4.16	Pollutant release to public sewer	0	0	0	0	-
32	4.17	List 1 Dangerous Substances	0	0	0	0	-
32	4.18	List 2 Dangerous Substances	0	0	0	0	-
32 >	**4.19** >	**Pollution Incidents (EA/NRW)** >	0	0	0	1	-
33	4.20	Pollution inventory substances	0	0	0	0	-
33	4.21	Pollution inventory waste transfers	0	0	0	0	-
33	4.22	Pollution inventory radioactive waste	0	0	0	0	-
Page	Section	**Hydrogeology** >	On site	0-50m	50-250m	250-500m	500-2000m
34 >	**5.1** >	**Superficial aquifer** >	Identified (within 500m)				
36 >	**5.2** >	**Bedrock aquifer** >	Identified (within 500m)				
38 >	**5.3** >	**Groundwater vulnerability** >	Identified (within 50m)				
39	5.4	Groundwater vulnerability- soluble rock risk	None (within 0m)				
39	5.5	Groundwater vulnerability- local information	None (within 0m)				
40 >	**5.6** >	**Groundwater abstractions** >	0	0	0	0	12
43	5.7	Surface water abstractions	0	0	0	0	0
43	5.8	Potable abstractions	0	0	0	0	0
44	5.9	Source Protection Zones	0	0	0	0	-
44	5.10	Source Protection Zones (confined aquifer)	0	0	0	0	-
Page	Section	**Hydrology** >	On site	0-50m	50-250m	250-500m	500-2000m

45 >	**6.1** >	**Water Network (OS MasterMap)** >	0	0	3	-	-
46 >	**6.2** >	**Surface water features** >	0	0	2	-	-
46 >	**6.3** >	**WFD Surface water body catchments** >	1	-	-	-	-
47 >	**6.4** >	**WFD Surface water bodies** >	0	0	0	-	-
47 >	**6.5** >	**WFD Groundwater bodies** >	1	-	-	-	-
Page	Section	River and coastal flooding	On site	0-50m	50-250m	250-500m	500-2000m
48	7.1	Risk of flooding from rivers and the sea	None (within 50m)				
48	7.2	Historical Flood Events	0	0	0	-	-
48	7.3	Flood Defences	0	0	0	-	-
49	7.4	Areas Benefiting from Flood Defences	0	0	0	-	-
49	7.5	Flood Storage Areas	0	0	0	-	-
50	7.6	Flood Zone 2	None (within 50m)				
50	7.7	Flood Zone 3	None (within 50m)				
Page	Section	Surface water flooding					
51	8.1	Surface water flooding	Negligible (within 50m)				
Page	Section	**Groundwater flooding** >					
52 >	**9.1** >	**Groundwater flooding** >	Moderate (within 50m)				
Page	Section	**Environmental designations** >	On site	0-50m	50-250m	250-500m	500-2000m
53	10.1	Sites of Special Scientific Interest (SSSI)	0	0	0	0	0
54	10.2	Conserved wetland sites (Ramsar sites)	0	0	0	0	0
54	10.3	Special Areas of Conservation (SAC)	0	0	0	0	0
54	10.4	Special Protection Areas (SPA)	0	0	0	0	0
54	10.5	National Nature Reserves (NNR)	0	0	0	0	0
55	10.6	Local Nature Reserves (LNR)	0	0	0	0	0
55 >	**10.7** >	**Designated Ancient Woodland** >	0	0	2	1	47
57	10.8	Biosphere Reserves	0	0	0	0	0
57	10.9	Forest Parks	0	0	0	0	0
57	10.10	Marine Conservation Zones	0	0	0	0	0
58	10.11	Green Belt	0	0	0	0	0

58	10.12	Proposed Ramsar sites	0	0	0	0	0
58	10.13	Possible Special Areas of Conservation (pSAC)	0	0	0	0	0
58	10.14	Potential Special Protection Areas (pSPA)	0	0	0	0	0
58	10.15	Nitrate Sensitive Areas	0	0	0	0	0
59 >	**10.16** >	**Nitrate Vulnerable Zones** >	1	1	0	0	1
60 >	**10.17** >	**SSSI Impact Risk Zones** >	1	-	-	-	-
61	10.18	SSSI Units	0	0	0	0	0
Page	Section	**Visual and cultural designations** >	On site	0-50m	50-250m	250-500m	500-2000m
62	11.1	World Heritage Sites	0	0	0	-	-
63	11.2	Area of Outstanding Natural Beauty	0	0	0	-	-
63	11.3	National Parks	0	0	0	-	-
63 >	**11.4** >	**Listed Buildings** >	0	1	2	-	-
64	11.5	Conservation Areas	0	0	0	-	-
64	11.6	Scheduled Ancient Monuments	0	0	0	-	-
64	11.7	Registered Parks and Gardens	0	0	0	-	-
Page	Section	**Agricultural designations** >	On site	0-50m	50-250m	250-500m	500-2000m
65 >	**12.1** >	**Agricultural Land Classification** >	Grade 3b (within 250m)				
66	12.2	Open Access Land	0	0	0	-	-
66	12.3	Tree Felling Licences	0	0	0	-	-
66	12.4	Environmental Stewardship Schemes	0	0	0	-	-
66	12.5	Countryside Stewardship Schemes	0	0	0	-	-
Page	Section	Habitat designations	On site	0-50m	50-250m	250-500m	500-2000m
68	13.1	Priority Habitat Inventory	0	0	0	-	-
68	13.2	Habitat Networks	0	0	0	-	-
68	13.3	Open Mosaic Habitat	0	0	0	-	-
68	13.4	Limestone Pavement Orders	0	0	0	-	-
Page	Section	**Geology 1:10,000 scale** >	On site	0-50m	50-250m	250-500m	500-2000m
69 >	**14.1** >	**10k Availability** >	Identified (within 500m)				
70	14.2	Artificial and made ground (10k)	0	0	0	0	-

71	14.3	Superficial geology (10k)	0	0	0	0	-
71	14.4	Landslip (10k)	0	0	0	0	-
72	14.5	Bedrock geology (10k)	0	0	0	0	-
72	14.6	Bedrock faults and other linear features (10k)	0	0	0	0	-
Page	Section	**Geology 1:50,000 scale >**	On site	0-50m	50-250m	250-500m	500-2000m
73 >	15.1 >	**50k Availability >**	Identified (within 500m)				
74 >	15.2 >	**Artificial and made ground (50k) >**	0	0	1	0	-
75	15.3	Artificial ground permeability (50k)	0	0	-	-	-
76 >	15.4 >	**Superficial geology (50k) >**	1	0	2	6	-
77 >	15.5 >	**Superficial permeability (50k) >**	Identified (within 50m)				
77	15.6	Landslip (50k)	0	0	0	0	-
77	15.7	Landslip permeability (50k)	None (within 50m)				
78 >	15.8 >	**Bedrock geology (50k) >**	1	1	2	5	-
79 >	15.9 >	**Bedrock permeability (50k) >**	Identified (within 50m)				
79 >	15.10 >	**Bedrock faults and other linear features (50k) >**	0	1	1	6	-
Page	Section	**Boreholes >**	On site	0-50m	50-250m	250-500m	500-2000m
81 >	16.1 >	**BGS Boreholes >**	0	0	6	-	-
Page	Section	**Natural ground subsidence >**					
83 >	17.1 >	**Shrink swell clays >**	Negligible (within 50m)				
84 >	17.2 >	**Running sands >**	Very low (within 50m)				
85 >	17.3 >	**Compressible deposits >**	Negligible (within 50m)				
86 >	17.4 >	**Collapsible deposits >**	Very low (within 50m)				
87 >	17.5 >	**Landslides >**	Very low (within 50m)				
88 >	17.6 >	**Ground dissolution of soluble rocks >**	Negligible (within 50m)				
Page	Section	**Mining and ground workings >**	On site	0-50m	50-250m	250-500m	500-2000m
90 >	18.1 >	**BritPits >**	0	0	0	1	-
91 >	18.2 >	**Surface ground workings >**	0	0	12	-	-
92 >	18.3 >	**Underground workings >**	0	0	12	8	37
94	18.4	Underground mining extents	0	0	0	0	-

94	18.5	Historical Mineral Planning Areas	0	0	0	0	-
94 >	**18.6** >	**Non-coal mining** >	1	1	4	5	14
97 >	**18.7** >	**JPB mining areas** >	Identified (within 0m)				
98	18.8	The Coal Authority non-coal mining	0	0	0	0	-
98 >	**18.9** >	**Researched mining** >	0	0	0	4	-
99	18.10	Mining record office plans	0	0	0	0	-
99	18.11	BGS mine plans	0	0	0	0	-
99 >	**18.12** >	**Coal mining** >	Identified (within 0m)				
99	18.13	Brine areas	None (within 0m)				
100	18.14	Gypsum areas	None (within 0m)				
100	18.15	Tin mining	None (within 0m)				
100	18.16	Clay mining	None (within 0m)				

Page	Section	**Ground cavities and sinkholes** >	On site	0-50m	50-250m	250-500m	500-2000m
101 >	**19.1** >	**Natural cavities** >	0	0	0	1	-
102	19.2	Mining cavities	0	0	0	0	0
102	19.3	Reported recent incidents	0	0	0	0	-
102	19.4	Historical incidents	0	0	0	0	-

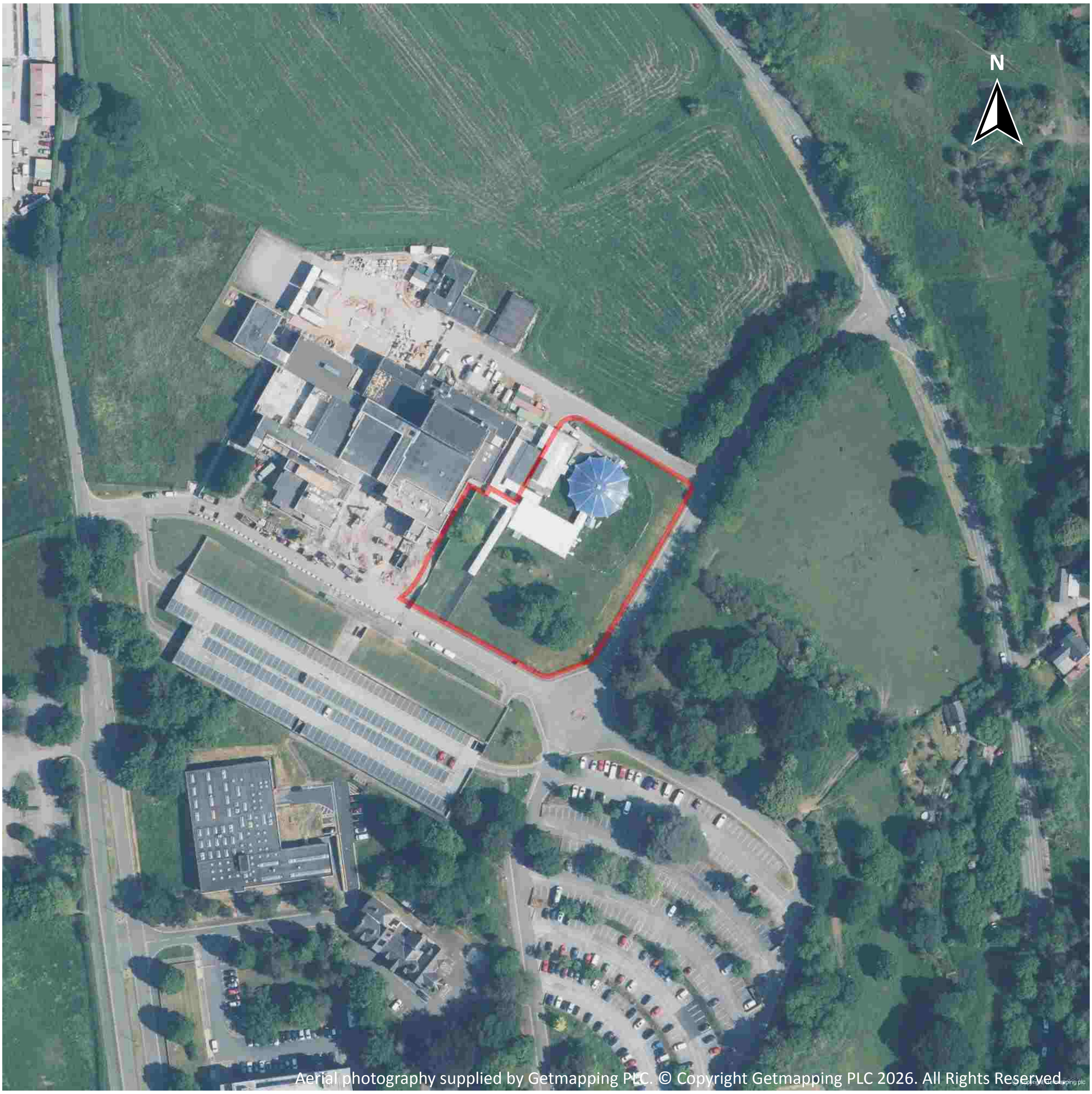
Page	Section	**Radon** >	
103 >	**20.1** >	**Radon** >	Between 5% and 10% (within 0m)

Page	Section	**Soil chemistry** >	On site	0-50m	50-250m	250-500m	500-2000m
105 >	**21.1** >	**BGS Estimated Background Soil Chemistry** >	1	1	-	-	-
105	21.2	BGS Estimated Urban Soil Chemistry	0	0	-	-	-
105	21.3	BGS Measured Urban Soil Chemistry	0	0	-	-	-

Page	Section	Railway infrastructure and projects	On site	0-50m	50-250m	250-500m	500-2000m
106	22.1	Underground railways (London)	0	0	0	-	-
106	22.2	Underground railways (Non-London)	0	0	0	-	-
106	22.3	Railway tunnels	0	0	0	-	-
106	22.4	Historical railway and tunnel features	0	0	0	-	-
106	22.5	Royal Mail tunnels	0	0	0	-	-

107	22.6	Historical railways	0	0	0	-	-
107	22.7	Railways	0	0	0	-	-
107	22.8	Crossrail 2	0	0	0	0	-
107	22.9	HS2	0	0	0	0	-

Recent aerial photograph



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Capture Date: 20/05/2023

Site Area: 0.59ha

Recent site history - 2020 aerial photograph

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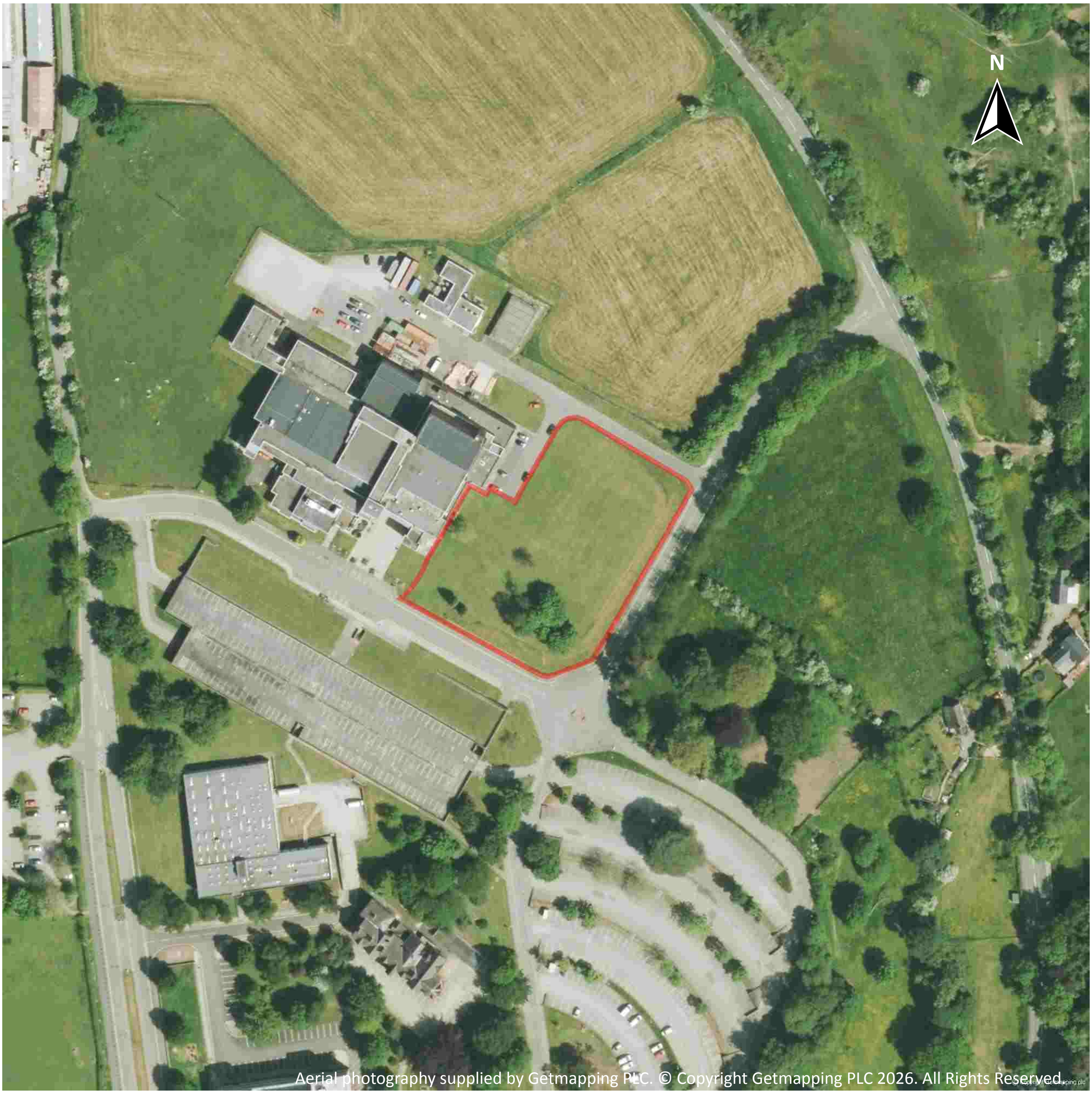
Capture Date: 10/04/2020

Site Area: 0.59ha

Recent site history - 2013 aerial photograph



Capture Date: 04/06/2013

Site Area: 0.59ha

Recent site history - 2009 aerial photograph

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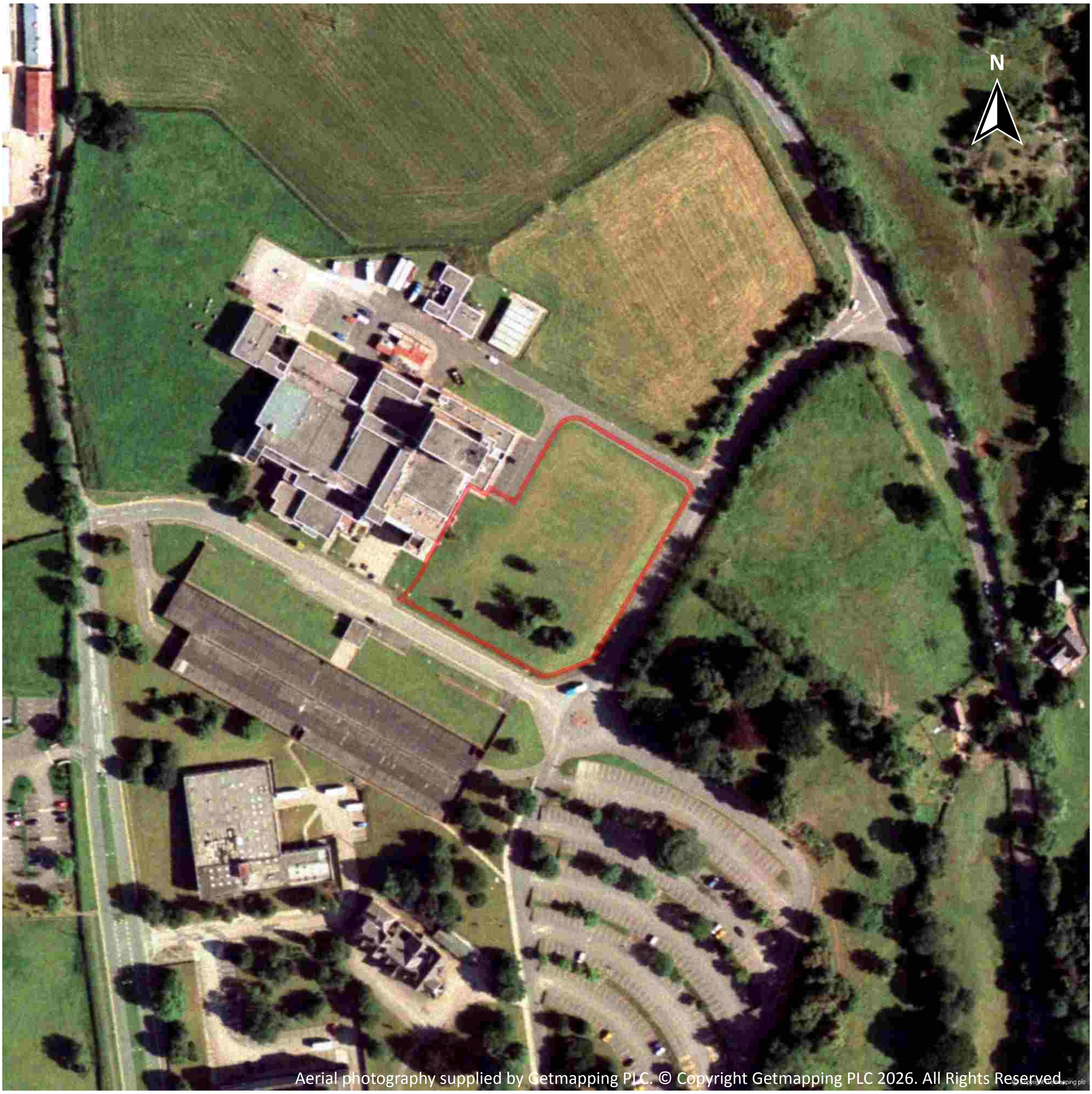
Capture Date: 01/06/2009

Site Area: 0.59ha

Recent site history - 2001 aerial photograph



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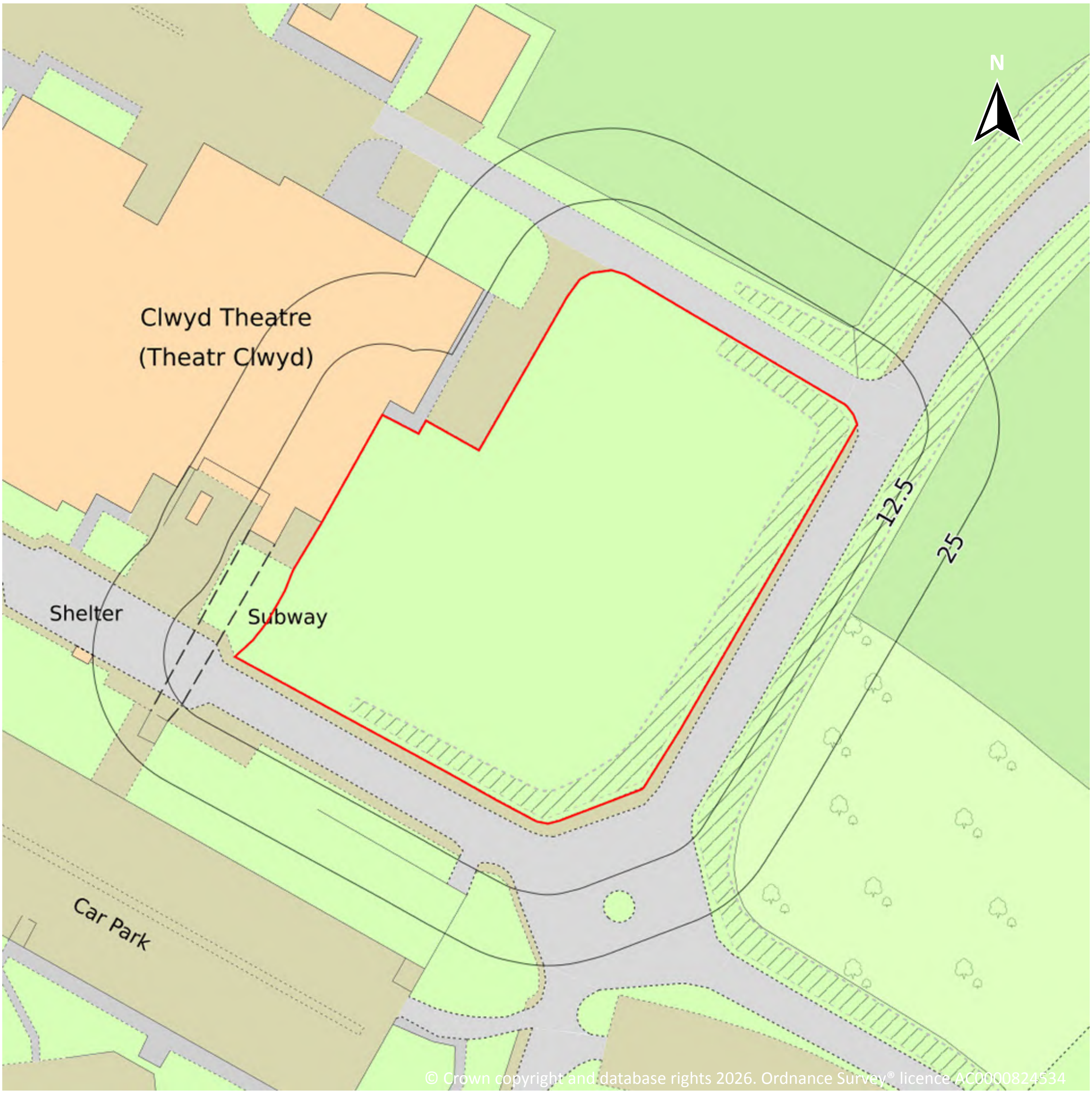
Capture Date: 28/07/2001

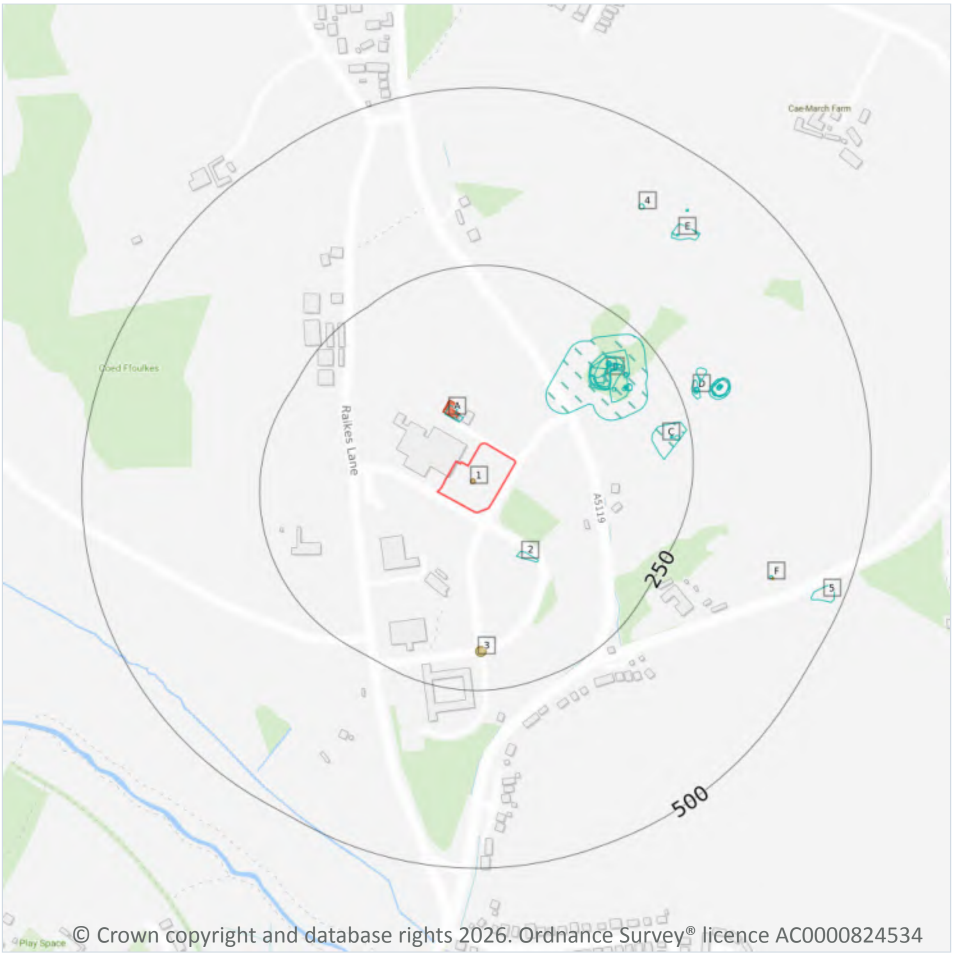
Site Area: 0.59ha

OS MasterMap site plan



Site Area: 0.59ha

1 Past land use



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🟥 Site Outline

Search buffers in metres (m)

▨ Historical industrial land uses

🟨 Historical tanks

🟥 Historical energy features

1.1 Historical industrial land uses

Records within 500m 47

Potentially contaminative land use features digitised from historical Ordnance Survey® mapping at 1:10,000 and 1:10,560 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use map on page 15 >

ID	Location	Land use	Dates present	Group ID
A	44m NW	Electric Substation	1989	820069

ID	Location	Land use	Dates present	Group ID
2	76m SE	Unspecified Ground Workings	1938	814170
B	89m NE	Colliery	1938	902953
B	150m NE	Unspecified Ground Workings	1910	974172
B	152m NE	Unspecified Heap	1938	962326
B	154m NE	Colliery	1914	928781
B	154m NE	Unspecified Ground Workings	1914	943814
B	159m NE	Unspecified Heap	1959 - 1971	988555
B	161m NE	Unspecified Heap	1898	899431
B	169m NE	Air Shafts	1910	833927
B	181m NE	Air Shafts	1910	987247
B	185m NE	Air Shafts	1938	930746
B	186m NE	Air Shafts	1914	925131
B	186m NE	Unspecified Shaft	1910	920851
B	186m NE	Disused Air Shaft	1959	808532
B	186m NE	Unspecified Disused Shaft	1971 - 1989	993373
B	187m NE	Unspecified Old Shafts	1898	845221
B	187m NE	Unspecified Shaft	1938	971427
B	188m NE	Unspecified Disused Shaft	1959 - 1989	879646
B	189m NE	Unspecified Shaft	1914	1004399
B	194m NE	Air Shafts	1910	877198
C	194m E	Refuse Heap	1872	809150
B	196m NE	Air Shafts	1938	945135
C	221m E	Unspecified Shaft	1872	825171
C	226m E	Unspecified Old Shafts	1898	845219
D	267m E	Unspecified Heap	1914	988404
D	270m E	Air Shafts	1910	944810
D	271m E	Unspecified Old Shafts	1898	845220
D	271m E	Air Shafts	1938	978619

ID	Location	Land use	Dates present	Group ID
D	273m E	Unspecified Old Shaft	1914	923263
D	283m NE	Unspecified Pit	1872	828734
D	289m E	Unspecified Heap	1910	928426
D	294m E	Unspecified Heap	1914	986042
D	294m E	Unspecified Heap	1938	871950
D	294m E	Unspecified Heap	1898	947388
D	295m E	Refuse Heap	1872	809149
D	302m E	Unspecified Old Shaft	1910	909951
D	303m E	Unspecified Old Shafts	1898	845224
D	303m E	Unspecified Old Shaft	1938	981981
D	305m E	Unspecified Old Shaft	1914	987195
D	308m E	Unspecified Shaft	1872	825172
E	384m NE	Refuse Heap	1872	809198
E	390m NE	Unspecified Shafts	1872	838875
F	392m SE	Unspecified Tank	1872	849517
4	395m NE	Unspecified Shafts	1872	838904
E	426m NE	Unspecified Shafts	1872	838876
5	457m SE	Unspecified Heap	1898	842334

This data is sourced from Ordnance Survey® / Groundsure.

1.2 Historical tanks

Records within 500m	**3**

Tank features digitised from historical Ordnance Survey® mapping at high-detail 1:1,250 and 1:2,500 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use map on **page 15 >**

ID	Location	Land use	Dates present	Group ID
1	**On site**	**Unspecified Tank**	**1874**	**116495**
3	188m S	Unspecified Tank	1996	116488
F	395m SE	Unspecified Tank	1874	116496

This data is sourced from Ordnance Survey® / Groundsure.

1.3 Historical energy features

Records within 500m	2

Energy features digitised from historical Ordnance Survey® mapping at high-detail 1:1,250 and 1:2,500 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use map on page 15 >

ID	Location	Land use	Dates present	Group ID
A	49m NW	Electricity Substation	1988 - 1991	90950
A	50m NW	Electricity Substation	1996	81475

This data is sourced from Ordnance Survey® / Groundsure.

1.4 Historical petrol stations

Records within 500m	0

Petrol stations digitised from historical Ordnance Survey® mapping at high-detail 1:1,250 and 1:2,500 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

This data is sourced from Ordnance Survey® / Groundsure.

1.5 Historical garages

Records within 500m	**0**

Garages digitised from historical Ordnance Survey® mapping at high-detail 1:1,250 and 1:2,500 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

This data is sourced from Ordnance Survey® / Groundsure.

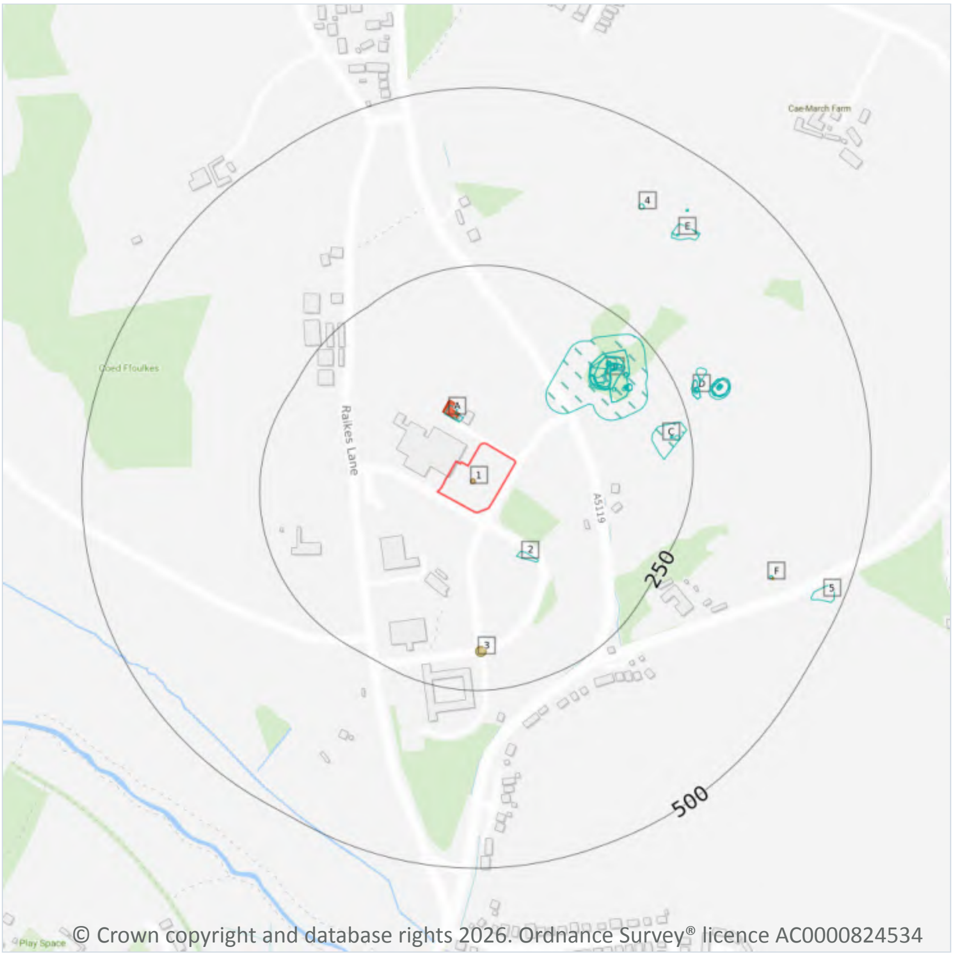
1.6 Historical military land

Records within 500m	**0**

Areas of military land digitised from multiple sources including the National Archives, local records, MOD records and verified other sources, intelligently grouped into contiguous features.

This data is sourced from Ordnance Survey® / Groundsure / other sources.

2 Past land use - un-grouped



— Site Outline

Search buffers in metres (m)

▨ Historical industrial land uses

🟨 Historical tanks

🟥 Historical energy features

2.1 Historical industrial land uses

Records within 500m	58

Potentially contaminative land use features digitised from historical Ordnance Survey® mapping at 1:10,000 and 10,560 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use - un-grouped map on page 20 >

ID	Location	Land Use	Date	Group ID
A	44m NW	Electric Substation	1989	820069
2	76m SE	Unspecified Ground Workings	1938	814170
B	89m NE	Colliery	1938	902953

ID	Location	Land Use	Date	Group ID
B	150m NE	Unspecified Ground Workings	1910	974172
B	152m NE	Unspecified Heap	1938	962326
B	154m NE	Unspecified Ground Workings	1914	943814
B	154m NE	Colliery	1914	928781
B	154m NE	Unspecified Ground Workings	1914	943814
B	154m NE	Colliery	1914	928781
B	159m NE	Unspecified Heap	1971	988555
B	159m NE	Unspecified Heap	1959	988555
B	161m NE	Unspecified Heap	1898	899431
B	169m NE	Air Shafts	1910	833927
B	181m NE	Air Shafts	1910	987247
B	185m NE	Air Shafts	1938	930746
B	186m NE	Air Shafts	1914	925131
B	186m NE	Unspecified Shaft	1910	920851
B	186m NE	Disused Air Shaft	1959	808532
B	186m NE	Unspecified Disused Shaft	1989	993373
B	186m NE	Unspecified Disused Shaft	1971	993373
B	187m NE	Unspecified Shaft	1938	971427
B	187m NE	Unspecified Old Shafts	1898	845221
B	188m NE	Unspecified Disused Shaft	1989	879646
B	188m NE	Unspecified Disused Shaft	1971	879646
B	188m NE	Unspecified Disused Shaft	1959	879646
B	189m NE	Unspecified Shaft	1914	1004399
B	189m NE	Unspecified Shaft	1914	1004399
B	194m NE	Air Shafts	1910	877198
C	194m E	Refuse Heap	1872	809150
B	196m NE	Air Shafts	1938	945135
C	221m E	Unspecified Shaft	1872	825171

ID	Location	Land Use	Date	Group ID
C	226m E	Unspecified Old Shafts	1898	845219
D	267m E	Unspecified Heap	1914	988404
D	267m E	Unspecified Heap	1914	988404
D	270m E	Air Shafts	1910	944810
D	271m E	Air Shafts	1938	978619
D	271m E	Unspecified Old Shafts	1898	845220
D	273m E	Unspecified Old Shaft	1914	923263
D	273m E	Unspecified Old Shaft	1914	923263
D	283m NE	Unspecified Pit	1872	828734
D	289m E	Unspecified Heap	1910	928426
D	294m E	Unspecified Heap	1914	986042
D	294m E	Unspecified Heap	1914	986042
D	294m E	Unspecified Heap	1938	871950
D	294m E	Unspecified Heap	1898	947388
D	295m E	Refuse Heap	1872	809149
D	302m E	Unspecified Old Shaft	1910	909951
D	303m E	Unspecified Old Shaft	1938	981981
D	303m E	Unspecified Old Shafts	1898	845224
D	305m E	Unspecified Old Shaft	1914	987195
D	305m E	Unspecified Old Shaft	1914	987195
D	308m E	Unspecified Shaft	1872	825172
E	384m NE	Refuse Heap	1872	809198
E	390m NE	Unspecified Shafts	1872	838875
F	392m SE	Unspecified Tank	1872	849517
4	395m NE	Unspecified Shafts	1872	838904
E	426m NE	Unspecified Shafts	1872	838876
5	457m SE	Unspecified Heap	1898	842334

This data is sourced from Ordnance Survey® / Groundsure.

2.2 Historical tanks

Records within 500m	**3**

Tank features digitised from historical Ordnance Survey® mapping at high-detail 1:1,250 and 1:2,500 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use - un-grouped map on **page 20 >**

ID	Location	Land Use	Date	Group ID
1	**On site**	**Unspecified Tank**	**1874**	**116495**
3	188m S	Unspecified Tank	1996	116488
F	395m SE	Unspecified Tank	1874	116496

This data is sourced from Ordnance Survey® / Groundsure.

2.3 Historical energy features

Records within 500m	**4**

Energy features digitised from historical Ordnance Survey® mapping at high-detail 1:1,250 and 1:2,500 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use - un-grouped map on **page 20 >**

ID	Location	Land Use	Date	Group ID
A	49m NW	Electricity Substation	1988	90950
A	49m NW	Electricity Substation	1991	90950
A	49m NW	Electricity Substation	1989	90950
A	50m NW	Electricity Substation	1996	81475

This data is sourced from Ordnance Survey® / Groundsure.

2.4 Historical petrol stations

Records within 500m	**0**

Petrol stations digitised from historical Ordnance Survey® mapping at high-detail 1:1,250 and 1:2,500 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

This data is sourced from Ordnance Survey® / Groundsure.

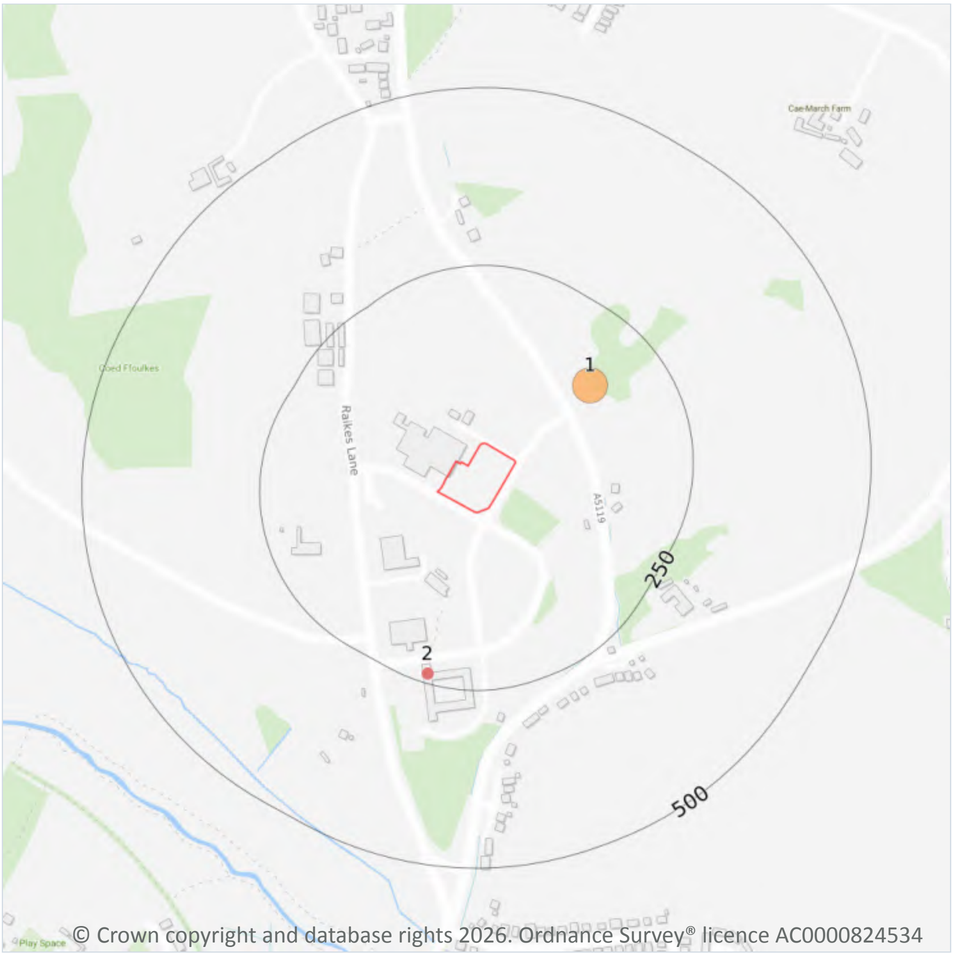
2.5 Historical garages

Records within 500m	**0**

Garages digitised from historical Ordnance Survey® mapping at high-detail 1:1,250 and 1:2,500 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

This data is sourced from Ordnance Survey® / Groundsure.

3 Waste and landfill



🟥	Site Outline
Search buffers in metres (m)	
🟧	Historical waste sites
●	Waste exemptions

3.1 Active or recent landfill

Records within 500m	0

Active or recently closed landfill sites under Environment Agency/Natural Resources Wales regulation.

This data is sourced from the Environment Agency and Natural Resources Wales.

3.2 Historical landfill (BGS records)

Records within 500m	0

Landfill sites identified on a survey carried out on behalf of the DoE in 1973. These sites may have been closed or operational at this time.

This data is sourced from the British Geological Survey.

3.3 Historical landfill (LA/mapping records)

Records within 500m	**0**

Landfill sites identified from Local Authority records and high detail historical mapping.

This data is sourced from the Ordnance Survey®/Groundsure and Local Authority records.

3.4 Historical landfill (EA/NRW records)

Records within 500m	**0**

Known historical (closed) landfill sites (e.g. sites where there is no PPC permit or waste management licence currently in force). This includes sites that existed before the waste licensing regime and sites that have been licensed in the past but where a licence has been revoked, ceased to exist or surrendered and a certificate of completion has been issued.

This data is sourced from the Environment Agency and Natural Resources Wales.

3.5 Historical waste sites

Records within 500m	**1**

Waste site records derived from Local Authority planning records and high detail historical mapping.

Features are displayed on the Waste and landfill map on **page 25 >**

ID	Location	Address	Further Details	Date
1	125m NE	Site Address: Tyn y Twll Landfill, Main Road, Sychdyn, Mold, Clwyd, CH7 6EA, WALES	Type of Site: Landfill Planning application reference: SCR/000330/22 Description: Scheme comprises screening opinion for landfill for agricultural improvements and temporary highway access improvements from the A5119. Data source: Historic Planning Application Data Type: Point	08/08/2022

This data is sourced from Ordnance Survey®/Groundsure and Local Authority records.

3.6 Licensed waste sites

Records within 500m	**0**

Active or recently closed waste sites under Environment Agency/Natural Resources Wales regulation.

This data is sourced from the Environment Agency and Natural Resources Wales.

3.7 Waste exemptions

Records within 500m	**1**

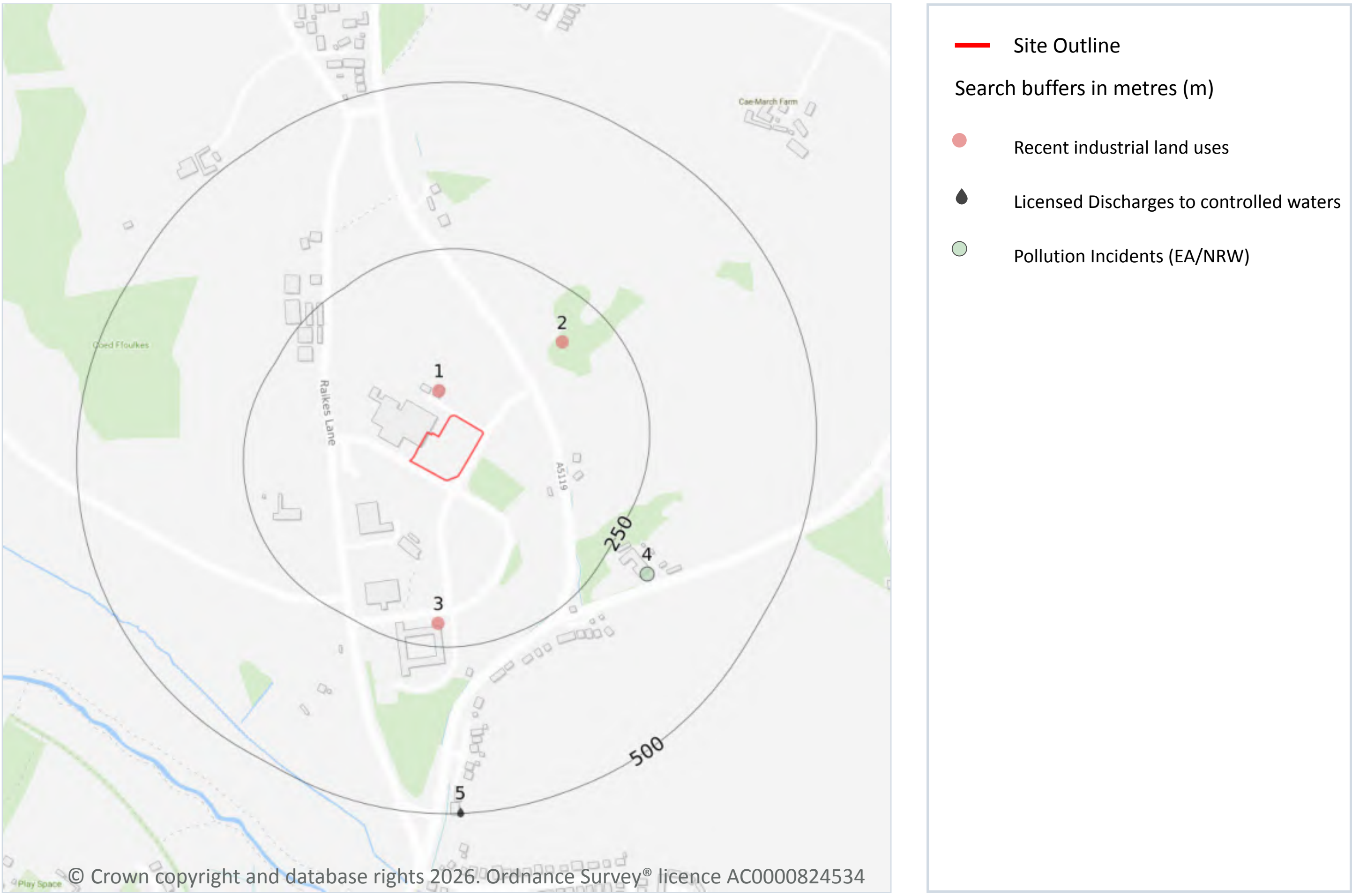
Activities involving the storage, treatment, use or disposal of waste that are exempt from needing a permit. Exemptions have specific limits and conditions that must be adhered to.

Features are displayed on the Waste and landfill map on **page 25 >**

ID	Location	Site	Reference	Category	Sub-Category	Description
2	237m S	Kier Construction, Flintshire County Council, County Hall, Mold, Flintshire, Ch7 6nf	NRW-WME054813	Using waste exemption	Not on a farm	Use of waste in construction

This data is sourced from the Environment Agency and Natural Resources Wales.

4 Current industrial land use



4.1 Recent industrial land uses

Records within 250m	**3**

Current potentially contaminative industrial sites.

Features are displayed on the Current industrial land use map on page 28 >

ID	Location	Company	Address	Activity	Category
1	43m NW	Electricity Sub Station	Clwyd, CH7	Electrical Features	Infrastructure and Facilities
2	180m NE	Shaft (Disused)	Clwyd, CH7	Unspecified Quarries Or Mines	Extractive Industries
3	215m S	Chimney	Clwyd, CH7	Chimneys	Industrial Features

This data is sourced from Ordnance Survey®.

4.2 National Geographic Database (NGD) - Current or recent tanks

Records within 250m	**0**

Current or recent tanks identified from the Ordnance Survey® NGD.

This data is sourced from Ordnance Survey®.

4.3 Current or recent petrol stations

Records within 500m	**0**

Open, closed, under development and obsolete petrol stations.

This data is sourced from Experian.

4.4 Electricity cables

Records within 500m	**0**

High voltage underground electricity transmission cables.

This data is sourced from National Grid.

4.5 Gas pipelines

Records within 500m	**0**

High pressure underground gas transmission pipelines.

This data is sourced from National Grid.

4.6 Sites determined as Contaminated Land

Records within 500m	**0**

Contaminated Land Register of sites designated under Part 2a of the Environmental Protection Act 1990.

This data is sourced from Local Authority records.

4.7 Control of Major Accident Hazards (COMAH)

Records within 500m	**0**

Control of Major Accident Hazards (COMAH) sites. This data includes upper and lower tier sites, and includes a historical archive of COMAH sites and Notification of Installations Handling Hazardous Substances (NIHHS) records.

This data is sourced from the Health and Safety Executive.

4.8 Regulated explosive sites

Records within 500m	**0**

Sites registered and licensed by the Health and Safety Executive under the Manufacture and Storage of Explosives Regulations 2005 (MSER). The last update to this data was in April 2011.

This data is sourced from the Health and Safety Executive.

4.9 Hazardous substance storage/usage

Records within 500m	**0**

Consents granted for a site to hold certain quantities of hazardous substances at or above defined limits in accordance with the Planning (Hazardous Substances) Regulations 2015.

This data is sourced from Local Authority records.

4.10 Historical licensed industrial activities (IPC)

Records within 500m	**0**

Integrated Pollution Control (IPC) records of substance releases to air, land and water. This data represents a historical archive as the IPC regime has been superseded.

This data is sourced from the Environment Agency and Natural Resources Wales.

4.11 Licensed industrial activities (Part A(1))

Records within 500m	**0**

Records of Part A(1) installations regulated under the Environmental Permitting (England and Wales) Regulations 2016 for the release of substances to the environment.

This data is sourced from the Environment Agency and Natural Resources Wales.

4.12 Licensed pollutant release (Part A(2)/B)

Records within 500m **0**

Records of Part A(2) and Part B installations regulated under the Environmental Permitting (England and Wales) Regulations 2016 for the release of substances to the environment.

This data is sourced from Local Authority records.

4.13 Radioactive Substance Authorisations

Records within 500m **0**

Records of the storage, use, accumulation and disposal of radioactive substances regulated under the Radioactive Substances Act 1993.

This data is sourced from the Environment Agency and Natural Resources Wales.

4.14 Licensed Discharges to controlled waters

Records within 500m **1**

Discharges of treated or untreated effluent to controlled waters under the Water Resources Act 1991.

Features are displayed on the Current industrial land use map on page 28 >

ID	Location	Address	Details	
5	499m S	MOLDBRYN AWELONSSO	Effluent Type: SEWAGE DISCHARGES - SEWER STORM OVERFLOW - WATER COMPANY Permit Number: CM0167901 Permit Version: 4 Receiving Water: TRIB OF BLACK BROOK	Status: Effective Issue date: 03/04/2008 Effective Date: 03/04/2008 Revocation Date: -

This data is sourced from the Environment Agency and Natural Resources Wales.

4.15 Pollutant release to surface waters (Red List)

Records within 500m **0**

Discharges of specified substances under the Environmental Protection (Prescribed Processes and Substances) Regulations 1991.

This data is sourced from the Environment Agency and Natural Resources Wales.

4.16 Pollutant release to public sewer

Records within 500m	**0**

Discharges of Special Category Effluents to the public sewer.

This data is sourced from the Environment Agency and Natural Resources Wales.

4.17 List 1 Dangerous Substances

Records within 500m	**0**

Discharges of substances identified on List I of European Directive E 2006/11/EC, and regulated under the Environmental Damage (Prevention and Remediation) Regulations 2015.

This data is sourced from the Environment Agency and Natural Resources Wales.

4.18 List 2 Dangerous Substances

Records within 500m	**0**

Discharges of substances identified on List II of European Directive E 2006/11/EC, and regulated under the Environmental Damage (Prevention and Remediation) Regulations 2015.

This data is sourced from the Environment Agency and Natural Resources Wales.

4.19 Pollution Incidents (EA/NRW)

Records within 500m	**1**

Records of substantiated pollution incidents. Since 2006 this data has only included category 1 (major) and 2 (significant) pollution incidents.

Features are displayed on the Current industrial land use map on **page 28 >**

ID	Location	Details	
4	318m SE	Incident Date: 19/07/2015 Incident Identification: 1356491 Pollutant: Sewage Materials Pollutant Description: Crude Sewage	Water Impact: - Land Impact: Category 3 (Minor) Air Impact: Category 3 (Minor)

This data is sourced from the Environment Agency and Natural Resources Wales.

4.20 Pollution inventory substances

Records within 500m	**0**

The pollution inventory (substances) includes reporting on annual emissions of certain regulated substances to air, controlled waters and land. A reporting threshold for each substance is also included. Where emissions fall below the reporting threshold, no value will be given. The data is given for the most recent complete year available.

This data is sourced from the Environment Agency and the Scottish Environment Protection Agency.

4.21 Pollution inventory waste transfers

Records within 500m	**0**

The pollution inventory (waste transfers) includes reporting on annual transfers and recovery/disposal of controlled wastes from a site. A reporting threshold for each waste type is also included. Where releases fall below the reporting threshold, no value will be given. The data is given for the most recent complete year available.

This data is sourced from the Environment Agency and the Scottish Environment Protection Agency.

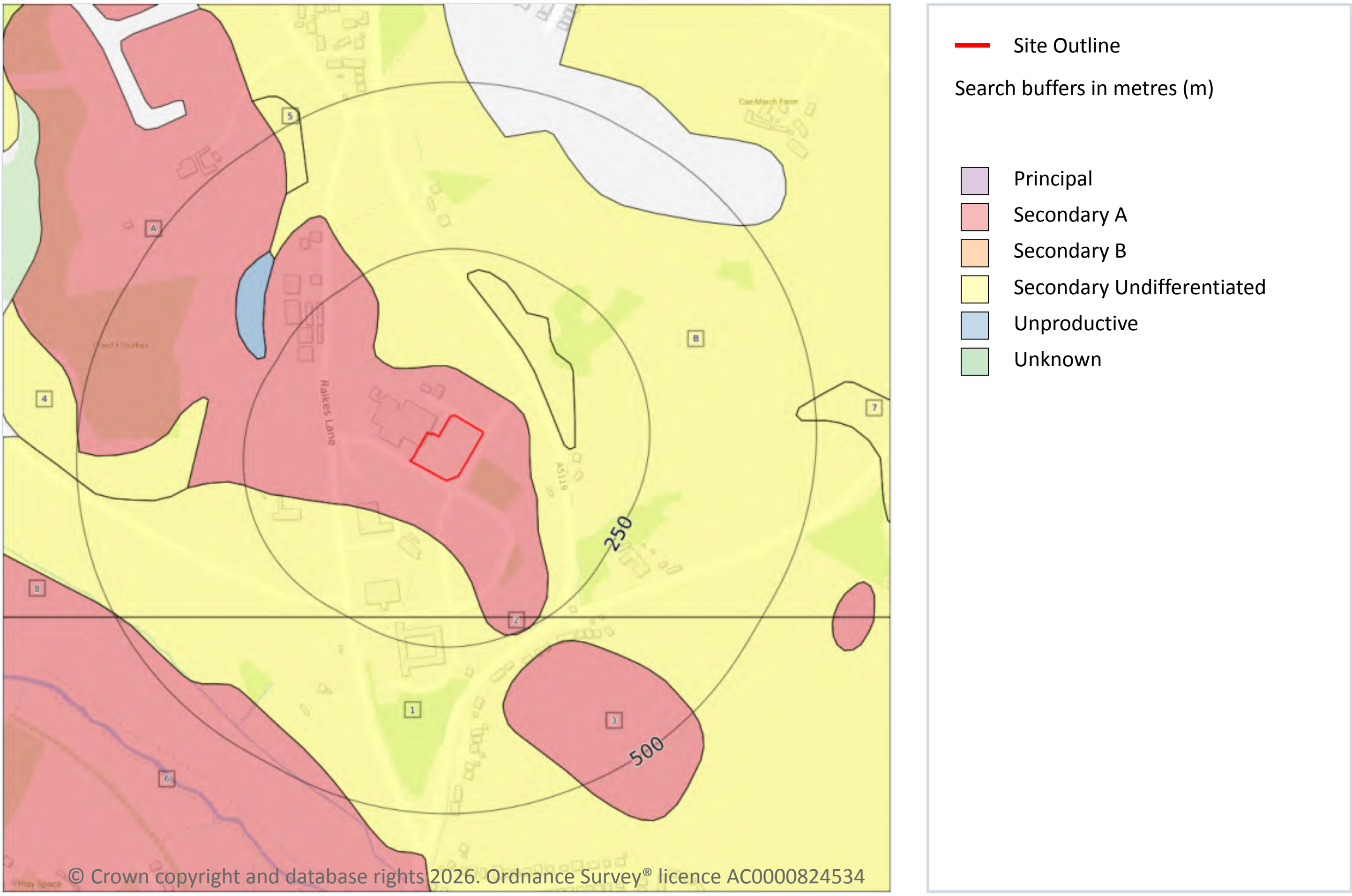
4.22 Pollution inventory radioactive waste

Records within 500m	**0**

The pollution inventory (radioactive wastes) includes reporting on annual releases of radioactive substances from a site, including the means of release. Where releases fall below the reporting threshold, no value will be given. The data is given for the most recent complete year available.

This data is sourced from the Environment Agency and the Scottish Environment Protection Agency.

5 Hydrogeology - Superficial aquifer



5.1 Superficial aquifer

Records within 500m	12

Aquifer status of groundwater held within superficial geology.

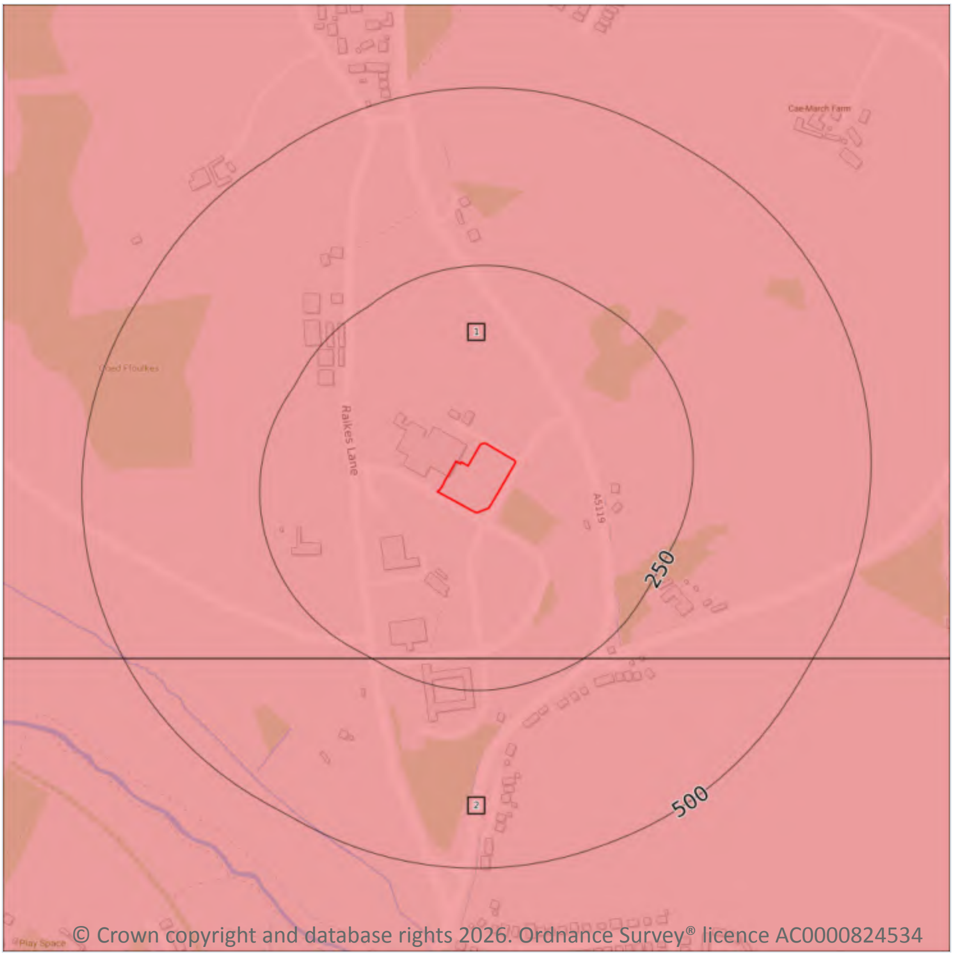
Features are displayed on the Hydrogeology map on page 34 >

ID	Location	Designation	Description
A	**On site**	**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**
B	60m NE	Secondary Undifferentiated	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type

ID	Location	Designation	Description
B	107m E	Secondary Undifferentiated	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
1	205m S	Secondary Undifferentiated	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
2	213m S	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
A	267m NW	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
3	290m SE	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
4	315m W	Secondary Undifferentiated	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
5	412m NW	Secondary Undifferentiated	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
6	428m SW	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
7	471m E	Secondary Undifferentiated	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
8	495m SW	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

This data is sourced from the British Geological Survey, the Environment Agency and Natural Resources Wales.

Bedrock aquifer



— Site Outline

Search buffers in metres (m)

🟪 Principal
🟥 Secondary A
🟧 Secondary B
🟨 Secondary Undifferentiated
🟦 Unproductive

5.2 Bedrock aquifer

Records within 500m	2

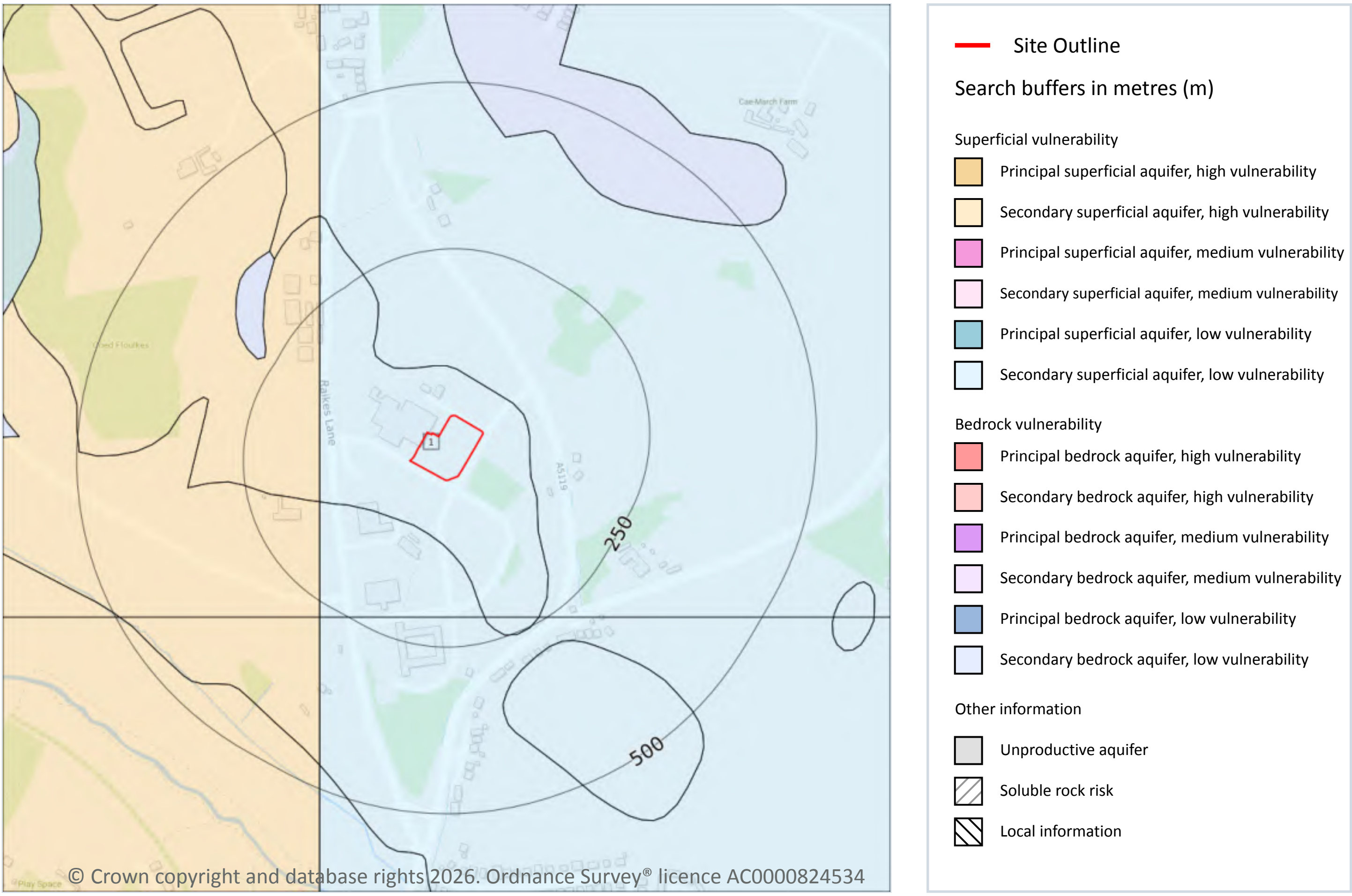
Aquifer status of groundwater held within bedrock geology.

Features are displayed on the Bedrock aquifer map on page 36 >

ID	Location	Designation	Description
1	**On site**	**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**
2	205m S	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

This data is sourced from the British Geological Survey, the Environment Agency and Natural Resources Wales.

Groundwater vulnerability



5.3 Groundwater vulnerability

Records within 50m	1

An assessment of the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a one kilometre square grid. Groundwater vulnerability is described as High, Medium or Low as follows:

- High - Areas able to easily transmit pollution to groundwater. They are likely to be characterised by high leaching soils and the absence of low permeability superficial deposits.
- Medium - Intermediate between high and low vulnerability.
- Low - Areas that provide the greatest protection from pollution. They are likely to be characterised by low leaching soils and/or the presence of superficial deposits characterised by a low permeability.

Features are displayed on the Groundwater vulnerability map on page 38 >

ID	Location	Summary	Soil / surface	Superficial geology	Bedrock geology
1	**On site**	**Summary Classification: Secondary superficial aquifer - Low Vulnerability** **Combined classification: Productive Bedrock Aquifer, Productive Superficial Aquifer**	**Leaching class: Low** **Infiltration value: <40%** **Dilution value: 300-550mm/year**	**Vulnerability: Low** **Aquifer type: Secondary** **Thickness: 3-10m** **Patchiness value: <90%** **Recharge potential: Low**	**Vulnerability: Low** **Aquifer type: Secondary** **Flow mechanism: Well connected fractures**

This data is sourced from the British Geological Survey, the Environment Agency and Natural Resources Wales.

5.4 Groundwater vulnerability- soluble rock risk

Records on site	**0**

This dataset identifies areas where solution features that enable rapid movement of a pollutant may be present within a 1km grid square.

This data is sourced from the British Geological Survey and the Environment Agency.

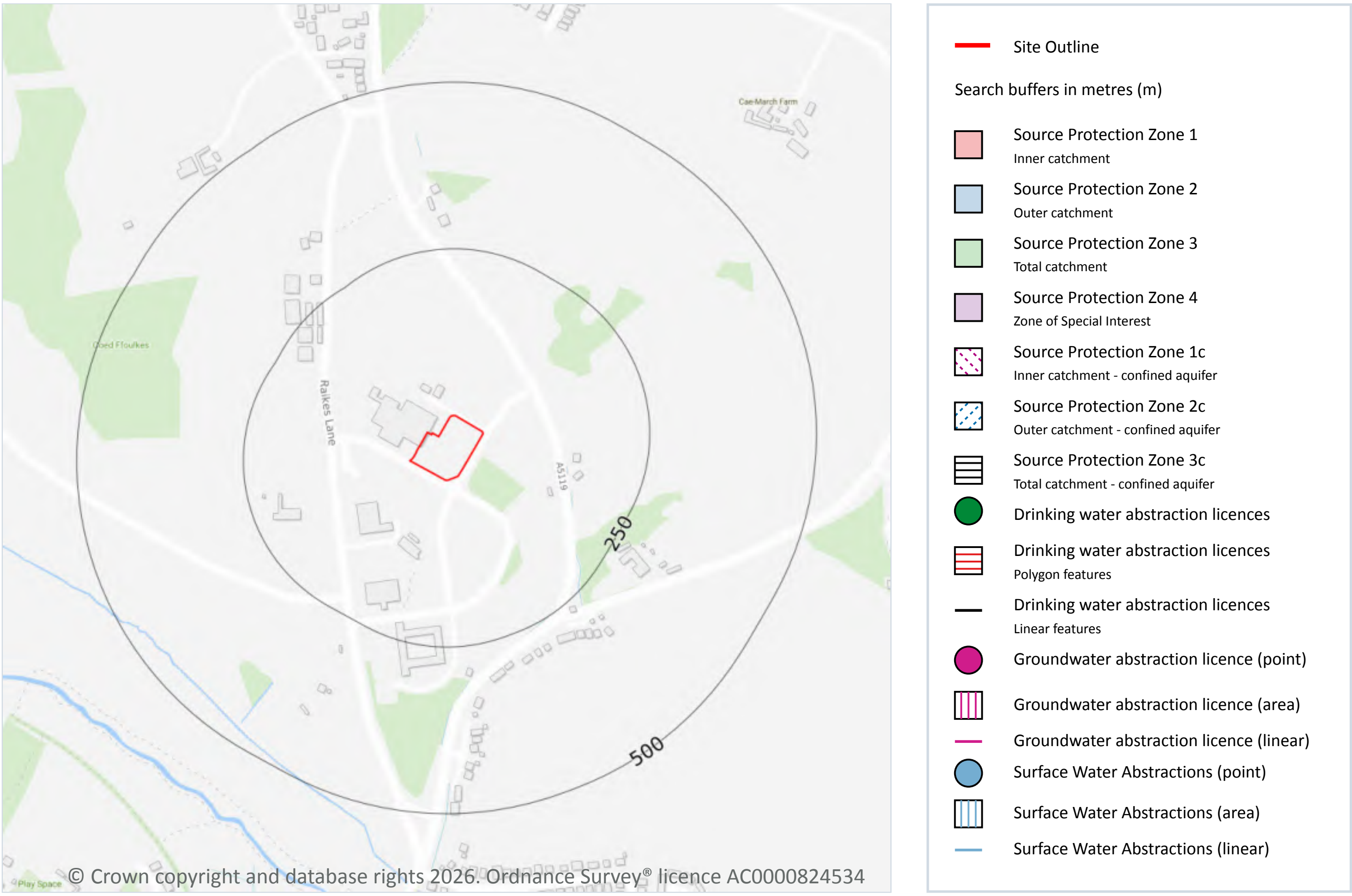
5.5 Groundwater vulnerability- local information

Records on site	**0**

This dataset identifies areas where additional local information affecting vulnerability is held by the Environment Agency. Further information can be obtained by contacting the Environment Agency local Area groundwater team through the Environment Agency National Customer Call Centre on 03798 506 506 or by email on enquiries@environment-agency.gov.uk ↗.

This data is sourced from the British Geological Survey and the Environment Agency.

Abstractions and Source Protection Zones



5.6 Groundwater abstractions

Records within 2000m	12

Licensed groundwater abstractions for sites extracting more than 20 cubic metres of water a day and includes active and historical records. The data may be for a single abstraction point, between two points (line data) or a larger area.

Features are displayed on the Abstractions and Source Protection Zones map on page 40 >

ID	Location	Details	
-	976m W	Status: Historical Licence No: WA/067/0008/006 Details: Evaporative Cooling Direct Source: EAW Groundwater Point: UNDERGROUND STRATA AT ALYN WORKS POINT B Data Type: Point Name: Synthite Ltd Easting: 323211 Northing: 364921	Annual Volume (m^3): 110000 Max Daily Volume (m^3): 327 Original Application No: - Original Start Date: 01/04/2015 Expiry Date: 31/03/2027 Issue No: 1 Version Start Date: 01/04/2015 Version End Date: -
-	978m W	Status: Historical Licence No: 24/67/8/0051 Details: Evaporative Cooling Direct Source: EAW Groundwater Point: BOREHOLE 11M DEEP, 250MM DIA Data Type: Point Name: Synthite Ltd Easting: 323210 Northing: 364920	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 12/01/1968 Expiry Date: - Issue No: 100 Version Start Date: 30/06/1998 Version End Date: -
-	978m W	Status: Historical Licence No: 24/67/8/0105 Details: Evaporative Cooling Direct Source: EAW Groundwater Point: BOREHOLE 11M DEEP, 250MM DIA Data Type: Point Name: Synthite Ltd Easting: 323210 Northing: 364920	Annual Volume (m^3): 110000 Max Daily Volume (m^3): 327 Original Application No: - Original Start Date: 15/10/2003 Expiry Date: 31/03/2008 Issue No: 1 Version Start Date: 07/03/2007 Version End Date: -
-	978m W	Status: Historical Licence No: 24/67/8/0111 Details: Evaporative Cooling Direct Source: EAW Groundwater Point: BOREHOLE 11M DEEP, 250MM DIA Data Type: Point Name: Synthite Ltd Easting: 323210 Northing: 364920	Annual Volume (m^3): 110000 Max Daily Volume (m^3): 327 Original Application No: - Original Start Date: 01/04/2008 Expiry Date: 31/03/2015 Issue No: 1 Version Start Date: 01/04/2008 Version End Date: -
-	1022m W	Status: Active Licence No: WA/067/0008/006 Details: Evaporative Cooling - High Direct Source: - Point: - Data Type: Point Name: - Easting: 323160 Northing: 364930	Annual Volume (m^3): 110000 Max Daily Volume (m^3): 327 Original Application No: - Original Start Date: 01/04/2015 Expiry Date: 31/03/2027 Issue No: - Version Start Date: - Version End Date: -

ID	Location	Details	
-	1022m W	Status: Historical Licence No: WA/067/0008/006 Details: Evaporative Cooling - High Direct Source: - Point: - Data Type: Point Name: - Easting: 323160 Northing: 364930	Annual Volume (m^3): 110000 Max Daily Volume (m^3): 336 Original Application No: - Original Start Date: 01/04/2015 Expiry Date: 31/03/2027 Issue No: - Version Start Date: - Version End Date: -
-	1022m W	Status: Historical Licence No: WA/067/0008/006 Details: Evaporative Cooling Direct Source: EAW Groundwater Point: UNDERGROUND STRATA ALYN WORKS POINT A Data Type: Point Name: Synthite Ltd Easting: 323160 Northing: 364930	Annual Volume (m^3): 110000 Max Daily Volume (m^3): 327 Original Application No: - Original Start Date: 01/04/2015 Expiry Date: 31/03/2027 Issue No: 1 Version Start Date: 01/04/2015 Version End Date: -
-	1022m W	Status: Historical Licence No: 24/67/8/0051 Details: Evaporative Cooling Direct Source: EAW Groundwater Point: 200MM DIA., 8M DEEP BOREHOLE Data Type: Point Name: Synthite Ltd Easting: 323160 Northing: 364930	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 12/01/1968 Expiry Date: - Issue No: 100 Version Start Date: 30/06/1998 Version End Date: -
-	1022m W	Status: Historical Licence No: 24/67/8/0105 Details: Evaporative Cooling Direct Source: EAW Groundwater Point: 200MM DIA., 8M DEEP BOREHOLE Data Type: Point Name: Synthite Ltd Easting: 323160 Northing: 364930	Annual Volume (m^3): 110000 Max Daily Volume (m^3): 327 Original Application No: - Original Start Date: 15/10/2003 Expiry Date: 31/03/2008 Issue No: 1 Version Start Date: 07/03/2007 Version End Date: -
-	1022m W	Status: Historical Licence No: 24/67/8/0111 Details: Evaporative Cooling Direct Source: EAW Groundwater Point: 200MM DIA., 8M DEEP BOREHOLE Data Type: Point Name: Synthite Ltd Easting: 323160 Northing: 364930	Annual Volume (m^3): 110000 Max Daily Volume (m^3): 327 Original Application No: - Original Start Date: 01/04/2008 Expiry Date: 31/03/2015 Issue No: 1 Version Start Date: 01/04/2008 Version End Date: -

ID	Location	Details	
-	1047m W	Status: Historical Licence No: 24/67/8/0050 Details: Non-Evaporative Cooling Direct Source: EAW Groundwater Point: BOREHOLE 3 Data Type: Point Name: Synthite Ltd Easting: 323110 Northing: 365022	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 12/01/1968 Expiry Date: - Issue No: 100 Version Start Date: 12/01/1968 Version End Date: -
-	1048m W	Status: Historical Licence No: 24/67/8/0050 Details: Non-Evaporative Cooling Direct Source: EAW Groundwater Point: BOREHOLE 1 Data Type: Point Name: Synthite Ltd Easting: 323110 Northing: 365021	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 12/01/1968 Expiry Date: - Issue No: 100 Version Start Date: 12/01/1968 Version End Date: -

This data is sourced from the Environment Agency and Natural Resources Wales.

5.7 Surface water abstractions

Records within 2000m	**0**

Licensed surface water abstractions for sites extracting more than 20 cubic metres of water a day and includes active and historical records. The data may be for a single abstraction point, a stretch of watercourse or a larger area.

This data is sourced from the Environment Agency and Natural Resources Wales.

5.8 Potable abstractions

Records within 2000m	**0**

Licensed potable water abstractions for sites extracting more than 20 cubic metres of water a day and includes active and historical records. The data may be for a single abstraction point, a stretch of watercourse or a larger area.

This data is sourced from the Environment Agency and Natural Resources Wales.

5.9 Source Protection Zones

Records within 500m	**0**

Source Protection Zones define the sensitivity of an area around a potable abstraction site to contamination.

This data is sourced from the Environment Agency and Natural Resources Wales.

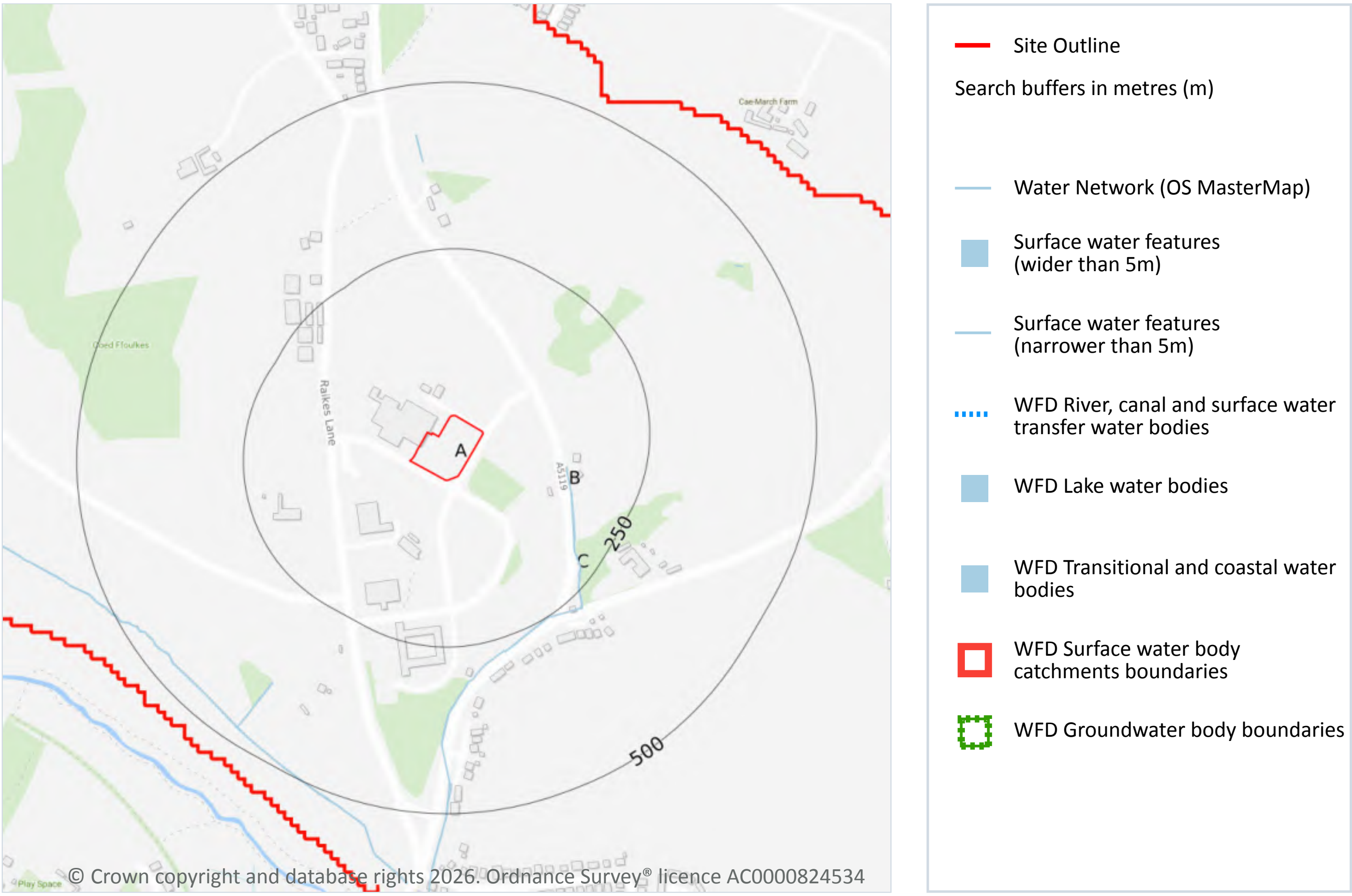
5.10 Source Protection Zones (confined aquifer)

Records within 500m	**0**

Source Protection Zones in the confined aquifer define the sensitivity around a deep groundwater abstraction to contamination. A confined aquifer would normally be protected from contamination by overlying geology and is only considered a sensitive resource if deep excavation/drilling is taking place.

This data is sourced from the Environment Agency and Natural Resources Wales.

6 Hydrology



6.1 Water Network (OS MasterMap)

Records within 250m 3

Detailed water network of Great Britain showing the flow and precise central course of every river, stream, lake and canal.

Features are displayed on the Hydrology map on page 45 >

ID	Location	Type of water feature	Ground level	Permanence	Name
B	135m E	Inland river not influenced by normal tidal action.	On ground surface	Watercourse contains water year round (in normal circumstances)	-

ID	Location	Type of water feature	Ground level	Permanence	Name
B	140m SE	Inland river not influenced by normal tidal action.	Underground	Watercourse contains water year round (in normal circumstances)	-
C	159m SE	Inland river not influenced by normal tidal action.	On ground surface	Watercourse contains water year round (in normal circumstances)	-

This data is sourced from the Ordnance Survey®.

6.2 Surface water features

Records within 250m	**2**

Covering rivers, streams and lakes (some overlap with OS MasterMap Water Network data in previous section) but additionally covers smaller features such as ponds. Rivers and streams narrower than 5m are represented as a single line. Lakes, ponds and rivers or streams wider than 5m are represented as polygons.

Features are displayed on the Hydrology map on **page 45 >**

This data is sourced from the Ordnance Survey®.

6.3 WFD Surface water body catchments

Records on site	**1**

The Water Framework Directive is an EU-led framework for the protection of inland surface waters, estuaries, coastal waters and groundwater through river basin-level management planning. In terms of surface water, these basins are broken down into smaller units known as management, operational and water body catchments.

Features are displayed on the Hydrology map on **page 45 >**

ID	Location	Type	Water body catchment	Water body ID	Operational catchment	Management catchment
A	**On site**	**River WB catchment**	**Alyn - Leadmill to Hope**	**GB111067052172**	**Alyn**	**Dee**

This data is sourced from the Environment Agency and Natural Resources Wales.

6.4 WFD Surface water bodies

Records identified 1

Surface water bodies under the Directive may be rivers, lakes, estuary or coastal. To achieve the purpose of the Directive, environmental objectives have been set and are reported on for each water body. The progress towards delivery of the objectives is then reported on by the relevant competent authorities at the end of each six-year cycle. The river water body directly associated with the catchment listed in the previous section is detailed below, along with any lake, canal, coastal or artificial water body within 250m of the site.

Features are displayed on the Hydrology map on **page 45 >**

ID	Location	Type	Name	Water body ID	Overall rating	Chemical rating	Ecological rating	Year
-	992m S	River	Alyn - Leadmill to Hope	GB111067052172	Moderate	Good	Moderate	2016

This data is sourced from the Environment Agency and Natural Resources Wales.

6.5 WFD Groundwater bodies

Records on site 1

Groundwater bodies are also covered by the Directive and the same regime of objectives and reporting detailed in the previous section is in place.

Features are displayed on the Hydrology map on **page 45 >**

ID	Location	Name	Water body ID	Overall rating	Chemical rating	Quantitative	Year
A	**On site**	**Dee Carboniferous Coal Measures**	**GB41102G204800**	**Poor**	**Poor**	**Good**	**2017**

This data is sourced from the Environment Agency and Natural Resources Wales.

7 River and coastal flooding

7.1 Risk of flooding from rivers and the sea

Records within 50m	**0**

The chance of flooding from rivers and/or the sea in any given year, based on cells of 50m within the Risk of Flooding from Rivers and Sea (RoFRaS)/Flood Risk Assessment Wales (FRAW) models. Each cell is allocated one of four flood risk categories, taking into account flood defences and their condition. The risk categories for RoFRaS for rivers and the sea and FRAW for rivers are; Very low (less than 1 in 1000 chance in any given year), Low (less than 1 in 100 but greater than or equal to 1 in 1000 chance), Medium (less than 1 in 30 but greater than or equal to 1 in 100 chance) or High (greater than or equal to 1 in 30 chance). The risk categories for FRAW for the sea are; Very low (less than 1 in 1000 chance in any given year), Low (less than 1 in 200 but greater than or equal to 1 in 1000 chance), Medium (less than 1 in 30 but greater than or equal to 1 in 200 chance) or High (greater than or equal to 1 in 30 chance).

This data is sourced from the Environment Agency and Natural Resources Wales.

7.2 Historical Flood Events

Records within 250m	**0**

Records of historic flooding from rivers, the sea, groundwater and surface water. Records began in 1946 when predecessor bodies started collecting detailed information about flooding incidents, although limited details may be included on flooding incidents prior to this date. Takes into account the presence of defences, structures, and other infrastructure where they existed at the time of flooding, and includes flood extents that may have been affected by overtopping, breaches or blockages.

This data is sourced from the Environment Agency and Natural Resources Wales.

7.3 Flood Defences

Records within 250m	**0**

Records of flood defences owned, managed or inspected by the Environment Agency and Natural Resources Wales. Flood defences can be structures, buildings or parts of buildings. Typically these are earth banks, stone and concrete walls, or sheet-piling that is used to prevent or control the extent of flooding.

This data is sourced from the Environment Agency and Natural Resources Wales.

7.4 Areas Benefiting from Flood Defences

Records within 250m	**0**

Areas that would benefit from the presence of flood defences in a 1 in 100 (1%) chance of flooding each year from rivers or 1 in 200 (0.5%) chance of flooding each year from the sea.

This data is sourced from the Environment Agency and Natural Resources Wales.

7.5 Flood Storage Areas

Records within 250m	**0**

Areas that act as a balancing reservoir, storage basin or balancing pond to attenuate an incoming flood peak to a flow level that can be accepted by the downstream channel or to delay the timing of a flood peak so that its volume is discharged over a longer period.

This data is sourced from the Environment Agency and Natural Resources Wales.

River and coastal flooding - Flood Zones

7.6 Flood Zone 2

Records within 50m	**0**

Areas of land at risk of flooding, when the presence of flood defences are ignored. Covering land between Flood Zone 3 (see next section) and the extent of the flooding from rivers or the sea with a 1 in 1000 (0.1%) chance of flooding each year.

This data is sourced from the Environment Agency and Natural Resources Wales.

7.7 Flood Zone 3

Records within 50m	**0**

Areas of land at risk of flooding, when the presence of flood defences are ignored. Covering land with a 1 in 100 (1%) or greater chance of flooding each year from rivers or a 1 in 200 (0.5%) or greater chance of flooding each year from the sea.

This data is sourced from the Environment Agency and Natural Resources Wales.

8 Surface water flooding

8.1 Surface water flooding

Highest risk on site	**Negligible**
Highest risk within 50m	**Negligible**

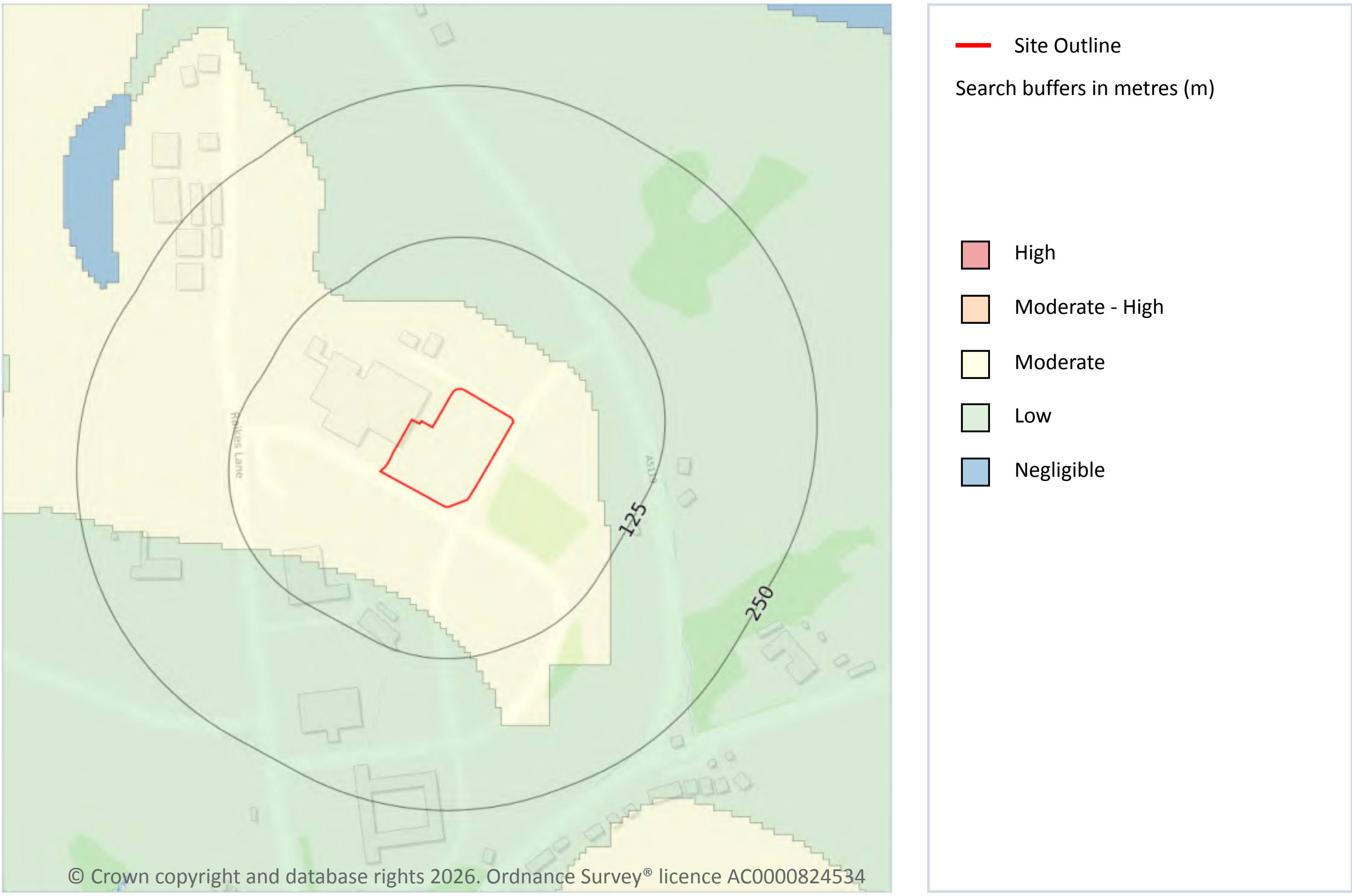
Ambiental Risk Analytics surface water (pluvial) FloodMap identifies areas likely to flood as a result of extreme rainfall events, i.e. land naturally vulnerable to surface water ponding or flooding. This data set was produced by simulating 1 in 30 year, 1 in 100 year, 1 in 250 year and 1 in 1,000 year rainfall events. Modern urban drainage systems are typically built to cope with rainfall events between 1 in 20 and 1 in 30 years, though some older ones may flood in a 1 in 5 year rainfall event.

The data shown on the map and in the table above shows the highest likelihood of flood events happening at the site. Lower likelihood events may have greater flood depths and hence a greater potential impact on a site. The table below shows the maximum flood depths for a range of return periods for the site.

Return period	Maximum modelled depth
1 in 1000 year	Negligible
1 in 250 year	Negligible
1 in 100 year	Negligible
1 in 30 year	Negligible

This data is sourced from Ambiental Risk Analytics.

9 Groundwater flooding



9.1 Groundwater flooding

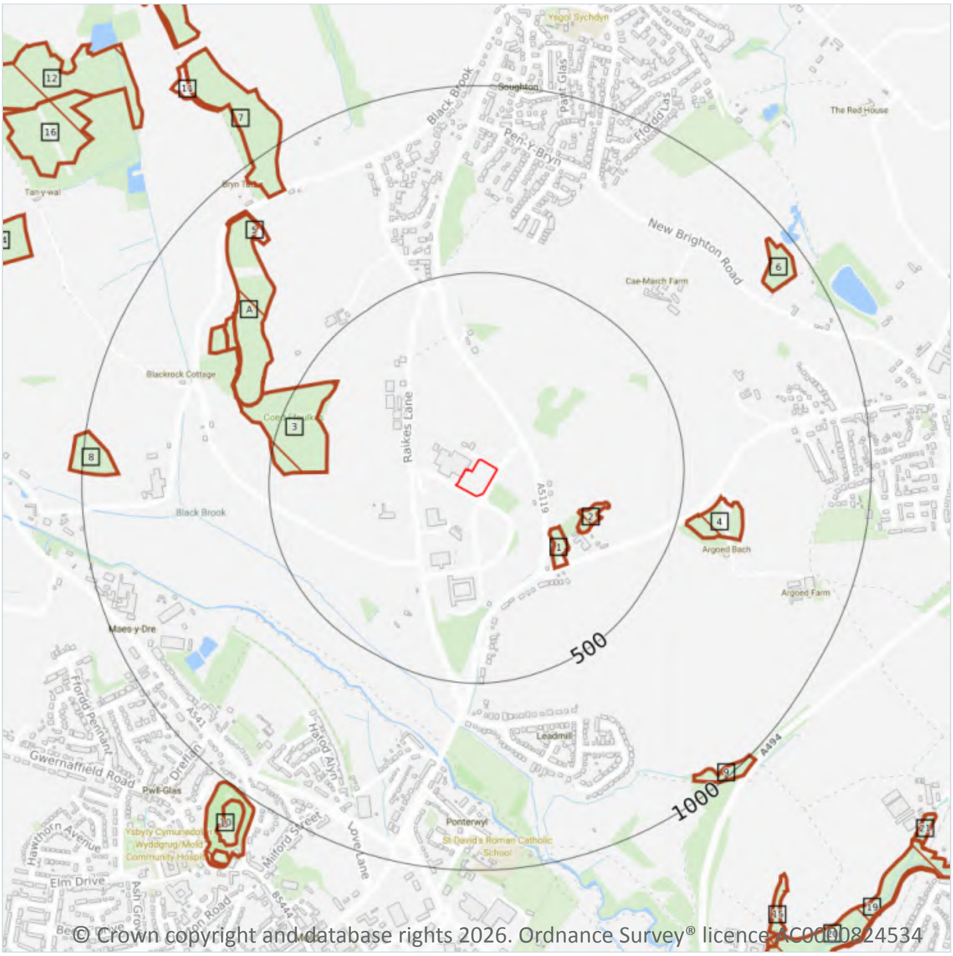
Highest risk on site	**Moderate**
Highest risk within 50m	**Moderate**

Groundwater flooding is caused by unusually high groundwater levels. It occurs when the water table rises above the ground surface or within underground structures such as basements or cellars. Groundwater flooding tends to exhibit a longer duration than surface water flooding, possibly lasting for weeks or months, and as a result it can cause significant damage to property. This risk assessment is based on a 1 in 100 year return period and a 5m Digital Terrain Model (DTM).

Features are displayed on the Groundwater flooding map on page 52 >

This data is sourced from Ambiental Risk Analytics.

10 Environmental designations



🟥 Site Outline

Search buffers in metres (m)

▨ Designated Ancient Woodland

10.1 Sites of Special Scientific Interest (SSSI)

Records within 2000m	**0**

Sites providing statutory protection for the best examples of UK flora, fauna, or geological or physiographical features. Originally notified under the National Parks and Access to the Countryside Act 1949, SSSIs were re-notified under the Wildlife and Countryside Act 1981. Improved provisions for the protection and management of SSSIs were introduced by the Countryside and Rights of Way Act 2000 (in England and Wales) and (in Scotland) by the Nature Conservation (Scotland) Act 2004 and the Wildlife and Natural Environment (Scotland) Act 2010.

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

10.2 Conserved wetland sites (Ramsar sites)

Records within 2000m	**0**

Ramsar sites are designated under the Convention on Wetlands of International Importance, agreed in Ramsar, Iran, in 1971. They cover all aspects of wetland conservation and wise use, recognizing wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well-being of human communities. These sites cover a broad definition of wetland; marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, and even some marine areas.

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

10.3 Special Areas of Conservation (SAC)

Records within 2000m	**0**

Areas which have been identified as best representing the range and variety within the European Union of habitats and (non-bird) species listed on Annexes I and II to the Directive. SACs are designated under the EC Habitats Directive.

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

10.4 Special Protection Areas (SPA)

Records within 2000m	**0**

Sites classified by the UK Government under the EC Birds Directive, SPAs are areas of the most important habitat for rare (listed on Annex I to the Directive) and migratory birds within the European Union.

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

10.5 National Nature Reserves (NNR)

Records within 2000m	**0**

Sites containing examples of some of the most important natural and semi-natural terrestrial and coastal ecosystems in Great Britain. They are managed to conserve their habitats, provide special opportunities for scientific study or to provide public recreation compatible with natural heritage interests.

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

10.6 Local Nature Reserves (LNR)

Records within 2000m **0**

Sites managed for nature conservation, and to provide opportunities for research and education, or simply enjoying and having contact with nature. They are declared by local authorities under the National Parks and Access to the Countryside Act 1949 after consultation with the relevant statutory nature conservation agency.

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

10.7 Designated Ancient Woodland

Records within 2000m **50**

Ancient woodlands are classified as areas which have been wooded continuously since at least 1600 AD. This includes semi-natural woodland and plantations on ancient woodland sites. 'Wooded continuously' does not mean there is or has previously been continuous tree cover across the whole site, and not all trees within the woodland have to be old.

Features are displayed on the Environmental designations map on page 53 >

ID	Location	Name	Woodland Type
1	204m SE	Unknown	Ancient Semi Natural Woodland
2	246m SE	Unknown	Restored Ancient Woodland Site
3	347m W	Unknown	Ancient Semi Natural Woodland
4	526m E	Unknown	Ancient Semi Natural Woodland
A	572m NW	Unknown	Ancient Semi Natural Woodland
A	629m W	Unknown	Ancient Semi Natural Woodland
A	709m NW	Unknown	Restored Ancient Woodland Site
5	808m NW	Unknown	Ancient Semi Natural Woodland
6	870m NE	Unknown	Restored Ancient Woodland Site
7	890m NW	Unknown	Restored Ancient Woodland Site
8	903m W	Unknown	Restored Ancient Woodland Site
9	941m SE	Unknown	Ancient Semi Natural Woodland
10	1002m SW	Unknown	Ancient Semi Natural Woodland
11	1163m NW	Unknown	Ancient Semi Natural Woodland
12	1262m NW	Unknown	Ancient Semi Natural Woodland
-	1278m N	Unknown	Ancient Semi Natural Woodland

ID	Location	Name	Woodland Type
14	1289m NW	Unknown	Plantation on Ancient Woodland Site
15	1296m SE	Unknown	Ancient Semi Natural Woodland
16	1329m NW	Unknown	Plantation on Ancient Woodland Site
17	1359m NW	Unknown	Restored Ancient Woodland Site
18	1367m NW	Unknown	Restored Ancient Woodland Site
19	1427m SE	Unknown	Ancient Semi Natural Woodland
20	1439m SE	Unknown	Ancient Semi Natural Woodland
21	1461m SE	Unknown	Ancient Semi Natural Woodland
-	1476m NW	Unknown	Ancient Semi Natural Woodland
-	1511m E	Unknown	Ancient Semi Natural Woodland
-	1544m NW	Unknown	Plantation on Ancient Woodland Site
-	1549m N	Unknown	Ancient Semi Natural Woodland
-	1557m N	Unknown	Plantation on Ancient Woodland Site
-	1561m N	Unknown	Plantation on Ancient Woodland Site
-	1573m N	Unknown	Restored Ancient Woodland Site
-	1580m W	Unknown	Ancient Semi Natural Woodland
-	1631m N	Unknown	Restored Ancient Woodland Site
-	1659m NW	Unknown	Ancient Semi Natural Woodland
-	1669m NW	Unknown	Restored Ancient Woodland Site
-	1690m NW	Unknown	Plantation on Ancient Woodland Site
-	1747m W	Unknown	Plantation on Ancient Woodland Site
-	1760m NW	Unknown	Restored Ancient Woodland Site
-	1773m NW	Unknown	Restored Ancient Woodland Site
-	1784m NW	Unknown	Plantation on Ancient Woodland Site
-	1792m NW	Unknown	Plantation on Ancient Woodland Site
-	1809m NW	Unknown	Restored Ancient Woodland Site
-	1815m NW	Unknown	Restored Ancient Woodland Site
-	1923m N	Unknown	Ancient Semi Natural Woodland

ID	Location	Name	Woodland Type
-	1970m NW	Unknown	Restored Ancient Woodland Site
-	1971m NW	Unknown	Plantation on Ancient Woodland Site
-	1971m W	Unknown	Ancient Semi Natural Woodland
-	1991m NW	Unknown	Plantation on Ancient Woodland Site
-	1993m NW	Unknown	Ancient Semi Natural Woodland
-	2000m N	Unknown	Restored Ancient Woodland Site

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

10.8 Biosphere Reserves

Records within 2000m	**0**

Biosphere Reserves are internationally recognised by UNESCO as sites of excellence to balance conservation and socioeconomic development between nature and people. They are recognised under the Man and the Biosphere (MAB) Programme with the aim of promoting sustainable development founded on the work of the local community.

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

10.9 Forest Parks

Records within 2000m	**0**

These are areas managed by the Forestry Commission designated on the basis of recreational, conservation or scenic interest.

This data is sourced from the Forestry Commission.

10.10 Marine Conservation Zones

Records within 2000m	**0**

A type of marine nature reserve in UK waters established under the Marine and Coastal Access Act (2009). They are designated with the aim to protect nationally important, rare or threatened habitats and species.

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

10.11 Green Belt

Records within 2000m	**0**

Areas designated to prevent urban sprawl by keeping land permanently open.

This data is sourced from the Ministry of Housing, Communities and Local Government.

10.12 Proposed Ramsar sites

Records within 2000m	**0**

Ramsar sites are areas listed as a Wetland of International Importance under the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) 1971. The sites here supplied have a status of 'Proposed' having been identified for potential adoption under the framework.

This data is sourced from Natural England.

10.13 Possible Special Areas of Conservation (pSAC)

Records within 2000m	**0**

Special Areas of Conservation are areas which have been identified as best representing the range and variety within the European Union of habitats and (non-bird) species listed on Annexes I and II to the Directive. SACs are designated under the EC Habitats Directive. Those sites supplied here are those with a status of 'Possible' having been identified for potential adoption under the framework.

This data is sourced from Natural England and Natural Resources Wales.

10.14 Potential Special Protection Areas (pSPA)

Records within 2000m	**0**

Special Protection Areas (SPAs) are areas designated (or ‘classified’) under the European Union Wild Birds Directive for the protection of nationally and internationally important populations of wild birds. Those sites supplied here are those with a status of 'Potential' having been identified for potential adoption under the framework.

This data is sourced from Natural England.

10.15 Nitrate Sensitive Areas

Records within 2000m	**0**

Areas where nitrate concentrations in drinking water sources exceeded or was at risk of exceeding the limit of 50 mg/l set by the 1980 EC Drinking Water Directive. Voluntary agricultural measures as a means of reducing the levels of nitrate were introduced by DEFRA as MAFF, with payments being made to farmers who complied. The scheme was started as a pilot in 1990 in ten areas, later implemented within 32 areas. The scheme was closed to further new entrants in 1998, although existing agreements continued for their full term. All Nitrate Sensitive Areas fell within the areas designated as Nitrate Vulnerable Zones (NVZs) in 1996 under the EC Nitrate Directive (91/676/EEC).

This data is sourced from Natural England.

10.16 Nitrate Vulnerable Zones

Records within 2000m	**3**

Areas at risk from agricultural nitrate pollution designated under the EC Nitrate Directive (91/676/EEC). These are areas of land that drain into waters polluted by nitrates. Farmers operating within these areas have to follow mandatory rules to tackle nitrate loss from agriculture.

Location	Name	Type	NVZ ID	Status
On site	**-**	**Surface Water**	**626**	**Existing**
44m W	-	Surface Water	626	Existing
776m NW	-	Surface Water	626	Existing

This data is sourced from Natural England and Natural Resources Wales.

SSSI Impact Zones and Units

10.17 SSSI Impact Risk Zones

Records on site	1

Developed to allow rapid initial assessment of the potential risks to SSSIs posed by development proposals. They define zones around each SSSI which reflect the particular sensitivities of the features for which it is notified and indicate the types of development proposal which could potentially have adverse impacts.

Features are displayed on the SSSI Impact Zones and Units map on page 60 >

ID	Location	Type of developments requiring consultation
1	**On site**	**https://irz.geodata.org.uk/IRZ/step2.html?irzcode=0300000630000&notes=&location=320386,370797 %20(IRZ%20polygon%20centre)**

This data is sourced from Natural England.

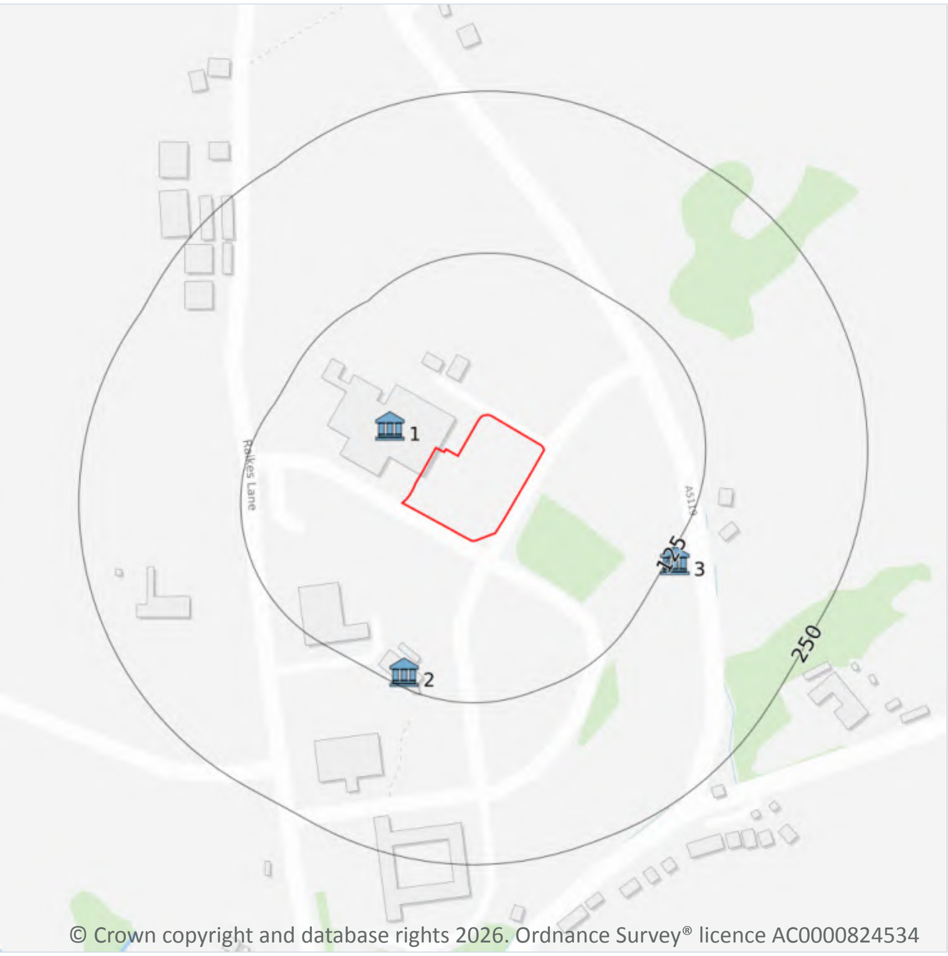
10.18 SSSI Units

Records within 2000m	**0**

Divisions of SSSIs used to record management and condition details. Units are the smallest areas for which Natural England gives a condition assessment, however, the size of units varies greatly depending on the types of management and the conservation interest.

This data is sourced from Natural England and Natural Resources Wales.

11 Visual and cultural designations



🟥	Site Outline
	Search buffers in metres (m)
🏛	Listed buildings
🟥	Conservation areas
⬜	Conservation areas - no data
▥	National Parks
▨	Areas of Outstanding Natural Beauty
🟨	Registered parks and gardens
▤	Scheduled Monuments
▨	World Heritage Sites

11.1 World Heritage Sites

Records within 250m	**0**

Sites designated for their globally important cultural or natural interest requiring appropriate management and protection measures. World Heritage Sites are designated to meet the UK's commitments under the World Heritage Convention.

This data is sourced from Historic England, Cadw and Historic Environment Scotland.

11.2 Area of Outstanding Natural Beauty

Records within 250m	**0**

Areas of Outstanding Natural Beauty (AONB) are conservation areas, chosen because they represent 18% of the finest countryside. Each AONB has been designated for special attention because of the quality of their flora, fauna, historical and cultural associations, and/or scenic views. The National Parks and Access to the Countryside Act of 1949 created AONBs and the Countryside and Rights of Way Act, 2000 added further regulation and protection. There are likely to be restrictions to some developments within these areas.

This data is sourced from Natural England, Natural Resources Wales and Scottish Natural Heritage.

11.3 National Parks

Records within 250m	**0**

In England and Wales, the purpose of National Parks is to conserve and enhance landscapes within the countryside whilst promoting public enjoyment of them and having regard for the social and economic well-being of those living within them. In Scotland National Parks have the additional purpose of promoting the sustainable use of the natural resources of the area and the sustainable social and economic development of its communities. The National Parks and Access to the Countryside Act 1949 established the National Park designation in England and Wales, and The National Parks (Scotland) Act 2000 in Scotland.

This data is sourced from Natural England, Natural Resources Wales and the Scottish Government.

11.4 Listed Buildings

Records within 250m	**3**

Buildings listed for their special architectural or historical interest. Building control in the form of 'listed building consent' is required in order to make any changes to that building which might affect its special interest. Listed buildings are graded to indicate their relative importance, however building controls apply to all buildings equally, irrespective of their grade, and apply to the interior and exterior of the building in its entirety, together with any curtilage structures.

Features are displayed on the Visual and cultural designations map on **page 62 >**

ID	Location	Name	Grade	Reference Number	Listed date
1	39m NW	Theatr Clwyd, At The Uppermost Part Of The Civic Complex Overlooking The Town Of Mold, On The E Side Of Raikes Lane.	II	87786	11/06/2019
2	114m SW	Llwynegrin County Civic Centre, Adjacent To County Library Headquarters In Civic Centre Complex.	II	407	30/03/1987
3	130m SE	Broadway, Set Back From The Road On Rising Ground Approximately A Hundred Yards From The Junction With The A494.	II	405	30/03/1987

This data is sourced from Historic England, Cadw and Historic Environment Scotland.

11.5 Conservation Areas

Records within 250m	**0**

Local planning authorities are obliged to designate as conservation areas any parts of their own area that are of special architectural or historic interest, the character and appearance of which it is desirable to preserve or enhance. Designation of a conservation area gives broader protection than the listing of individual buildings. All the features within the area, listed or otherwise, are recognised as part of its character. Conservation area designation is the means of recognising the importance of all factors and of ensuring that planning decisions address the quality of the landscape in its broadest sense.

This data is sourced from Historic England, Cadw and Historic Environment Scotland.

11.6 Scheduled Ancient Monuments

Records within 250m	**0**

A scheduled monument is an historic building or site that is included in the Schedule of Monuments kept by the Secretary of State for Digital, Culture, Media and Sport. The regime is set out in the Ancient Monuments and Archaeological Areas Act 1979. The Schedule of Monuments has c.20,000 entries and includes sites such as Roman remains, burial mounds, castles, bridges, earthworks, the remains of deserted villages and industrial sites. Monuments are not graded, but all are, by definition, considered to be of national importance.

This data is sourced from Historic England, Cadw and Historic Environment Scotland.

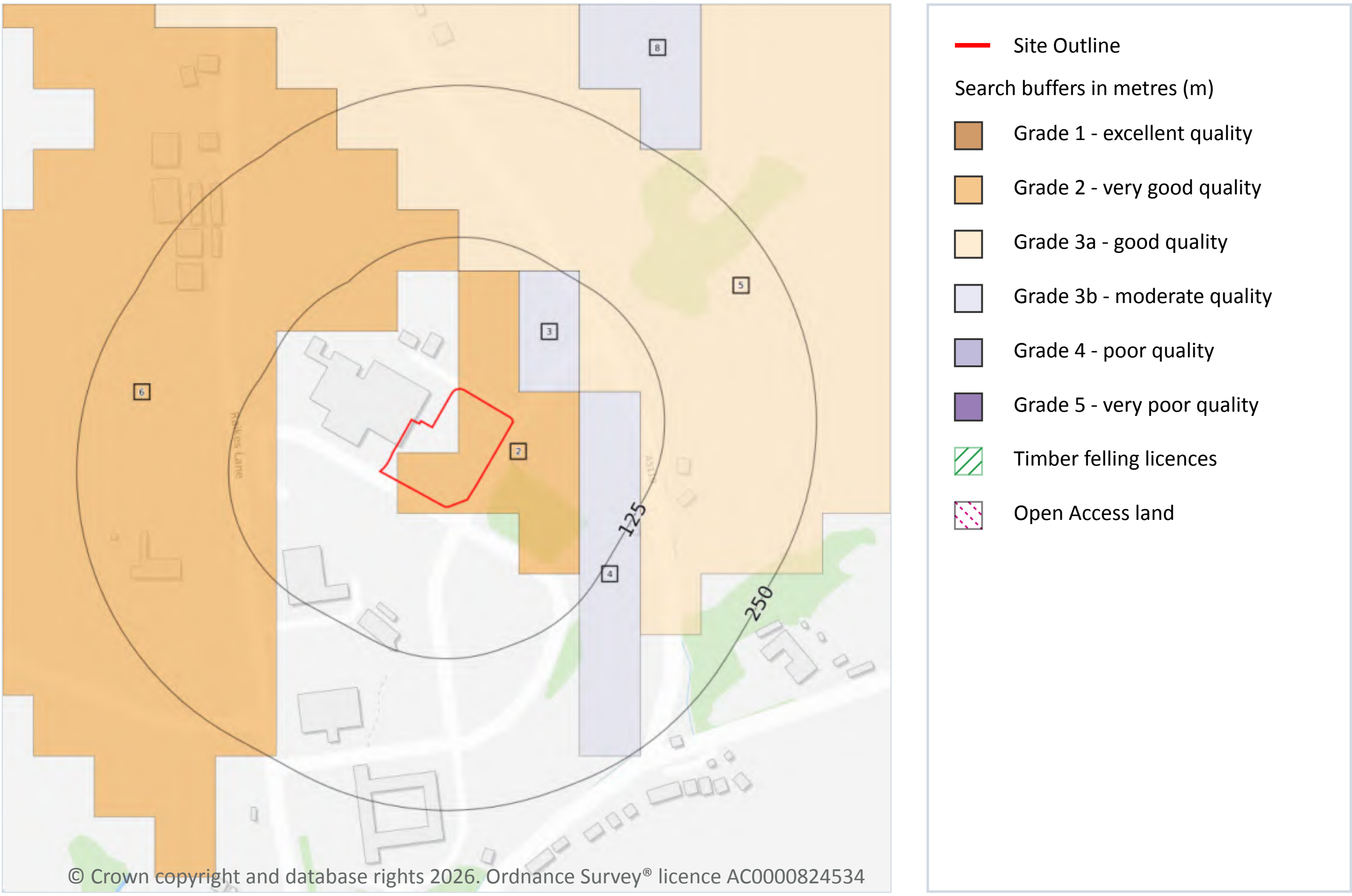
11.7 Registered Parks and Gardens

Records within 250m	**0**

Parks and gardens assessed to be of particular interest and of special historic interest. The emphasis being on 'designed' landscapes, rather than on planting or botanical importance. Registration is a 'material consideration' in the planning process, meaning that planning authorities must consider the impact of any proposed development on the special character of the landscape.

This data is sourced from Historic England, Cadw and Historic Environment Scotland.

12 Agricultural designations



12.1 Agricultural Land Classification

Records within 250m	6

Classification of the quality of agricultural land taking into consideration multiple factors including climate, physical geography and soil properties. It should be noted that the categories for the grading of agricultural land are not consistent across England, Wales and Scotland.

Features are displayed on the Agricultural designations map on page 65 >

ID	Location	Classification	Description
2	**On site**	**Grade 2**	**Good quality agricultural land**
3	22m NE	Grade 3b	Moderate quality agricultural land
4	55m E	Grade 3b	Moderate quality agricultural land

ID	Location	Classification	Description
5	60m E	Grade 3a	Good to moderate quality agricultural land
6	67m NW	Grade 2	Good quality agricultural land
8	245m NE	Grade 3b	Moderate quality agricultural land

This data is sourced from Natural Resources Wales.

12.2 Open Access Land

Records within 250m	**0**

The Countryside and Rights of Way Act 2000 (CROW Act) gives a public right of access to land without having to use paths. Access land includes mountains, moors, heaths and downs that are privately owned. It also includes common land registered with the local council and some land around the England Coast Path. Generally permitted activities on access land are walking, running, watching wildlife and climbing.

This data is sourced from Natural England and Natural Resources Wales.

12.3 Tree Felling Licences

Records within 250m	**0**

Felling Licence Application (FLA) areas approved by Forestry Commission England. Anyone wishing to fell trees must ensure that a licence or permission under a grant scheme has been issued by the Forestry Commission before any felling is carried out or that one of the exceptions apply.

This data is sourced from the Forestry Commission.

12.4 Environmental Stewardship Schemes

Records within 250m	**0**

Environmental Stewardship covers a range of schemes that provide financial incentives to farmers, foresters and land managers to look after and improve the environment. The schemes identified may be historical schemes that have now expired, or may still be active.

This data is sourced from Natural England.

12.5 Countryside Stewardship Schemes

Records within 250m	**0**

Countryside Stewardship covers a range of schemes that provide financial incentives to farmers, foresters and land managers to look after and improve the environment. Main objectives are to improve the farmed environment for wildlife and to reduce diffuse water pollution.

This data is sourced from Natural England.

13 Habitat designations

13.1 Priority Habitat Inventory

Records within 250m	**0**

Habitats of principal importance as named under Natural Environment and Rural Communities Act (2006) Section 41.

This data is sourced from Natural England.

13.2 Habitat Networks

Records within 250m	**0**

Habitat networks for 18 priority habitat networks (based primarily, but not exclusively, on the priority habitat inventory) and areas suitable for the expansion of networks through restoration and habitat creation.

This data is sourced from Natural England.

13.3 Open Mosaic Habitat

Records within 250m	**0**

Sites verified as Open Mosaic Habitat. Mosaic habitats are brownfield sites that are identified under the UK Biodiversity Action Plan as a priority habitat due to the habitat variation within a single site, supporting an array of invertebrates.

This data is sourced from Natural England.

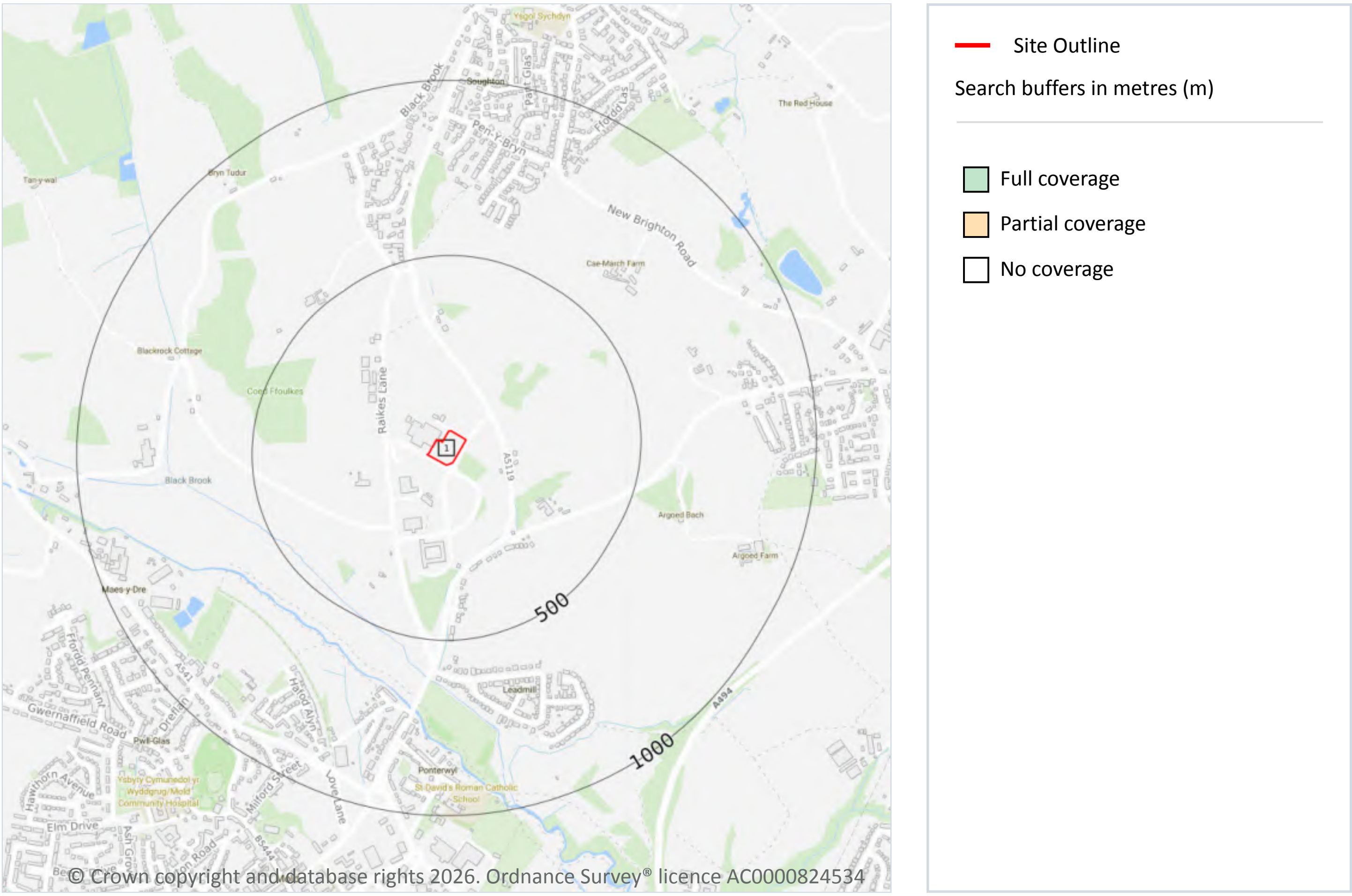
13.4 Limestone Pavement Orders

Records within 250m	**0**

Limestone pavements are outcrops of limestone where the surface has been worn away by natural means over millennia. These rocks have the appearance of paving blocks, hence their name. Not only do they have geological interest, they also provide valuable habitats for wildlife. These habitats are threatened due to their removal for use in gardens and water features. Many limestone pavements have been designated as SSSIs which affords them some protection. In addition, Section 34 of the Wildlife and Countryside Act 1981 gave them additional protection via the creation of Limestone Pavement Orders, which made it a criminal offence to remove any part of the outcrop. The associated Limestone Pavement Priority Habitat is part of the UK Biodiversity Action Plan priority habitat in England.

This data is sourced from Natural England.

14 Geology 1:10,000 scale - Availability



14.1 10k Availability

Records within 500m	1

An indication on the coverage of 1:10,000 scale geology data for the site, the most detailed dataset provided by the British Geological Survey. Either 'Full', 'Partial' or 'No coverage' for each geological theme.

Features are displayed on the Geology 1:10,000 scale - Availability map on page 69 >

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	On site	No coverage	No coverage	No coverage	No coverage	NoCov

This data is sourced from the British Geological Survey.

Geology 1:10,000 scale - Artificial and made ground

14.2 Artificial and made ground (10k)

Records within 500m	**0**

Details of made, worked, infilled, disturbed and landscaped ground at 1:10,000 scale. Artificial ground can be associated with potentially contaminated material, unpredictable engineering conditions and instability.

This data is sourced from the British Geological Survey.

Geology 1:10,000 scale - Superficial

14.3 Superficial geology (10k)

Records within 500m	**0**

Superficial geological deposits at 1:10,000 scale. Also known as 'drift', these are the youngest geological deposits, formed during the Quaternary. They rest on older deposits or rocks referred to as bedrock.

This data is sourced from the British Geological Survey.

14.4 Landslip (10k)

Records within 500m	**0**

Mass movement deposits on BGS geological maps at 1:10,000 scale. Primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground.

This data is sourced from the British Geological Survey.

Geology 1:10,000 scale - Bedrock

14.5 Bedrock geology (10k)

Records within 500m	**0**

Bedrock geology at 1:10,000 scale. The main mass of rocks forming the Earth and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

This data is sourced from the British Geological Survey.

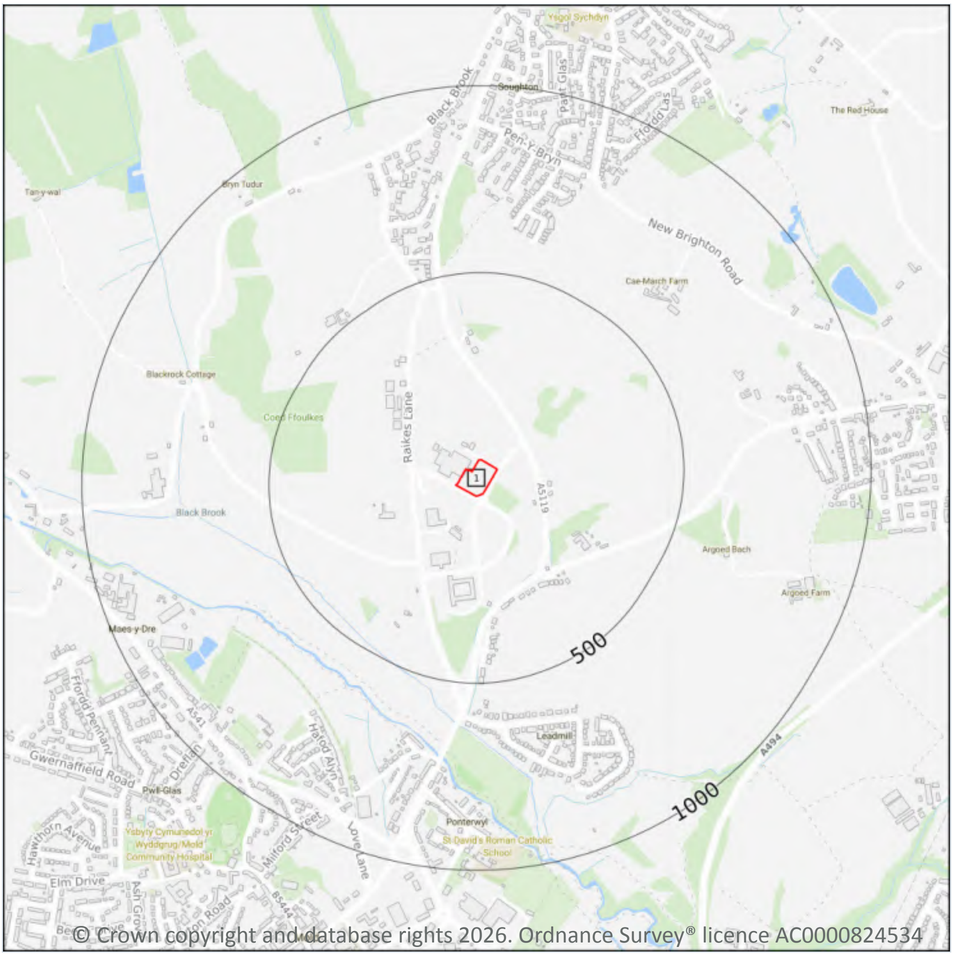
14.6 Bedrock faults and other linear features (10k)

Records within 500m	**0**

Linear features at the ground or bedrock surface at 1:10,000 scale of six main types; rock, fault, fold axis, mineral vein, alteration area or landform. Features are either observed or inferred, and relate primarily to bedrock.

This data is sourced from the British Geological Survey.

15 Geology 1:50,000 scale - Availability



🟥 Site Outline

Search buffers in metres (m)

☐ Geological map tile

15.1 50k Availability

Records within 500m 1

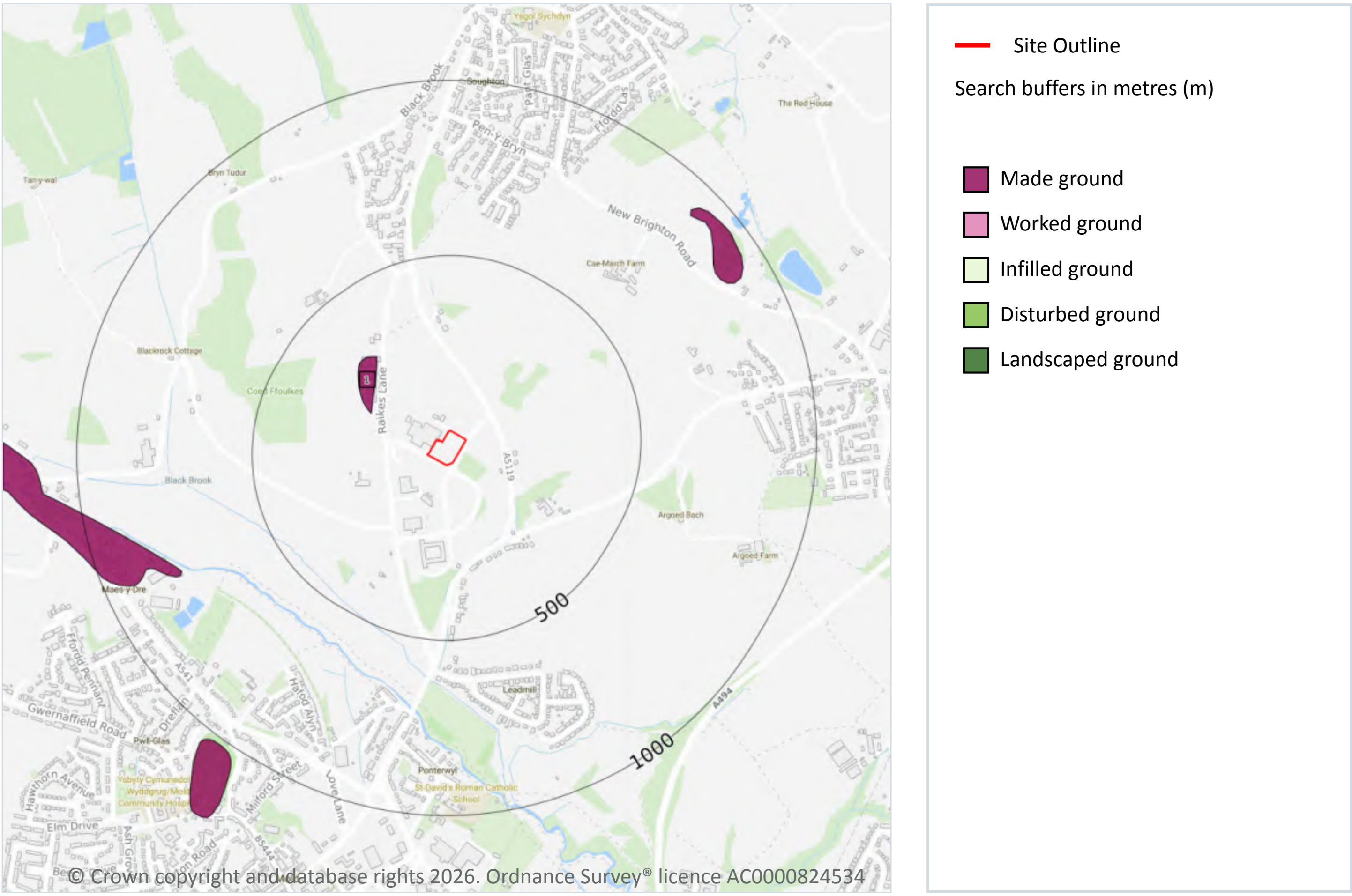
An indication on the coverage of 1:50,000 scale geology data for the site. Either 'Full' or 'No coverage' for each geological theme. Where 50k data is not available, this area has been filled in with 625k scale data.

Features are displayed on the Geology 1:50,000 scale - Availability map on page 73 >

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	**On site**	**Full**	**Full**	**Full**	**Full**	**EW108_flint_v4**

This data is sourced from the British Geological Survey.

Geology 1:50,000 scale - Artificial and made ground



15.2 Artificial and made ground (50k)

Records within 500m	**1**

Details of made, worked, infilled, disturbed and landscaped ground at 1:50,000 scale. Artificial ground can be associated with potentially contaminated material, unpredictable engineering conditions and instability.

Features are displayed on the Geology 1:50,000 scale - Artificial and made ground map on page 74 >

ID	Location	LEX Code	Description	Rock description
1	200m NW	MGR-ARTDP	Made Ground	Artificial deposit

This data is sourced from the British Geological Survey.

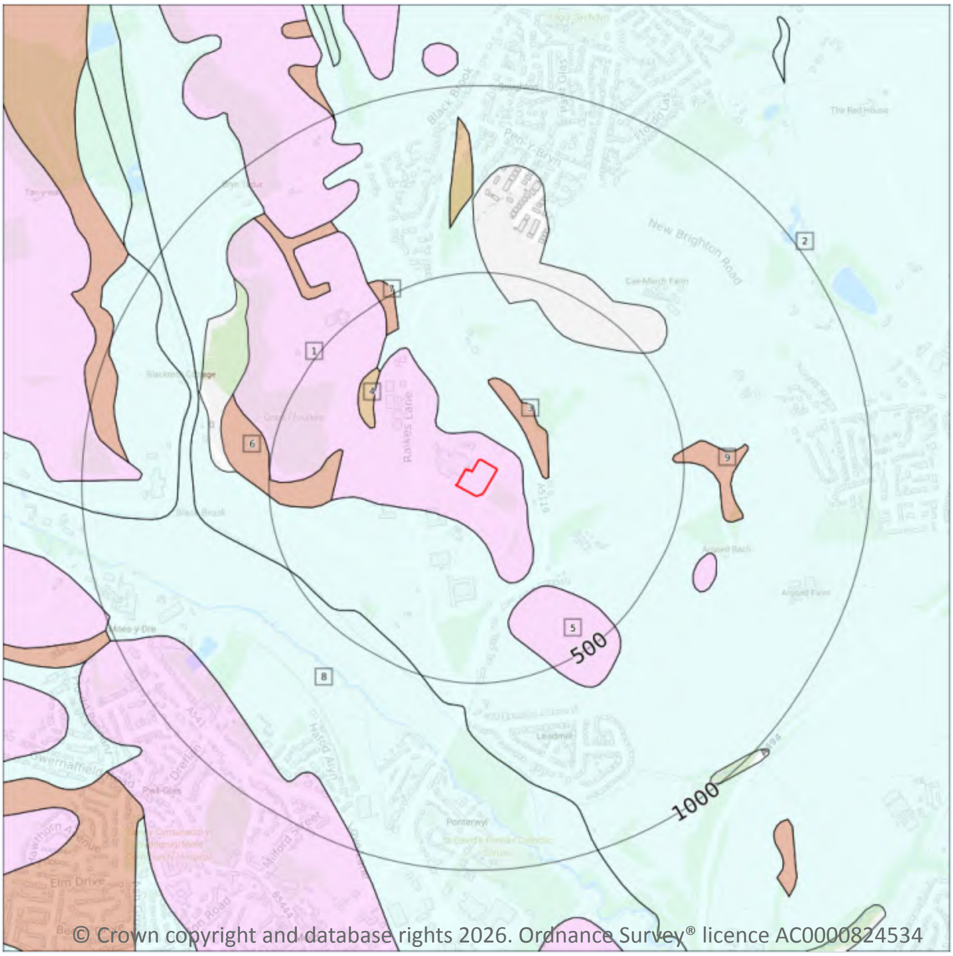
15.3 Artificial ground permeability (50k)

Records within 50m	**0**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any artificial deposits (the zone between the land surface and the water table).

This data is sourced from the British Geological Survey.

Geology 1:50,000 scale - Superficial



🟥 Site Outline

Search buffers in metres (m)

▨ Landslip (50k)

Superficial geology (50k)
Please see table for more details.

15.4 Superficial geology (50k)

Records within 500m	9

Superficial geological deposits at 1:50,000 scale. Also known as 'drift', these are the youngest geological deposits, formed during the Quaternary. They rest on older deposits or rocks referred to as bedrock.

Features are displayed on the Geology 1:50,000 scale - Superficial map on page 76 >

ID	Location	LEX Code	Description	Rock description
1	**On site**	**GFDUD-XSV**	**Glaciofluvial deposits, Devensian**	**Sand and gravel**
2	60m NE	TILLD-DMTN	Till, Devensian	Diamicton
3	107m E	HEAD-XCZSV	Head	Clay, silt, sand and gravel

ID	Location	LEX Code	Description	Rock description
4	267m NW	PEAT-P	Peat	Peat
5	290m SE	GFDUD-XSV	Glaciofluvial deposits, Devensian	Sand and gravel
6	315m W	HEAD-XCZSV	Head	Clay, silt, sand and gravel
7	412m NW	HEAD-XCZSV	Head	Clay, silt, sand and gravel
8	428m SW	ALV-XCZSV	Alluvium	Clay, silt, sand and gravel
9	471m E	HEAD-XCZSV	Head	Clay, silt, sand and gravel

This data is sourced from the British Geological Survey.

15.5 Superficial permeability (50k)

Records within 50m **1**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any superficial deposits (the zone between the land surface and the water table).

Location	Flow type	Maximum permeability	Minimum permeability
On site	**Intergranular**	**Very High**	**High**

This data is sourced from the British Geological Survey.

15.6 Landslip (50k)

Records within 500m **0**

Mass movement deposits on BGS geological maps at 1:50,000 scale. Primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground.

This data is sourced from the British Geological Survey.

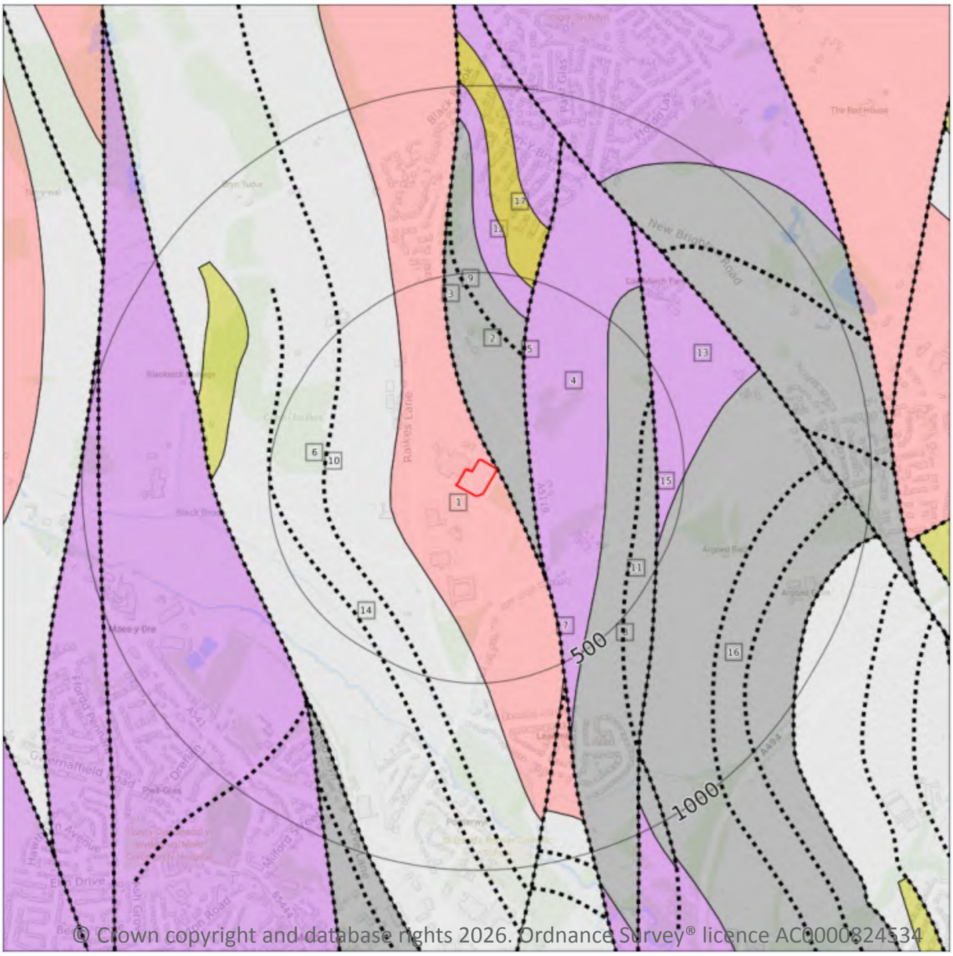
15.7 Landslip permeability (50k)

Records within 50m **0**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any landslip deposits (the zone between the land surface and the water table).

This data is sourced from the British Geological Survey.

Geology 1:50,000 scale - Bedrock



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🟥 Site Outline

Search buffers in metres (m)

.... Bedrock faults and other linear features (50k)

Bedrock geology (50k)
Please see table for more details.

15.8 Bedrock geology (50k)

Records within 500m 9

Bedrock geology at 1:50,000 scale. The main mass of rocks forming the Earth and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

Features are displayed on the Geology 1:50,000 scale - Bedrock map on page 78 >

ID	Location	LEX Code	Description	Rock age
1	**On site**	**GS-SDAR**	**Gwespyr Sandstone-Interbedded sandstone and [subequal/subordinate] argillaceous rocks**	**Namurian**
2	1m NE	PMCM-MDSS	Pennine Middle Coal Measures Formation-Mudstone, siltstone and sandstone	Westphalian
4	89m E	ETM-MDSC	Etruria Formation-Mudstone, sandstone and conglomerate	Westphalian

ID	Location	LEX Code	Description	Rock age
6	174m W	PLCM-MDSS	Pennine Lower Coal Measures Formation-Mudstone, siltstone and sandstone	Westphalian
8	294m E	PMCM-MDSS	Pennine Middle Coal Measures Formation-Mudstone, siltstone and sandstone	Westphalian
12	394m N	ETM-MDSC	Etruria Formation-Mudstone, sandstone and conglomerate	Westphalian
13	426m E	ETM-MDSC	Etruria Formation-Mudstone, sandstone and conglomerate	Westphalian
16	471m E	PMCM-MDSS	Pennine Middle Coal Measures Formation-Mudstone, siltstone and sandstone	Westphalian
17	477m N	ETM-SDST	Etruria Formation-Sandstone	Westphalian

This data is sourced from the British Geological Survey.

15.9 Bedrock permeability (50k)

Records within 50m **2**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of bedrock (the zone between the land surface and the water table).

Location	Flow type	Maximum permeability	Minimum permeability
On site	**Fracture**	**Moderate**	**Low**
1m NE	Fracture	Moderate	Low

This data is sourced from the British Geological Survey.

15.10 Bedrock faults and other linear features (50k)

Records within 500m **8**

Linear features at the ground or bedrock surface at 1:50,000 scale of six main types; rock, fault, fold axis, mineral vein, alteration area or landform. Features are either observed or inferred, and relate primarily to bedrock.

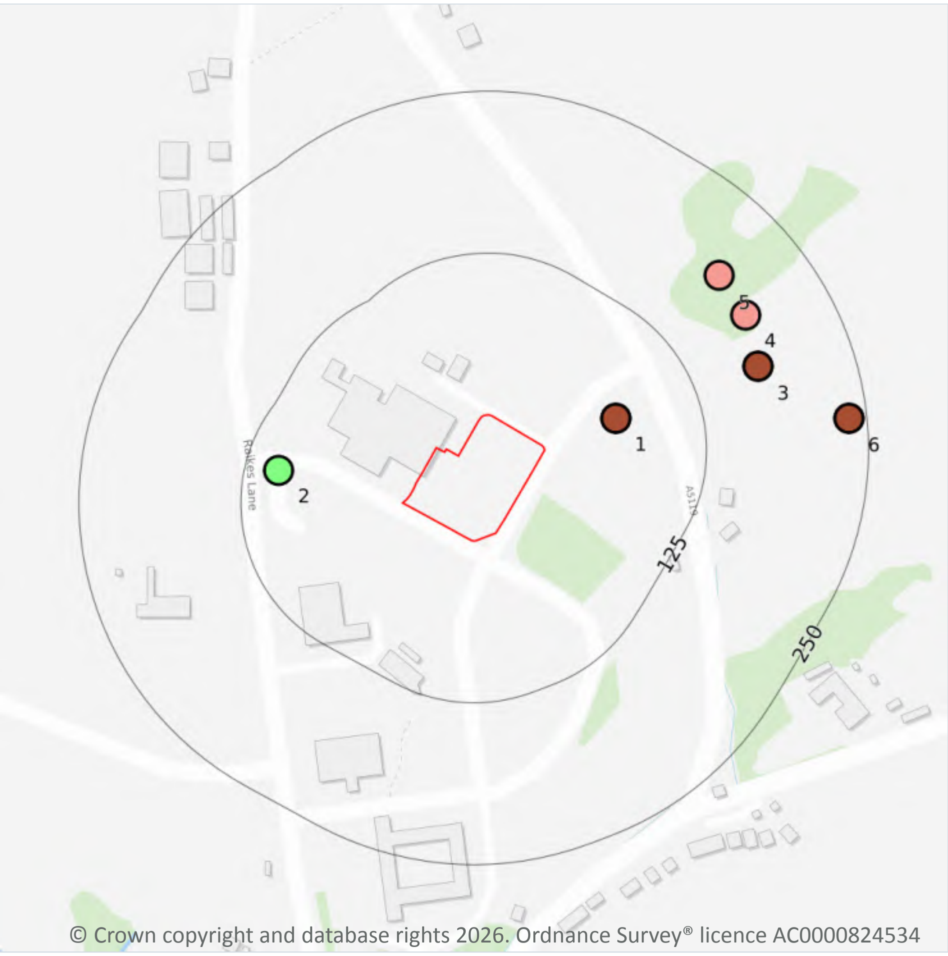
Features are displayed on the Geology 1:50,000 scale - Bedrock map on page 78 >

ID	Location	Category	Description
3	1m NE	FAULT	Fault, inferred, crossmark on downthrow side, throw in metres
5	89m E	FAULT	Fault, inferred, displacement unknown
7	276m SE	FAULT	Fault, inferred, crossmark on downthrow side, throw in metres

ID	Location	Category	Description
9	298m N	ROCK	Coal seam, inferred
10	340m SW	ROCK	Coal seam, inferred
11	381m E	ROCK	Coal seam, inferred
14	426m SW	ROCK	Coal seam, inferred
15	426m E	FAULT	Fault, inferred, displacement unknown

This data is sourced from the British Geological Survey.

16 Boreholes



Site Outline

Search buffers in metres (m)

● Confidential

● 0 - 10m

● 10 - 30m

● 30m+

● Unknown

16.1 BGS Boreholes

Records within 250m 6

The Single Onshore Boreholes Index (SOBI); an index of over one million records of boreholes, shafts and wells from all forms of drilling and site investigation work held by the British Geological Survey. Covering onshore and nearshore boreholes dating back to at least 1790 and ranging from one to several thousand metres deep.

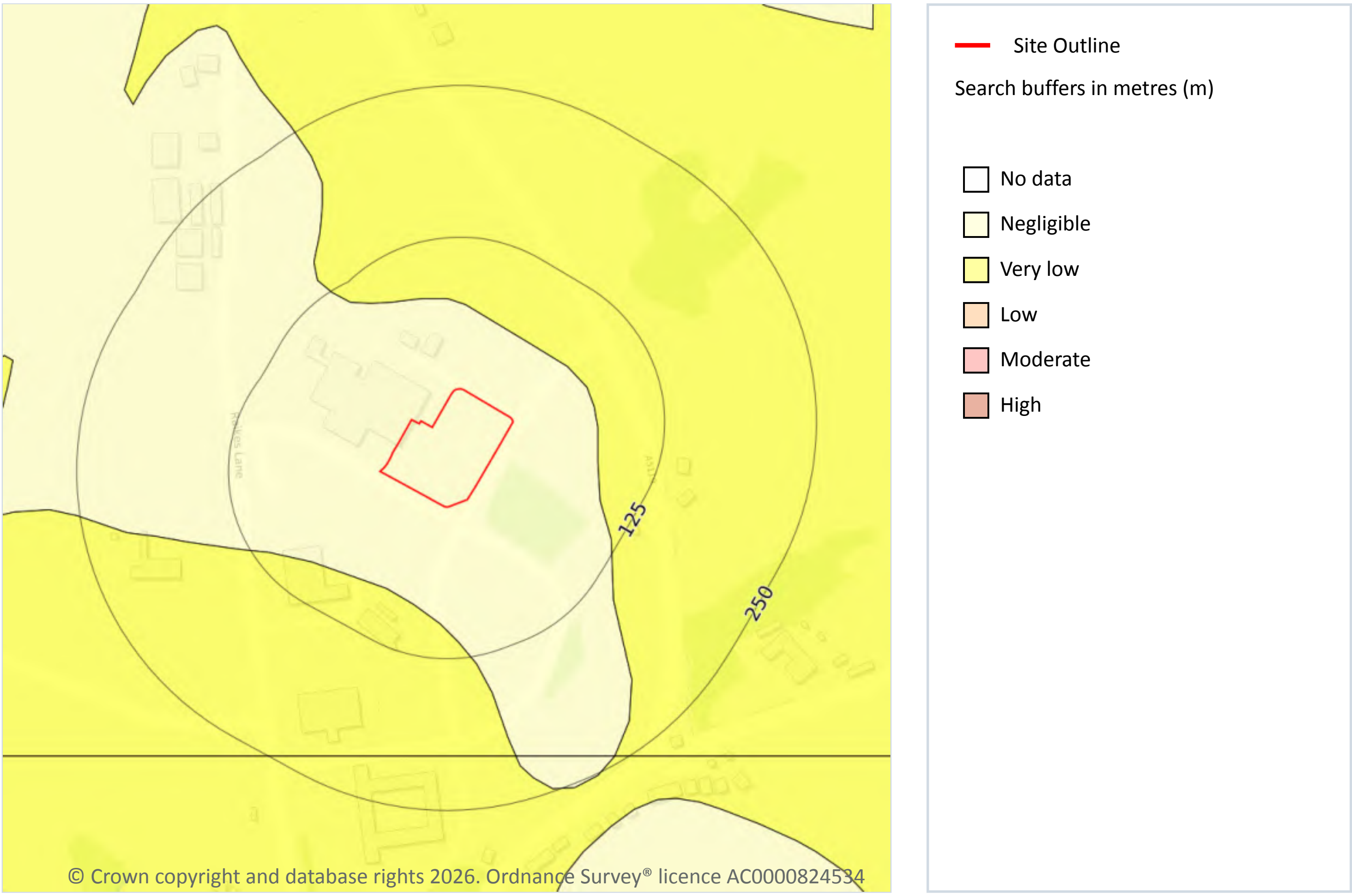
Features are displayed on the Boreholes map on page 81 >

ID	Location	Grid reference	Name	Length	Confidential	Web link
1	60m E	324300 365300	TY'N TWLL COLLIERY	-1.0	N	148510 ↗
2	99m W	324040 365260	GLASFRYN	15.0	N	148455 ↗
3	177m E	324410 365340	TY'N TWLL COLL	-1.0	N	148540 ↗

ID	Location	Grid reference	Name	Length	Confidential	Web link
4	186m NE	324400 365380	TY'N TWLL COLL. AIR SHAFT	67.97	N	148539 ↗
5	190m NE	324380 365410	TY'N TWLL COLL. NO.1 SHAFT	67.97	N	148538 ↗
6	236m E	324480 365300	TY'N TWLL COLL. OLD SHAFT	-1.0	N	148543 ↗

This data is sourced from the British Geological Survey.

17 Natural ground subsidence - Shrink swell clays



17.1 Shrink swell clays

Records within 50m	1

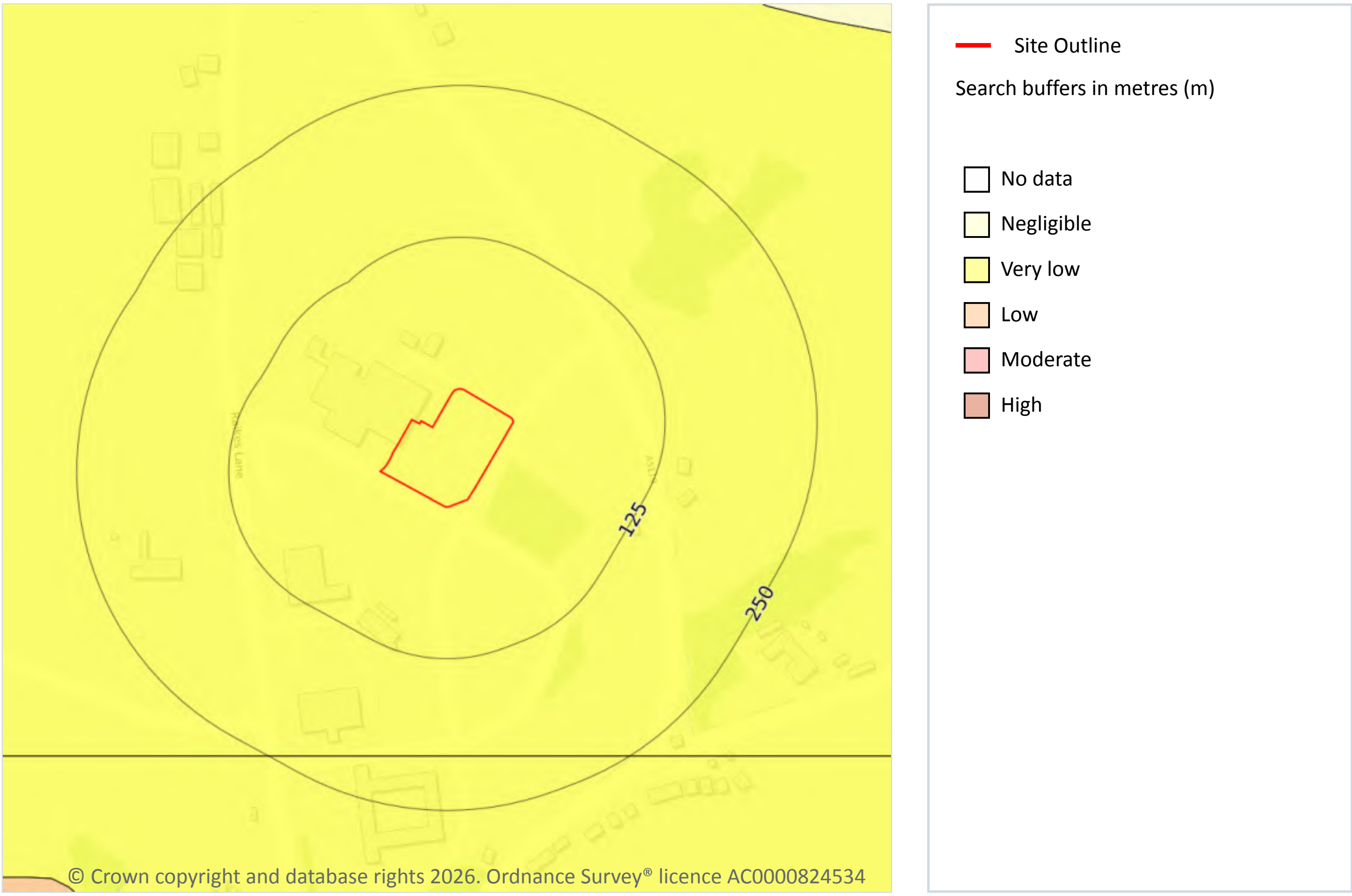
The potential hazard presented by soils that absorb water when wet (making them swell), and lose water as they dry (making them shrink). This shrink-swell behaviour is controlled by the type and amount of clay in the soil, and by seasonal changes in the soil moisture content (related to rainfall and local drainage).

Features are displayed on the Natural ground subsidence - Shrink swell clays map on page 83 >

Location	Hazard rating	Details
On site	**Negligible**	**Ground conditions predominantly non-plastic.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Running sands



17.2 Running sands

Records within 50m	**1**

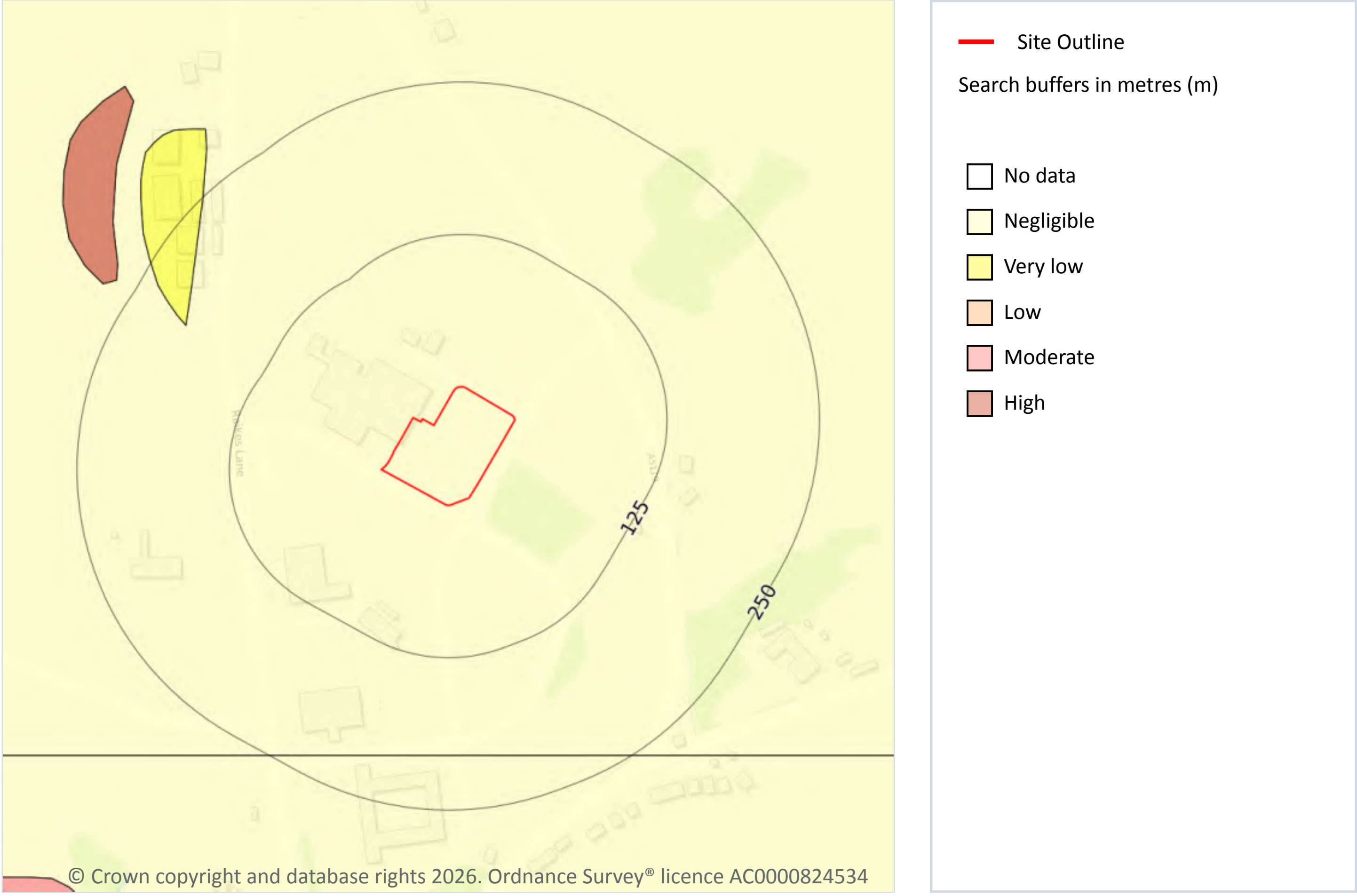
The potential hazard presented by rocks that can contain loosely-packed sandy layers that can become fluidised by water flowing through them. Such sands can 'run', removing support from overlying buildings and causing potential damage.

Features are displayed on the Natural ground subsidence - Running sands map on **page 84 >**

Location	Hazard rating	Details
On site	**Very low**	**Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Compressible deposits



17.3 Compressible deposits

Records within 50m	**1**

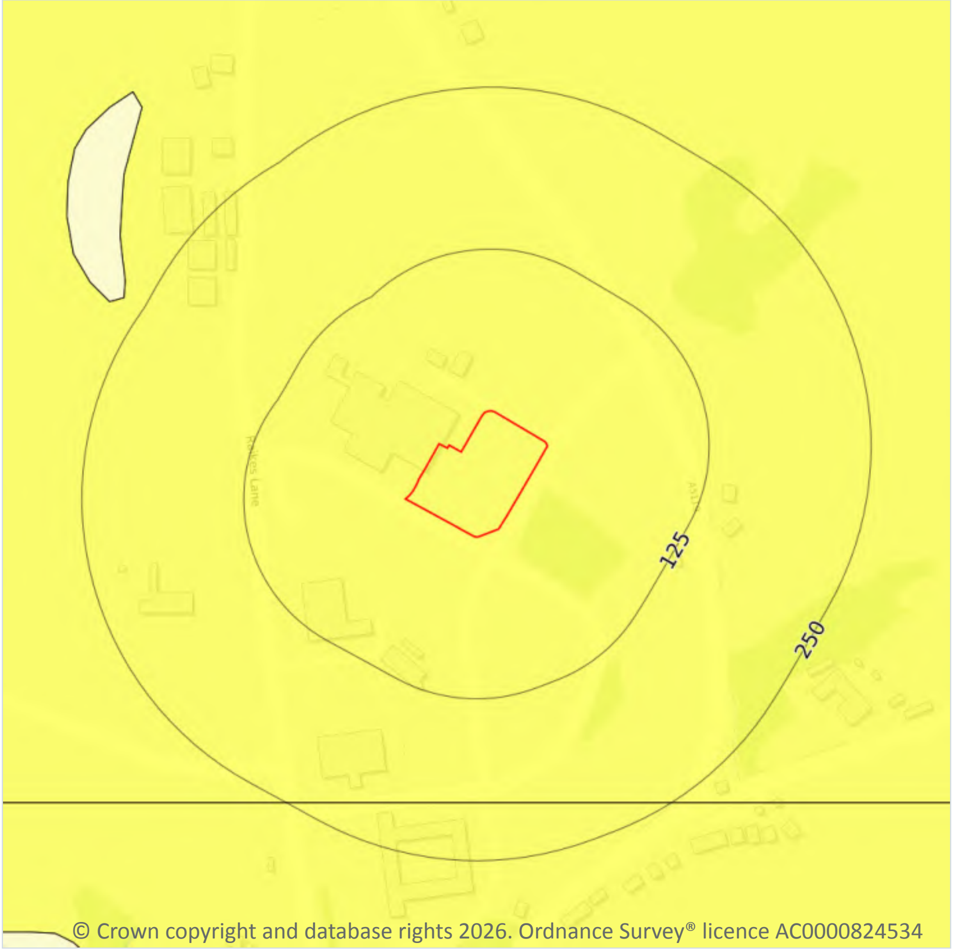
The potential hazard presented by types of ground that may contain layers of very soft materials like clay or peat and may compress if loaded by overlying structures, or if the groundwater level changes, potentially resulting in depression of the ground and disturbance of foundations.

Features are displayed on the Natural ground subsidence - Compressible deposits map on **page 85 >**

Location	Hazard rating	Details
On site	**Negligible**	**Compressible strata are not thought to occur.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Collapsible deposits



Site Outline

Search buffers in metres (m)

☐ No data
☐ Negligible
☐ Very low
☐ Low
☐ Moderate
☐ High

17.4 Collapsible deposits

Records within 50m	1

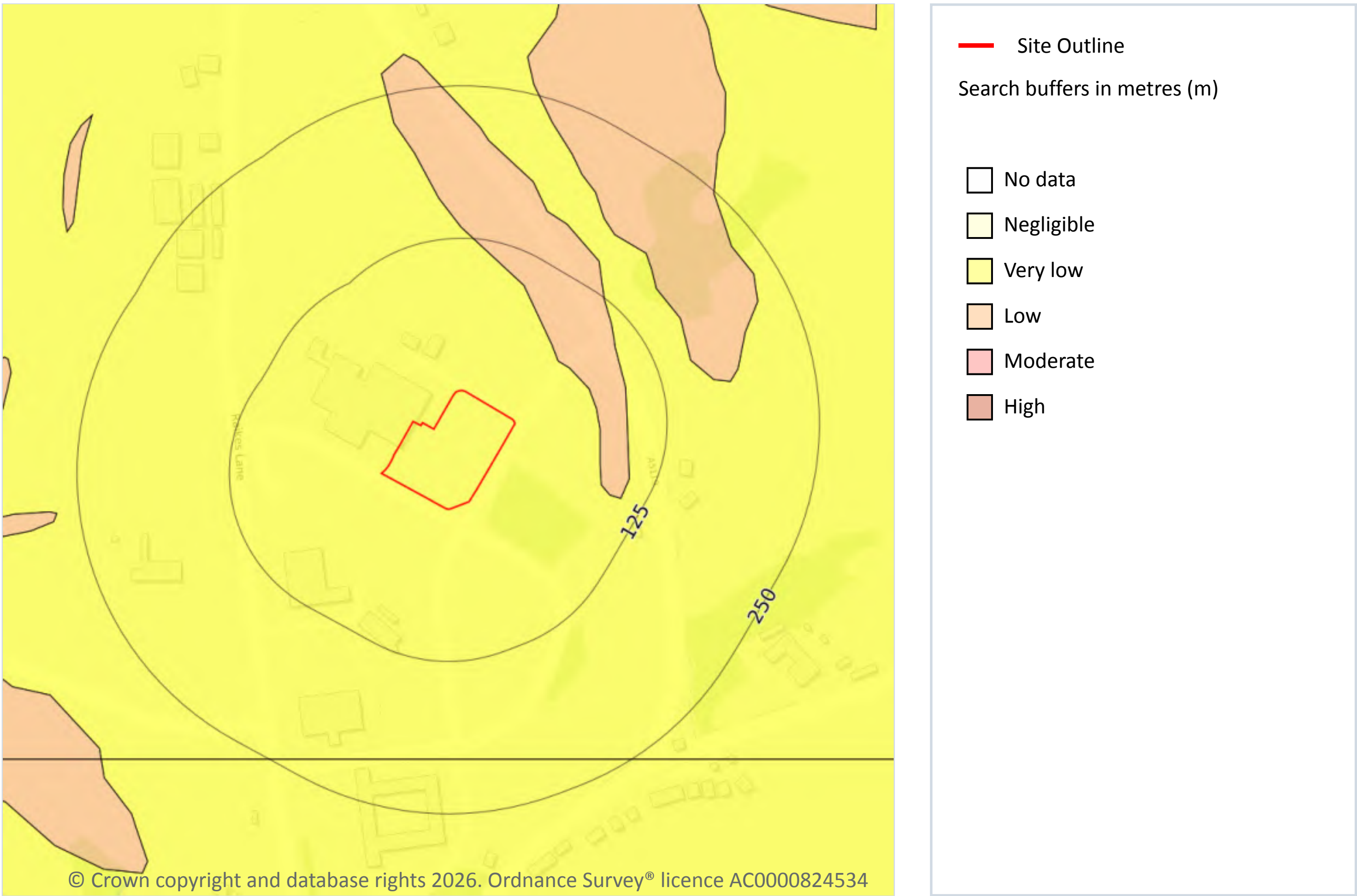
The potential hazard presented by natural deposits that could collapse when a load (such as a building) is placed on them or they become saturated with water.

Features are displayed on the Natural ground subsidence - Collapsible deposits map on page 86 >

Location	Hazard rating	Details
On site	**Very low**	**Deposits with potential to collapse when loaded and saturated are unlikely to be present.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Landslides



17.5 Landslides

Records within 50m	**1**

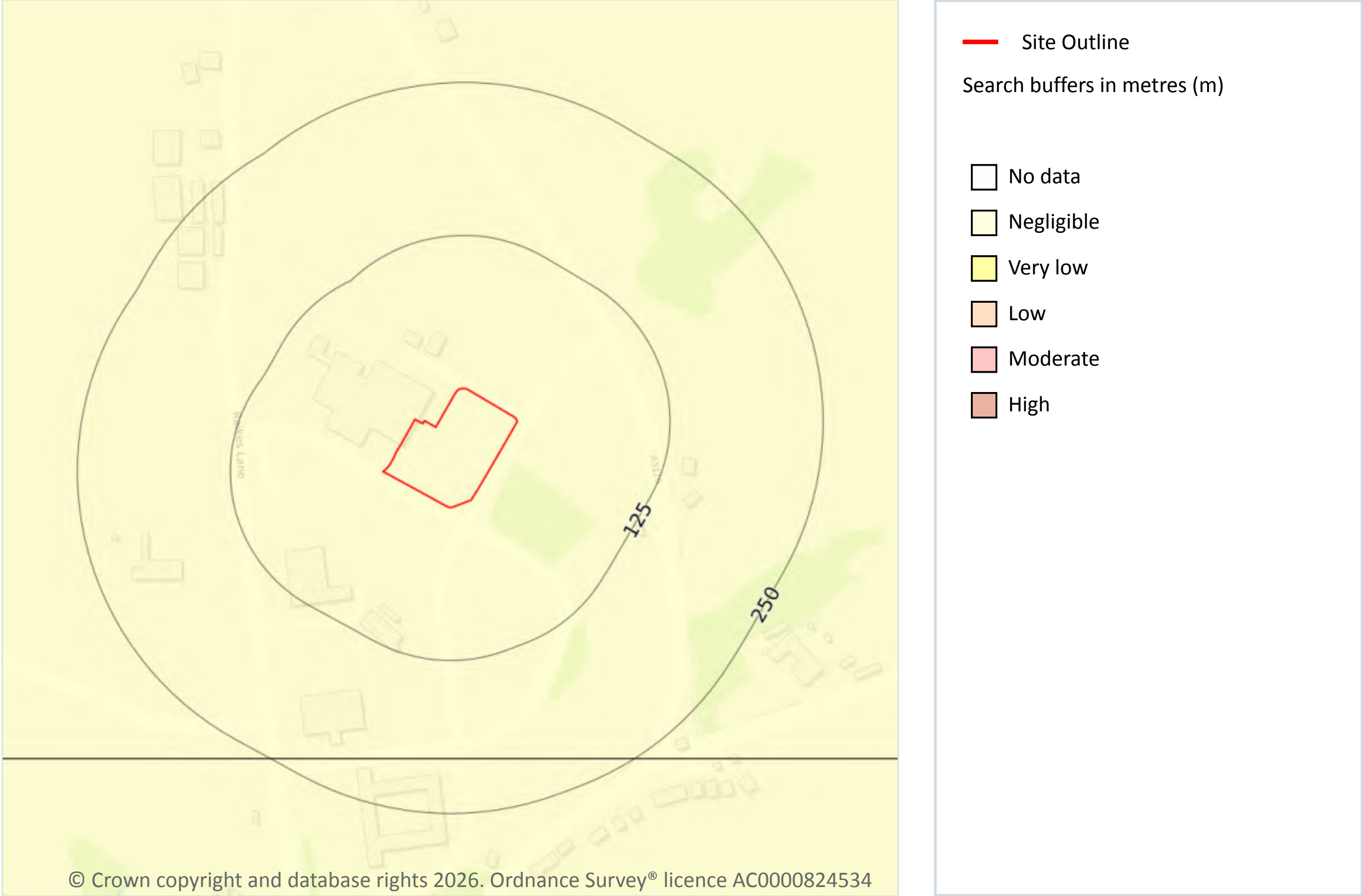
The potential for landsliding (slope instability) to be a hazard assessed using 1:50,000 scale digital maps of superficial and bedrock deposits, combined with information from the BGS National Landslide Database and scientific and engineering reports.

Features are displayed on the Natural ground subsidence - Landslides map on page 87 >

Location	Hazard rating	Details
On site	**Very low**	**Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Ground dissolution of soluble rocks



17.6 Ground dissolution of soluble rocks

Records within 50m	1

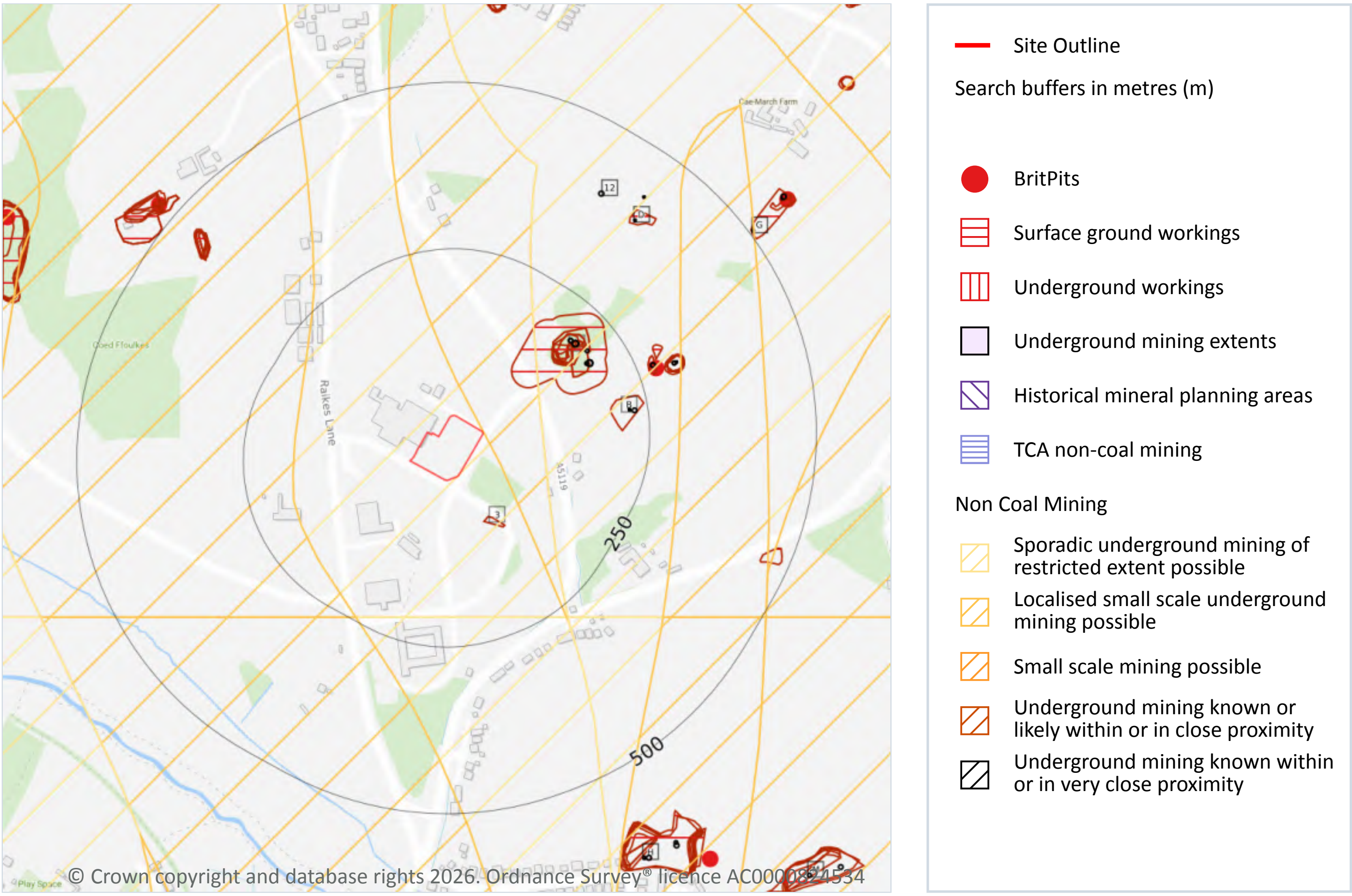
The potential hazard presented by ground dissolution, which occurs when water passing through soluble rocks produces underground cavities and cave systems. These cavities reduce support to the ground above and can cause localised collapse of the overlying rocks and deposits.

Features are displayed on the Natural ground subsidence - Ground dissolution of soluble rocks map on page 88 >

Location	Hazard rating	Details
On site	**Negligible**	**Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.**

This data is sourced from the British Geological Survey.

18 Mining and ground workings



18.1 BritPits

Records within 500m	1

BritPits (an abbreviation of British Pits) is a database maintained by the British Geological Survey of currently active and closed surface and underground mineral workings. Details of major mineral handling sites, such as wharfs and rail depots are also held in the database.

Features are displayed on the Mining and ground workings map on page 90 >

ID	Location	Details	Description
C	277m E	Name: Broadway Shafts Address: MOLD, Flintshire Commodity: Coal, Deep Status: Ceased	Type: Working is wholly underground, access by shaft, adit, drift or incline. Working may be termed Colliery, Mine, Drift Mine, Slant, Level, Adit or Ingoing Eye (Ingaun' Ee' - Scots). May also be locally termed `Quarry’ or `Underground Quarry’ when referring to sites extracting building stone (e.g. in Dorset and Wiltshire). The location given is that of the mine entrance and may be approximate for older sites shown on contemporaneous mapping by the Geological Survey used as the source document. Status description: Site which has ceased to extract minerals. May be considered as 'Closed' by operator. May be considered to have 'Active', 'Dormant' or 'Expired' planning permissions by the Mineral Planning Authority.

This data is sourced from the British Geological Survey.

18.2 Surface ground workings

Records within 250m	**12**

Historical land uses identified from Ordnance Survey® mapping that involved ground excavation at the surface. These features may or may not have been subsequently backfilled.

Features are displayed on the Mining and ground workings map on page 90 >

ID	Location	Land Use	Year of mapping	Mapping scale
3	76m SE	Unspecified Ground Workings	1938	1:10560
A	89m NE	Colliery	1938	1:10560
A	150m NE	Unspecified Ground Workings	1910	1:10560
A	152m NE	Unspecified Heap	1938	1:10560
A	154m NE	Unspecified Ground Workings	1914	1:10560
A	154m NE	Colliery	1914	1:10560
A	154m NE	Unspecified Ground Workings	1914	1:10560
A	154m NE	Colliery	1914	1:10560
A	159m NE	Unspecified Heap	1971	1:10000
A	159m NE	Unspecified Heap	1959	1:10560
A	161m NE	Unspecified Heap	1898	1:10560
B	194m E	Refuse Heap	1872	1:10560

This is data is sourced from Ordnance Survey®/Groundsure.

18.3 Underground workings

Records within 1000m **57**

Historical land uses identified from Ordnance Survey® mapping that indicate the presence of underground workings e.g. mine shafts.

Features are displayed on the Mining and ground workings map on page 90 >

ID	Location	Land Use	Year of mapping	Mapping scale
A	185m NE	Air Shafts	1938	1:10560
A	186m NE	Unspecified Disused Shaft	1989	1:10000
A	186m NE	Unspecified Disused Shaft	1971	1:10000
A	186m NE	Disused Air Shaft	1959	1:10560
A	187m NE	Unspecified Shaft	1938	1:10560
A	187m NE	Unspecified Old Shafts	1898	1:10560
A	188m NE	Unspecified Disused Shaft	1989	1:10000
A	188m NE	Unspecified Disused Shaft	1971	1:10000
A	188m NE	Unspecified Disused Shaft	1959	1:10560
A	196m NE	Air Shafts	1938	1:10560
B	221m E	Unspecified Shaft	1872	1:10560
B	226m E	Unspecified Old Shafts	1898	1:10560
C	271m E	Unspecified Old Shafts	1898	1:10560
C	271m E	Air Shafts	1938	1:10560
C	303m E	Unspecified Old Shaft	1938	1:10560
C	303m E	Unspecified Old Shafts	1898	1:10560
C	308m E	Unspecified Shaft	1872	1:10560
D	390m NE	Unspecified Shafts	1872	1:10560
12	395m NE	Unspecified Shafts	1872	1:10560
D	426m NE	Unspecified Shafts	1872	1:10560
G	505m NE	Unspecified Shaft	1872	1:10560
G	569m NE	Unspecified Shaft	1872	1:10560
G	570m NE	Old Coal Shaft	1938	1:10560

ID	Location	Land Use	Year of mapping	Mapping scale
G	570m NE	Unspecified Old Shaft	1898	1:10560
H	635m SE	Coal Shafts	1872	1:10560
H	636m SE	Unspecified Old Shafts	1898	1:10560
H	637m SE	Coal Shafts	1872	1:10560
H	640m SE	Unspecified Old Shafts	1898	1:10560
-	681m E	Coal Shaft	1872	1:10560
-	792m SW	Unspecified Disused Shafts	1981	1:10000
-	792m SW	Unspecified Disused Shafts	1964	1:10560
M	795m SE	Coal Shafts	1872	1:10560
-	798m SW	Old Coal Shafts	1938	1:10560
-	798m SW	Unspecified Disused Shafts	1992	1:10000
-	811m SW	Unspecified Disused Shafts	1981	1:10000
-	811m SW	Unspecified Disused Shafts	1964	1:10560
-	815m SW	Old Coal Shafts	1938	1:10560
-	815m SW	Old Coal Shafts	1898	1:10560
M	817m SE	Coal Shafts	1872	1:10560
-	820m SW	Unspecified Disused Shafts	1992	1:10000
-	822m E	Unspecified Shaft	1872	1:10560
-	859m E	Unspecified Old Shafts	1898	1:10560
-	864m E	Unspecified Old Shafts	1898	1:10560
-	893m NE	Unspecified Old Shafts	1898	1:10560
-	916m NE	Old Coal Shafts	1938	1:10560
-	916m NE	Unspecified Disused Shafts	1971	1:10000
-	916m NE	Unspecified Shafts	1959	1:10560
-	922m NE	Unspecified Old Shafts	1898	1:10560
-	934m NE	Old Coal Shafts	1938	1:10560
-	936m NE	Unspecified Disused Shafts	1989	1:10000
-	936m NE	Unspecified Disused Shafts	1971	1:10000

ID	Location	Land Use	Year of mapping	Mapping scale
-	936m NE	Unspecified Shafts	1959	1:10560
-	942m NE	Unspecified Old Shafts	1898	1:10560
-	942m E	Old Coal Shaft	1938	1:10560
-	943m E	Unspecified Disused Shaft	1990	1:10000
-	943m E	Unspecified Disused Shaft	1975	1:10000
-	946m E	Unspecified Old Shaft	1898	1:10560

This is data is sourced from Ordnance Survey®/Groundsure.

18.4 Underground mining extents

Records within 500m	**0**

This data identifies underground mine workings that could present a potential risk, including adits and seam workings. These features have been identified from BGS Geological mapping and mine plans sourced from the BGS and various collections and sources.

This data is sourced from Groundsure.

18.5 Historical Mineral Planning Areas

Records within 500m	**0**

Boundaries of mineral planning permissions for England and Wales. This data was collated between the 1940s (and retrospectively to the 1930s) and the mid 1980s. The data includes permitted, withdrawn and refused permissions.

This data is sourced from the British Geological Survey.

18.6 Non-coal mining

Records within 1000m	**25**

The potential for historical non-coal mining to have affected an area. The assessment is drawn from expert knowledge and literature in addition to the digital geological map of Britain. Mineral commodities may be divided into seven general categories - vein minerals, chalk, oil shale, building stone, bedded ores, evaporites and 'other' commodities (including ball clay, jet, black marble, graphite and chert).

Features are displayed on the Mining and ground workings map on page 90 >

ID	Location	Name	Commodity	Class	Likelihood
1	**On site**	**Not available**	**Vein Mineral**	**A**	**Underground mine workings are uncommon, although the geology is similar to that worked elsewhere. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.**
2	1m NE	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
4	89m E	Not available	Vein Mineral	A	Underground mine workings are uncommon, although the geology is similar to that worked elsewhere. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
5	174m W	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
6	205m S	Not available	Vein Mineral	A	Underground mine workings are uncommon, although the geology is similar to that worked elsewhere. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
7	245m SW	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
8	267m SE	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
9	268m SE	Not available	Vein Mineral	A	Underground mine workings are uncommon, although the geology is similar to that worked elsewhere. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
10	294m E	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.

ID	Location	Name	Commodity	Class	Likelihood
11	373m SE	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
14	471m E	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
15	505m SE	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
16	601m SW	Not available	Vein Mineral	A	Underground mine workings are uncommon, although the geology is similar to that worked elsewhere. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
17	602m SW	Not available	Vein Mineral	A	Underground mine workings are uncommon, although the geology is similar to that worked elsewhere. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
J	625m W	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
19	693m SW	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
K	714m NE	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
-	755m E	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.

ID	Location	Name	Commodity	Class	Likelihood
-	780m E	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
-	804m E	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
-	811m SE	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
-	859m S	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
-	917m SE	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
-	921m SE	Not available	Vein Mineral	A	Underground mine workings are uncommon, although the geology is similar to that worked elsewhere. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
-	936m E	Not available	Iron Ore (Bedded)	B	Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.

This data is sourced from the British Geological Survey.

18.7 JPB mining areas

Records on site	**1**

Areas which could be affected by former coal and other mining. This data includes some mine plans unavailable to the Coal Authority.

Location	Details
On site	**In addition to being located inside an area where The Coal Authority have information on coal mining activities, Johnson Poole & Bloomer (JPB) have information such as mining plans and maps held within their archive of mining activities that have occurred within 1km of this property which may supplement this information. Please note, the plans held by JPB may also relate to non-mining records. Further details and a quote for services (if appropriate) can be obtained by emailing this report to enquiries.gs@jpb.co.uk ↗.**

This data is sourced from Johnson Poole and Bloomer.

18.8 The Coal Authority non-coal mining

Records within 500m	**0**

This data provides an indication of the potential zone of influence of recorded underground non-coal mining workings. Any and all analysis and interpretation of Coal Authority Data in this report is made by Groundsure, and is in no way supported, endorsed or authorised by the Coal Authority. The use of the data is restricted to the terms and provisions contained in this report. Data reproduced in this report may be the copyright of the Coal Authority and permission should be sought from Groundsure prior to any re-use.

This data is sourced from The Coal Authority.

18.9 Researched mining

Records within 500m	**4**

This data indicates areas of potential mining identified from alternative or archival sources, including; BGS Geological paper maps, Lidar data, aerial photographs (from World War II onwards), archaeological data services, websites, Tithe maps, and various text/plans from collected books and reports. Some of this data is approximate and Groundsure have interpreted the resultant risk area and, where possible, specific areas of risk have been captured.

Location	Mineral type
438m NE	Unspecified
459m E	Unspecified
466m NE	Unspecified
487m NE	Unspecified

This data is sourced from Groundsure.

18.10 Mining record office plans

Records within 500m	**0**

This dataset is representative of Mining Record Office and/or plan extents held by Groundsure and should be considered approximate. Where possible, plans have been located and any specific areas of risk they depict have been captured.

This data is sourced from Groundsure.

18.11 BGS mine plans

Records within 500m	**0**

This dataset is representative of BGS mine plans held by Groundsure and should be considered approximate. Where possible, plans have been located and any specific areas of risk they depict have been captured.

This data is sourced from Groundsure.

18.12 Coal mining

Records on site	**1**

Areas which could be affected by past, current or future coal mining.

Location	Details
On site	**The site is located within a coal mining area as defined by the Coal Authority. A Consultants Coal Mining Report is recommended to further assess coal mining issues at the site. This can be ordered directly through Groundsure or your preferred search provider.**

This data is sourced from the Coal Authority.

18.13 Brine areas

Records on site	**0**

The Cheshire Brine Compensation District indicates areas that may be affected by salt and brine extraction in Cheshire and where compensation would be available where damage from this mining has occurred. Damage from salt and brine mining can still occur outside this district, but no compensation will be available.

This data is sourced from the Cheshire Brine Subsidence Compensation Board.

18.14 Gypsum areas

Records on site	**0**

Generalised areas that may be affected by gypsum extraction.

This data is sourced from British Gypsum.

18.15 Tin mining

Records on site	**0**

Generalised areas that may be affected by historical tin mining.

This data is sourced from Groundsure.

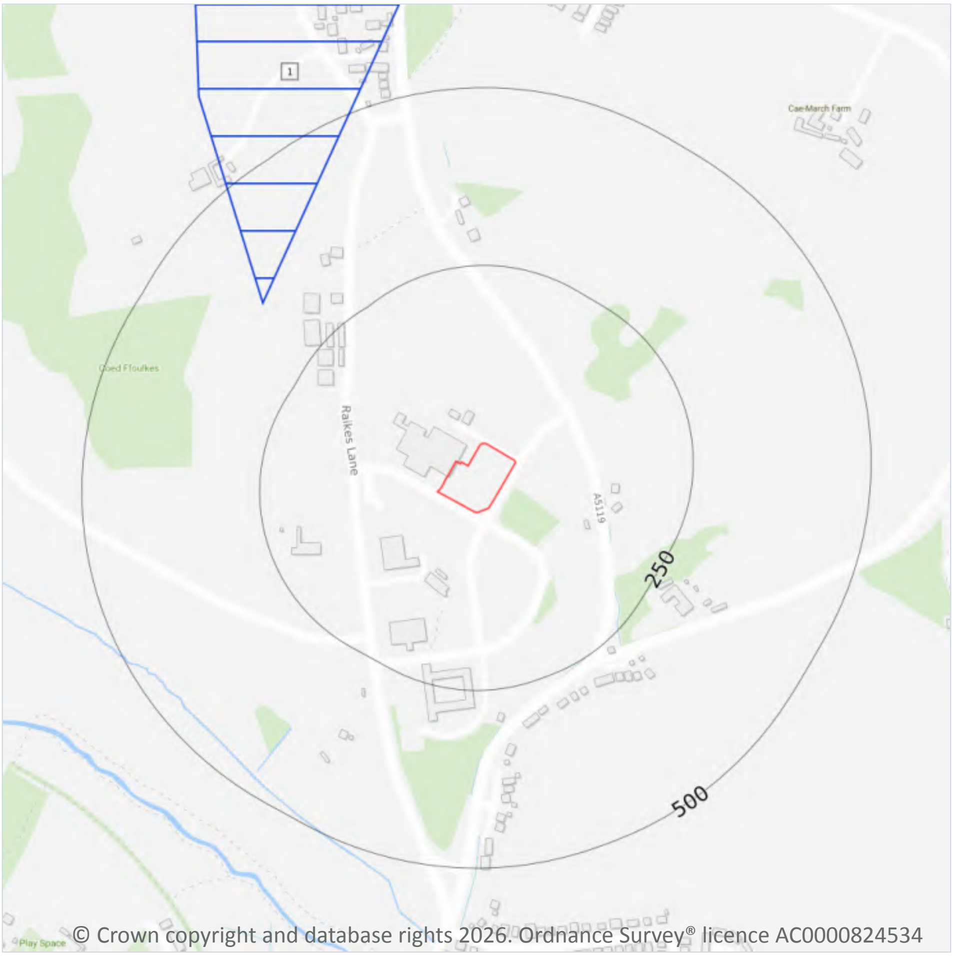
18.16 Clay mining

Records on site	**0**

Generalised areas that may be affected by kaolin and ball clay extraction.

This data is sourced from the Kaolin and Ball Clay Association (UK).

19 Ground cavities and sinkholes



🟥	Site Outline
Search buffers in metres (m)	
▤	Natural cavities (Area)
●	Natural cavities (Point)
●	Mining cavities
●	Reported recent incidents
▥	Historical incidents

19.1 Natural cavities

Records within 500m	1

Industry recognised national database of natural cavities. Sinkholes and caves are formed by the dissolution of soluble rock, such as chalk and limestone, gulls and fissures by cambering. Ground instability can result from movement of loose material contained within these cavities, often triggered by water.

Features are displayed on the Ground cavities and sinkholes map on page 101 >

ID	Location	Details
1	351m NW	Type: Swallow Hole x 7 Superficial Geology: - Bedrock Geology: Carboniferous Limestone Supergroup, Lower Coal Measures, Middle Coal Measures, Millstone Grit Group, Upper Carboniferous Limestone

This data is sourced from Stantec UK Ltd.

19.2 Mining cavities

Records within 1000m	**0**

Industry recognised national database of mining cavities. Degraded mines may result in hazardous subsidence (crown holes). Climatic conditions and water escape can also trigger subsidence over mine entrances and workings.

This data is sourced from Stantec UK Ltd.

19.3 Reported recent incidents

Records within 500m	**0**

This data identifies sinkhole information gathered from media reports and Groundsure's own records. This data goes back to 2014 and includes relative accuracy ratings for each event and links to the original data sources. The data is updated on a regular basis and should not be considered a comprehensive catalogue of all sinkhole events. The absence of data in this database does not mean a sinkhole definitely has not occurred during this time.

This data is sourced from Groundsure.

19.4 Historical incidents

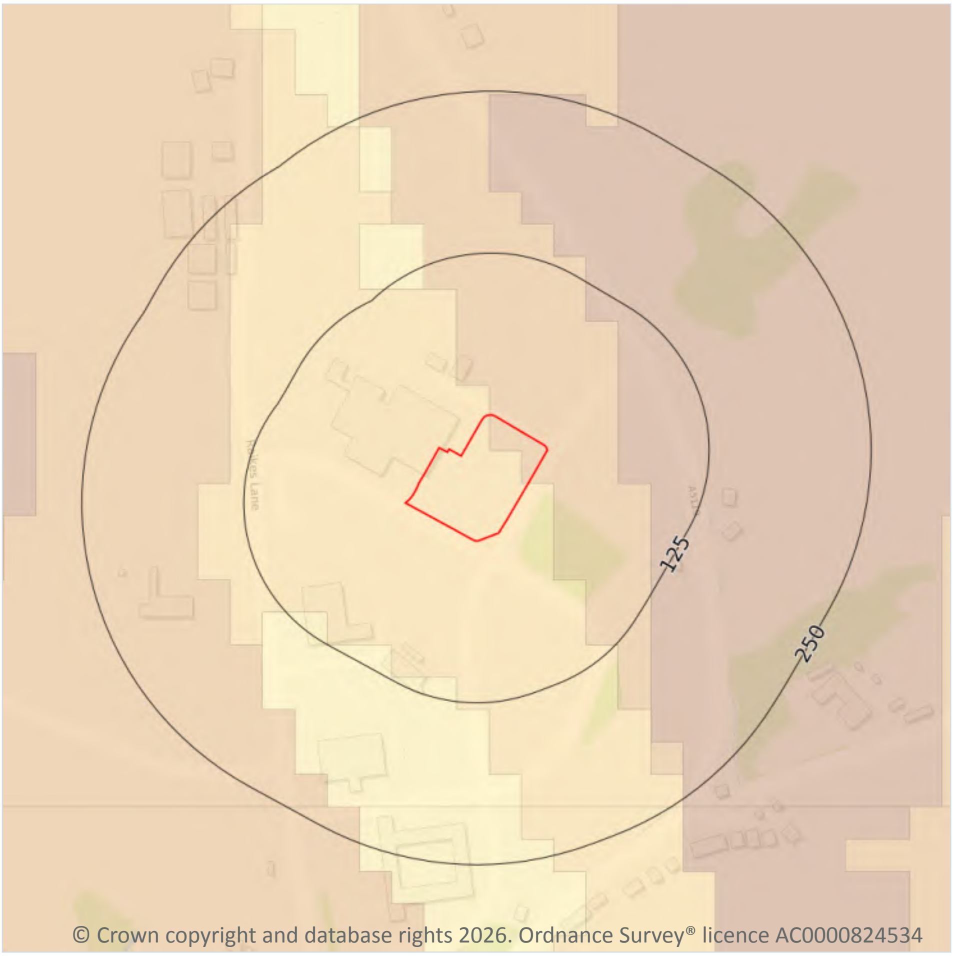
Records within 500m	**0**

This dataset comprises an extract of 1:10,560, 1:10,000, 1:2,500 and 1:1,250 scale historical Ordnance Survey® maps held by Groundsure, dating back to the 1840s. It shows shakeholes, deneholes and other 'holes' as noted on these maps. Dene holes are medieval chalk extraction pits, usually comprising a narrow shaft with a number of chambers at the base of the shaft. Shakeholes are an alternative name for suffusion sinkholes, most commonly found in the limestone landscapes of North Yorkshire but also extensively noted around the Brecon Beacons National Park.

Not all 'holes' noted on Ordnance Survey® mapping will necessarily be present within this dataset.

This data is sourced from Groundsure.

20 Radon



— Site Outline

Search buffers in metres (m)

▨ Greater than 30%

▨ Between 10% and 30%

▨ Between 5% and 10%

▨ Between 3% and 5%

▨ Between 1% and 3%

☐ Less than 1%

20.1 Radon

Records on site **2**

The Radon Potential data classifies areas based on their likelihood of a property having a radon level at or above the Action Level in Great Britain. The dataset is intended for use at 1:50,000 scale and was derived from both geological assessments and indoor radon measurements (more than 560,000 records). A minimum 50m buffer should be considered when searching the maps, as the smallest detectable feature at this scale is 50m. The findings of this section should supersede any estimations derived from the Indicative Atlas of Radon in Great Britain (1:100,000 scale).

Features are displayed on the Radon map on page 103 >

Location	Estimated properties affected	Radon Protection Measures required
On site	**Between 3% and 5%**	**Basic**

Location	Estimated properties affected	Radon Protection Measures required
On site	**Between 5% and 10%**	**Basic**

This data is sourced from the British Geological Survey and UK Health Security Agency.

21 Soil chemistry

21.1 BGS Estimated Background Soil Chemistry

Records within 50m	**2**

The estimated values provide the likely background concentration of the potentially harmful elements Arsenic, Cadmium, Chromium, Lead and Nickel in topsoil. The values are estimated primarily from rural topsoil data collected at a sample density of approximately 1 per 2 km^2. In areas where rural soil samples are not available, estimation is based on stream sediment data collected from small streams at a sampling density of 1 per 2.5 km^2; this is the case for most of Scotland, Wales and southern England. The stream sediment data are converted to soil-equivalent concentrations prior to the estimation.

Location	Arsenic	Bioaccessible Arsenic	Lead	Bioaccessible Lead	Cadmium	Chromium	Nickel
On site	**15 mg/kg**	**No data**	**100 - 200 mg/kg**	**60 - 120 mg/kg**	**1.8 mg/kg**	**60 - 90 mg/kg**	**15 - 30 mg/kg**
1m NE	15 mg/kg	No data	100 - 200 mg/kg	60 - 120 mg/kg	1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg

This data is sourced from the British Geological Survey.

21.2 BGS Estimated Urban Soil Chemistry

Records within 50m	**0**

Estimated topsoil chemistry of Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Tin and Zinc and bioaccessible Arsenic and Lead in 23 urban centres across Great Britain. These estimates are derived from interpolation of the measured urban topsoil data referred to above and provide information across each city between the measured sample locations (4 per km^2).

This data is sourced from the British Geological Survey.

21.3 BGS Measured Urban Soil Chemistry

Records within 50m	**0**

The locations and measured total concentrations (mg/kg) of Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Tin and Zinc in urban topsoil samples from 23 urban centres across Great Britain. These are collected at a sample density of 4 per km^2.

This data is sourced from the British Geological Survey.

22 Railway infrastructure and projects

22.1 Underground railways (London)

Records within 250m	**0**

Details of all active London Underground lines, including approximate tunnel roof depth and operational hours.

This data is sourced from publicly available information by Groundsure.

22.2 Underground railways (Non-London)

Records within 250m	**0**

Details of the Merseyrail system, the Tyne and Wear Metro and the Glasgow Subway. Not all parts of all systems are located underground. The data contains location information only and does not include a depth assessment.

This data is sourced from publicly available information by Groundsure.

22.3 Railway tunnels

Records within 250m	**0**

Railway tunnels taken from contemporary Ordnance Survey® mapping.

This data is sourced from the Ordnance Survey®.

22.4 Historical railway and tunnel features

Records within 250m	**0**

Railways and tunnels digitised from historical Ordnance Survey® mapping as scales of 1:1,250, 1:2,500, 1:10,000 and 1:10,560.

This data is sourced from Ordnance Survey®/Groundsure.

22.5 Royal Mail tunnels

Records within 250m	**0**

The Post Office Railway, otherwise known as the Mail Rail, is an underground railway running through Central London from Paddington Head District Sorting Office to Whitechapel Eastern Head Sorting Office. The line is 10.5km long. The data includes details of the full extent of the tunnels, the depth of the tunnel, and the depth to track level.

This data is sourced from Groundsure/the Postal Museum.

22.6 Historical railways

Records within 250m	**0**

Former railway lines, including dismantled lines, abandoned lines, disused lines, historic railways and razed lines.

This data is sourced from OpenStreetMap.

22.7 Railways

Records within 250m	**0**

Currently existing railway lines, including standard railways, narrow gauge, funicular, trams and light railways.

This data is sourced from Ordnance Survey® and OpenStreetMap.

22.8 Crossrail 2

Records within 500m	**0**

Crossrail 2 is a proposed railway linking the national rail networks in Surrey and Hertfordshire via an underground tunnel through London.

This data is sourced from publicly available information by Groundsure.

22.9 HS2

Records within 500m	**0**

HS2 is a proposed high speed rail network running from London to Manchester and Leeds via Birmingham. Main civils construction on Phase 1 (London to Birmingham) of the project began in 2019, and it is currently anticipated that this phase will be fully operational by 2026. Construction on Phase 2a (Birmingham to Crewe) is anticipated to commence in 2021, with the service fully operational by 2027. Construction on Phase 2b (Crewe to Manchester and Birmingham to Leeds) is scheduled to begin in 2023 and be operational by 2033.

This data is sourced from HS2 ltd.

Data providers

Groundsure works with respected data providers to bring you the most relevant and accurate information. To find out who they are and their areas of expertise see https://www.groundsure.com/sources-reference ↗.

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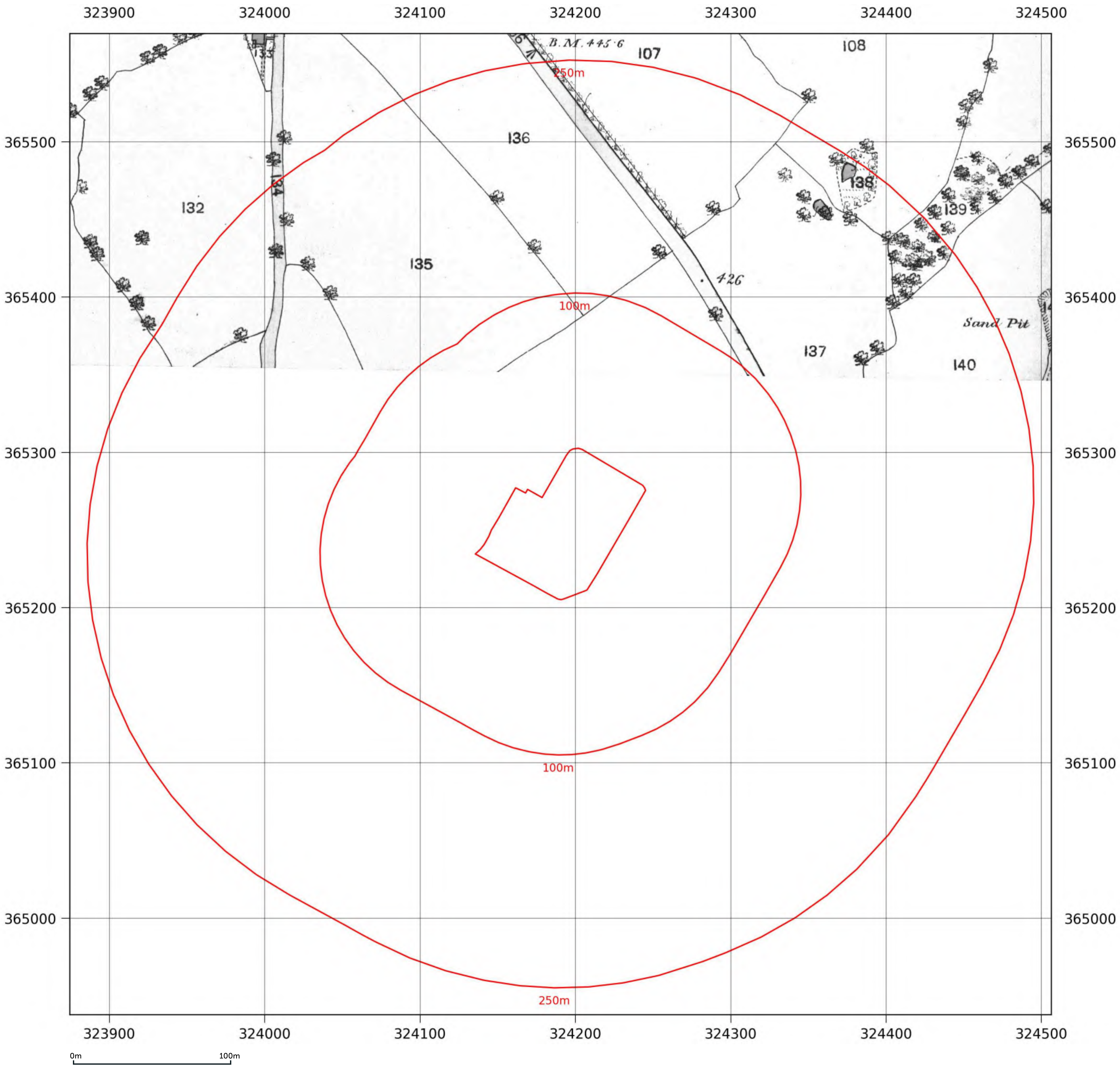

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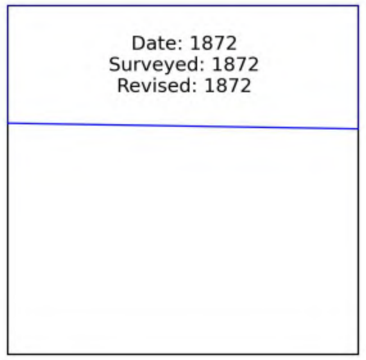

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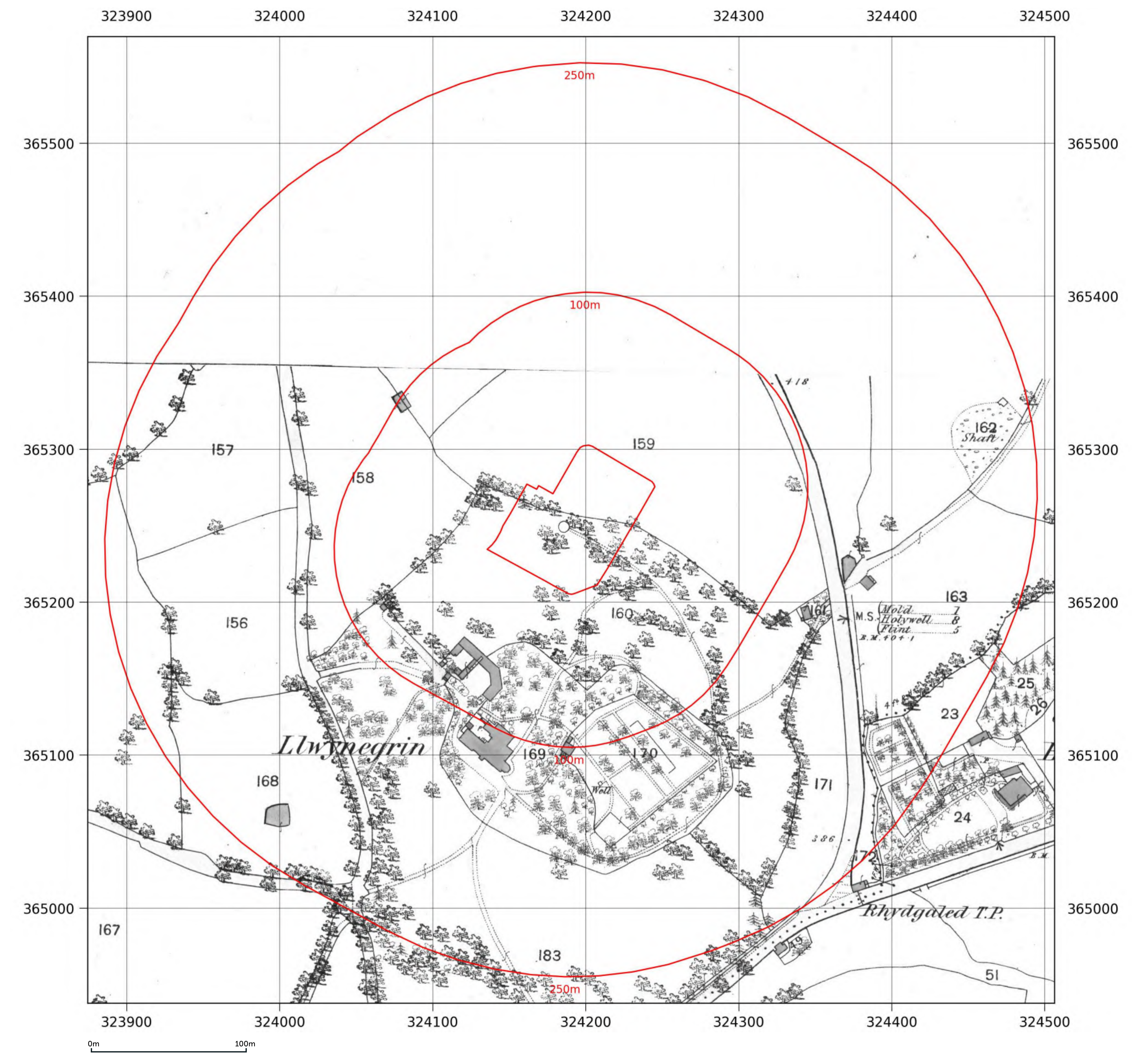

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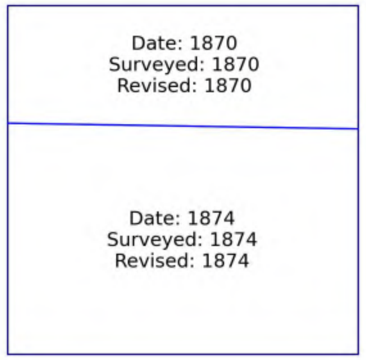

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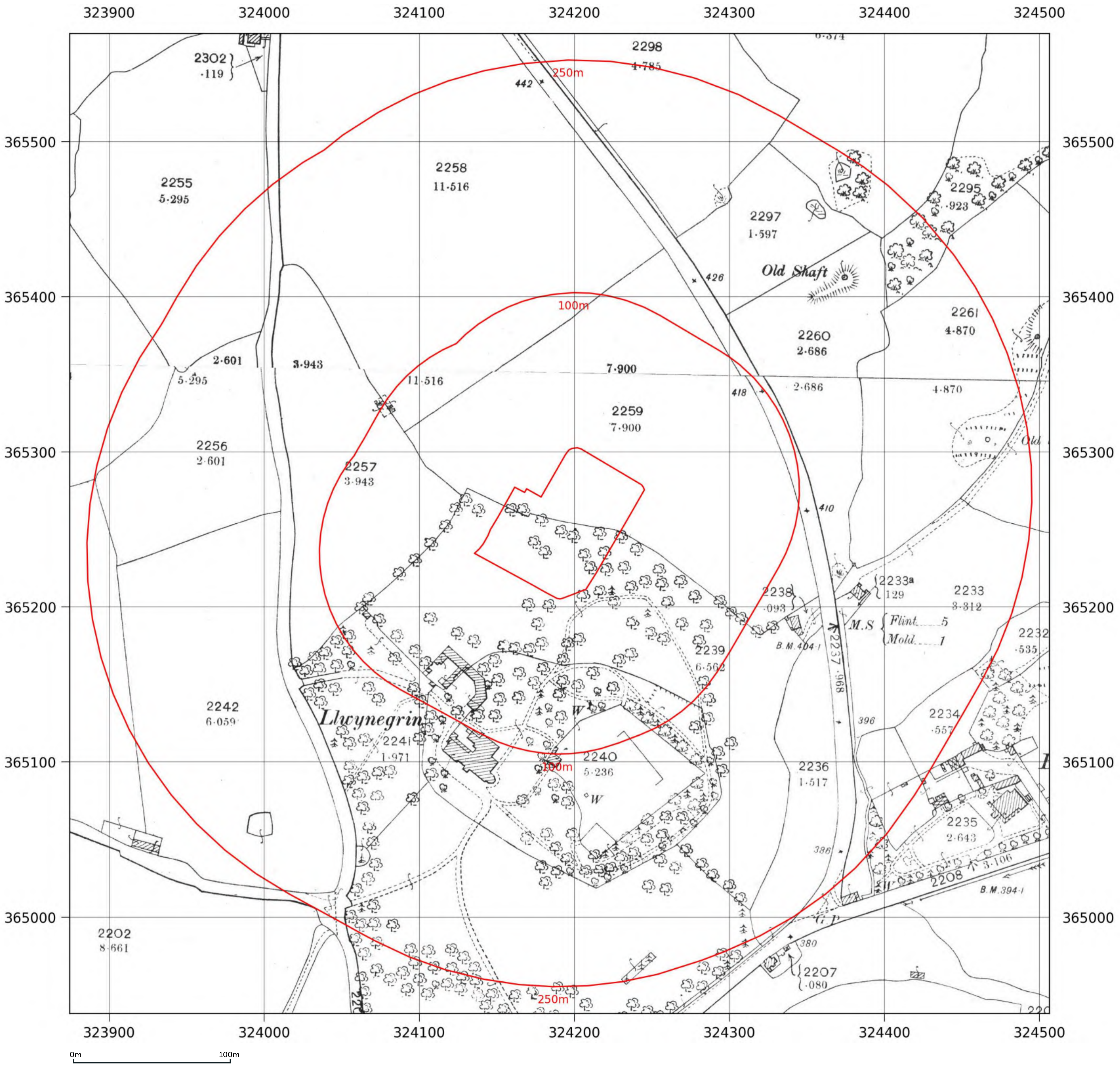

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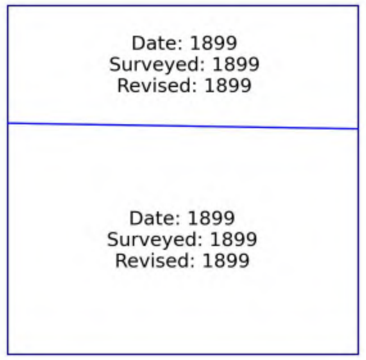

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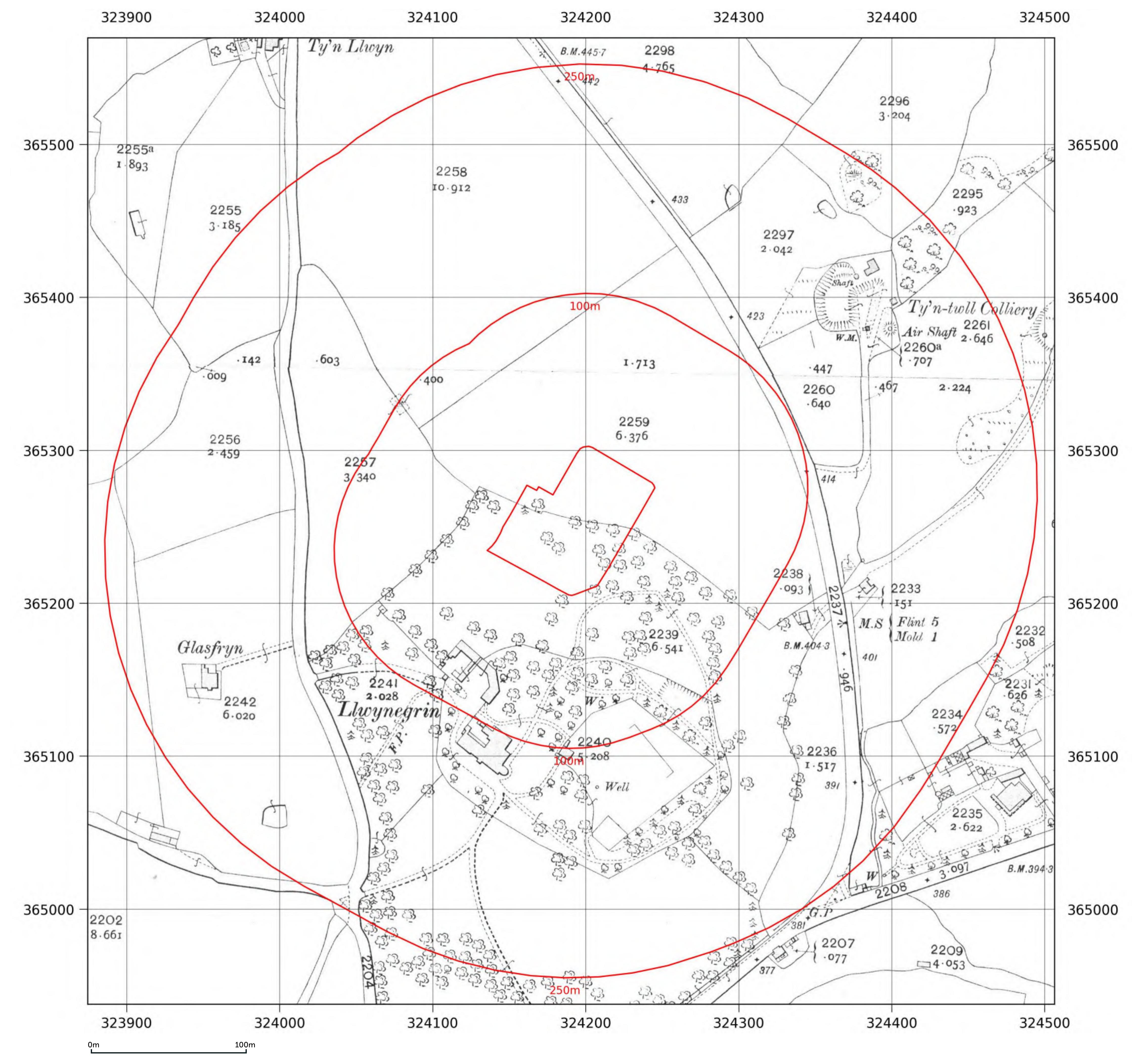

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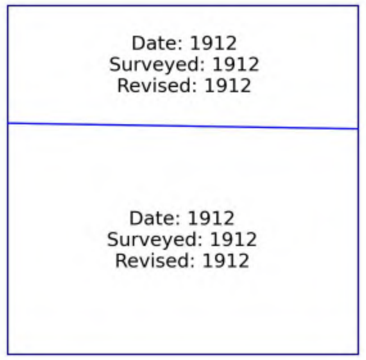

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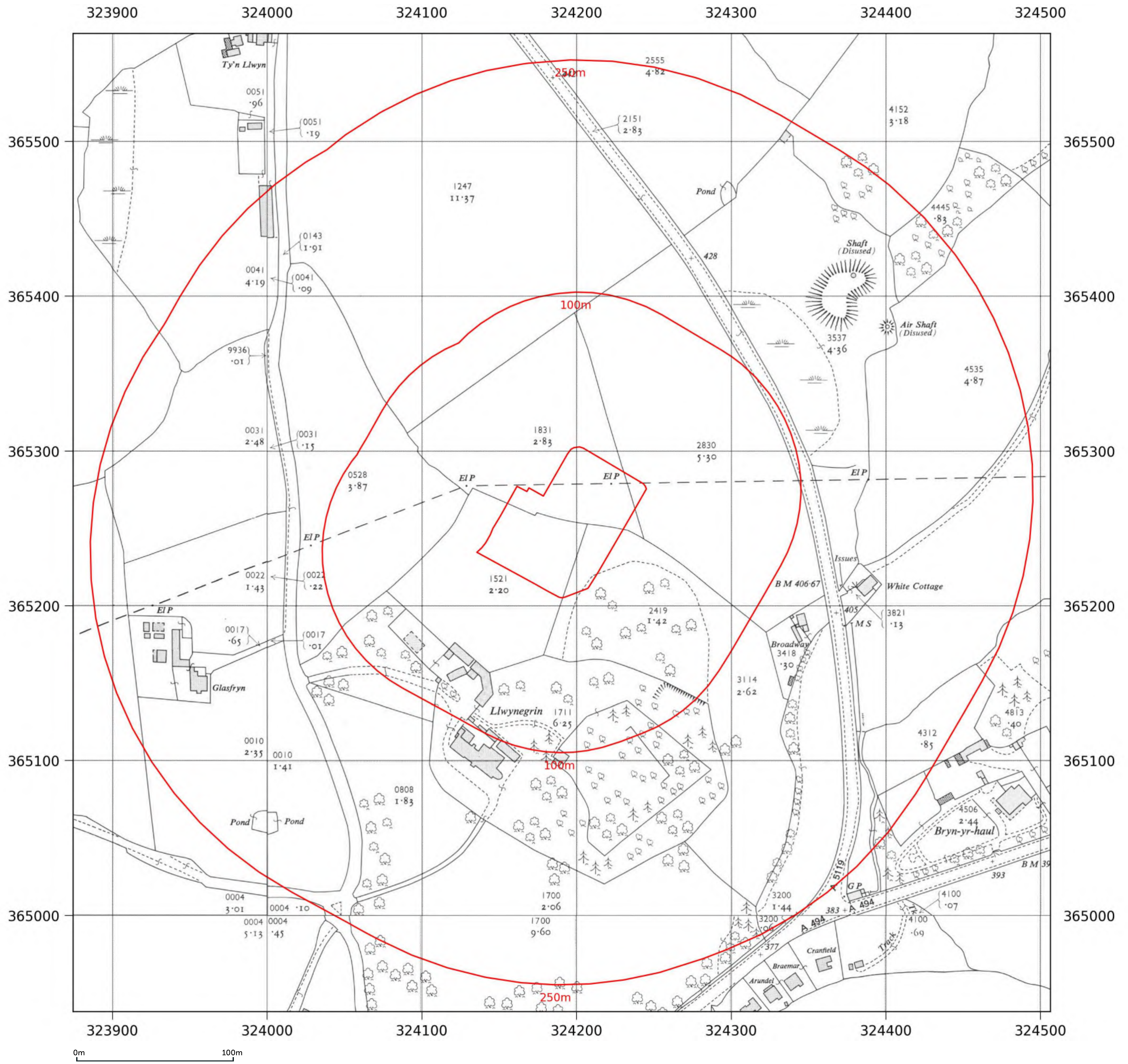

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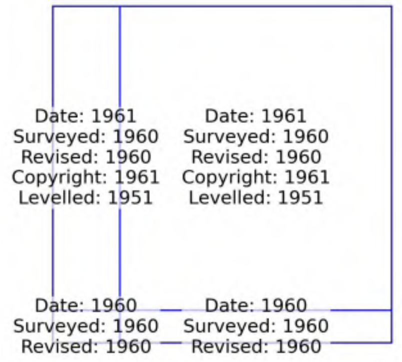

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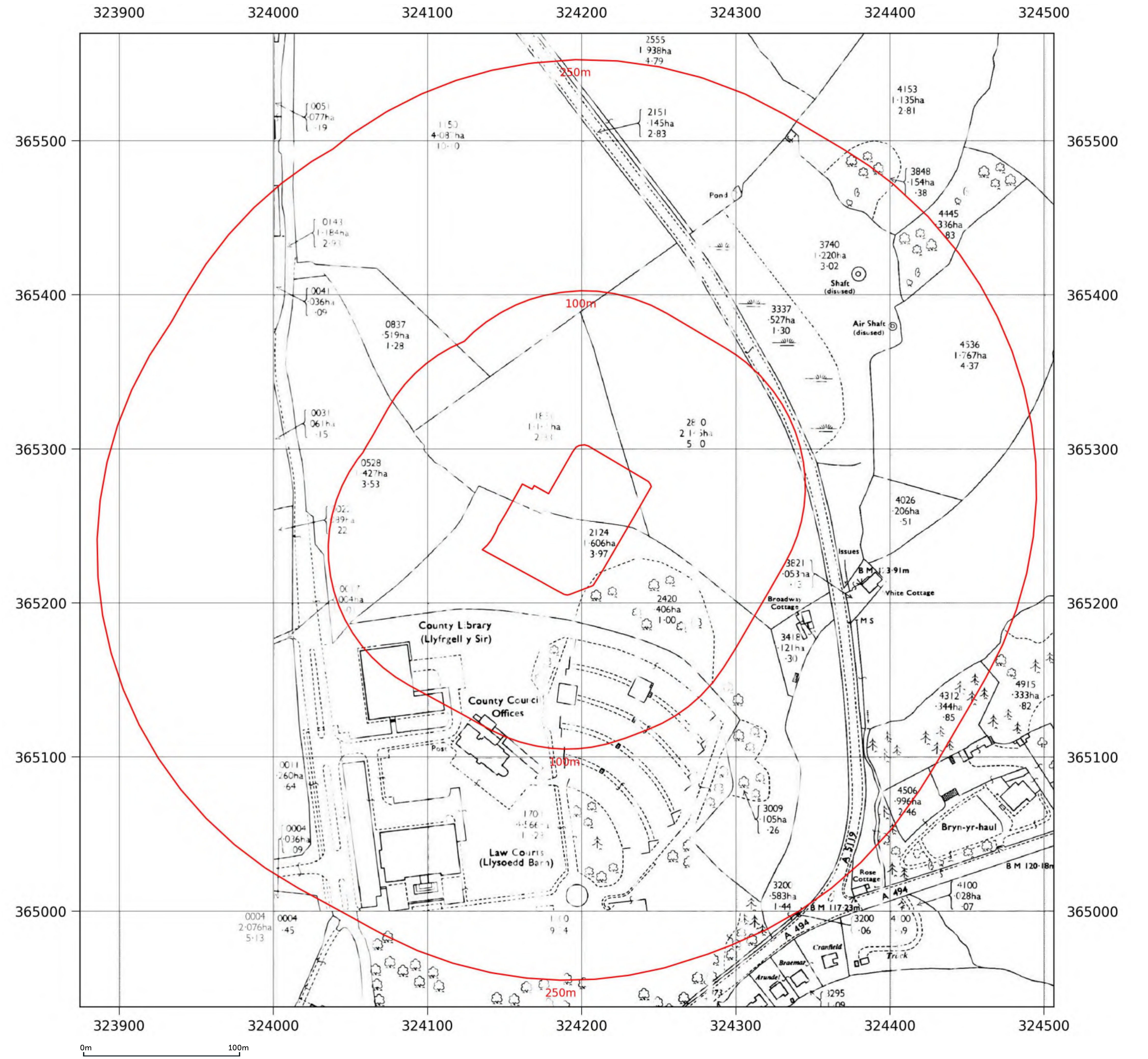

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Grid ref:	324192.82, 365252.4
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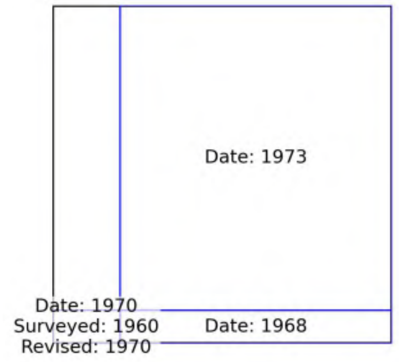

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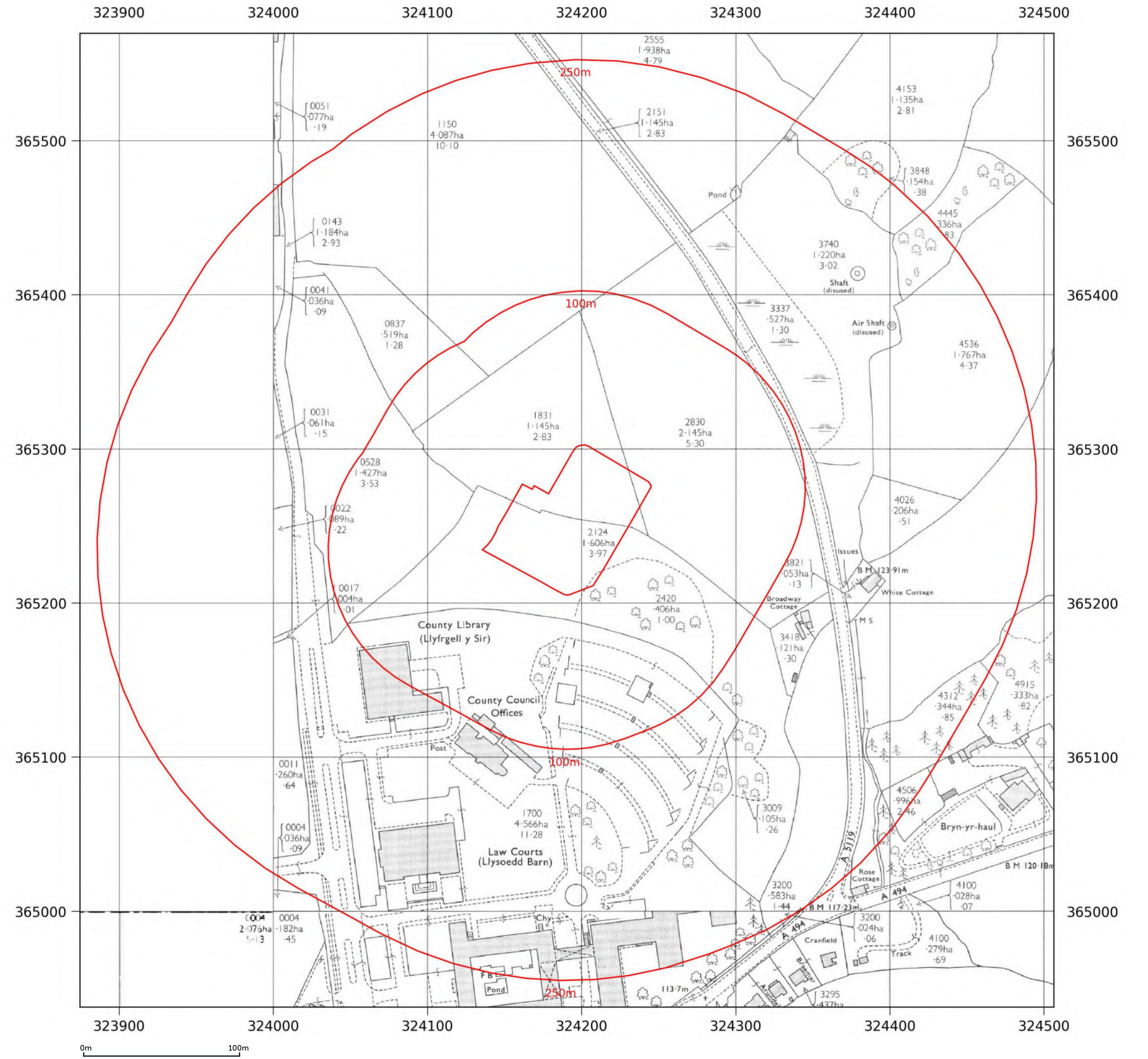

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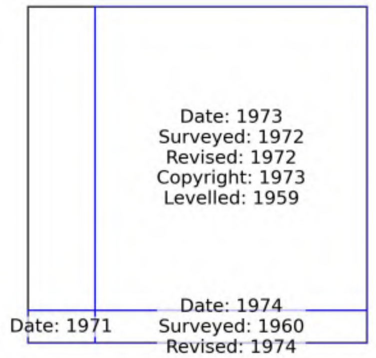

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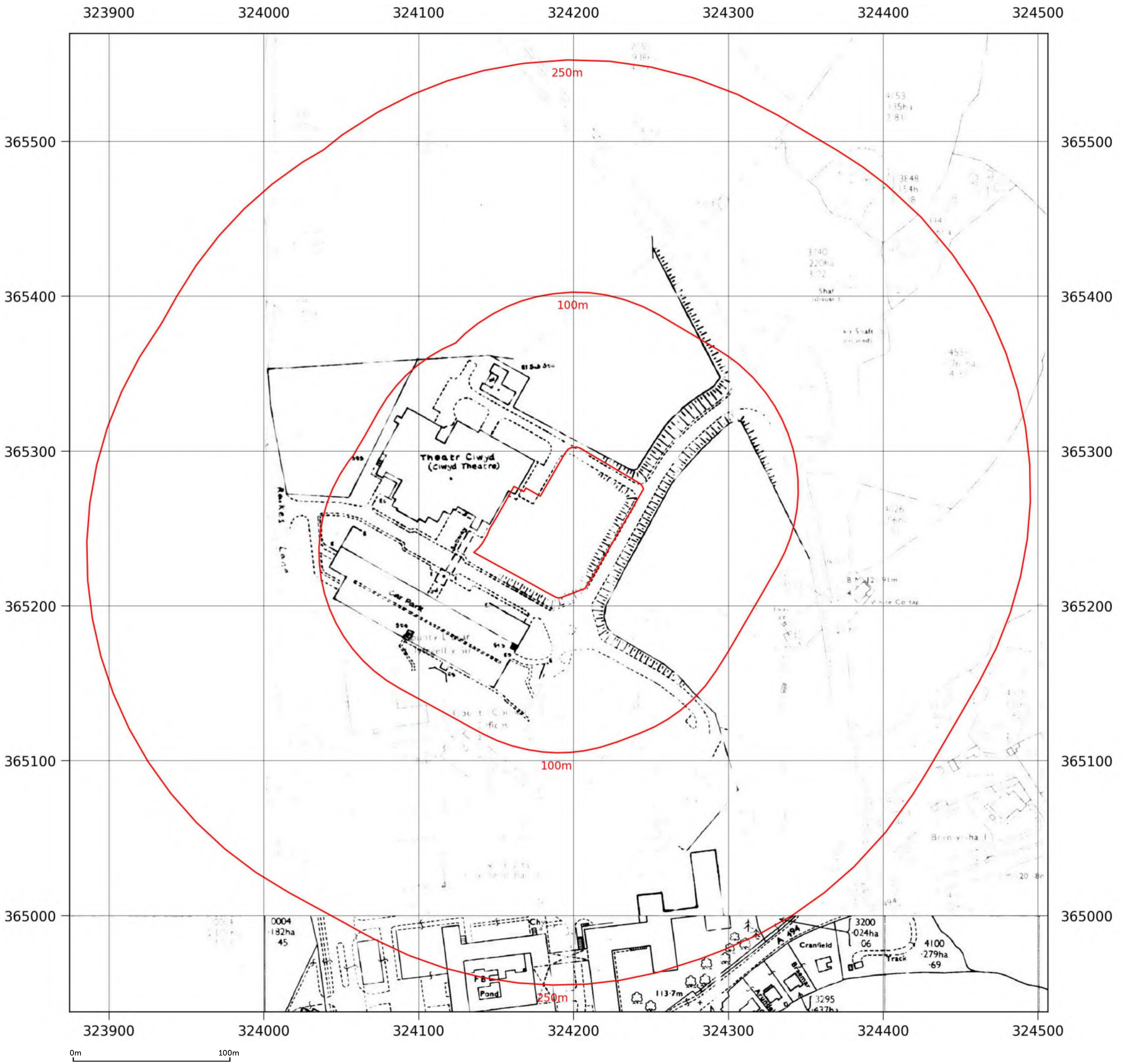

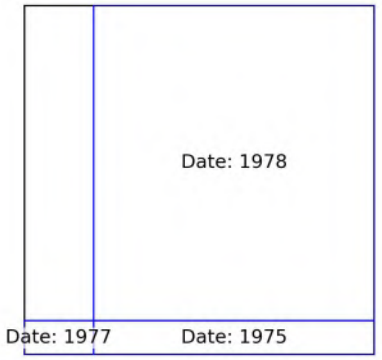

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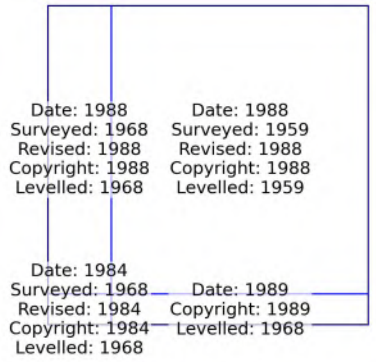

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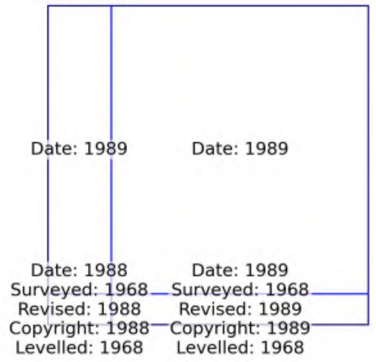

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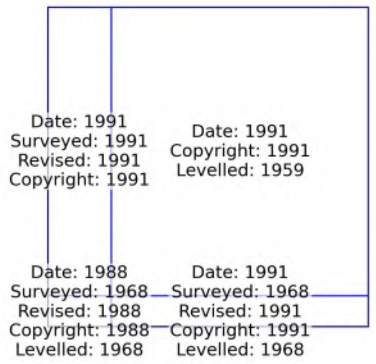

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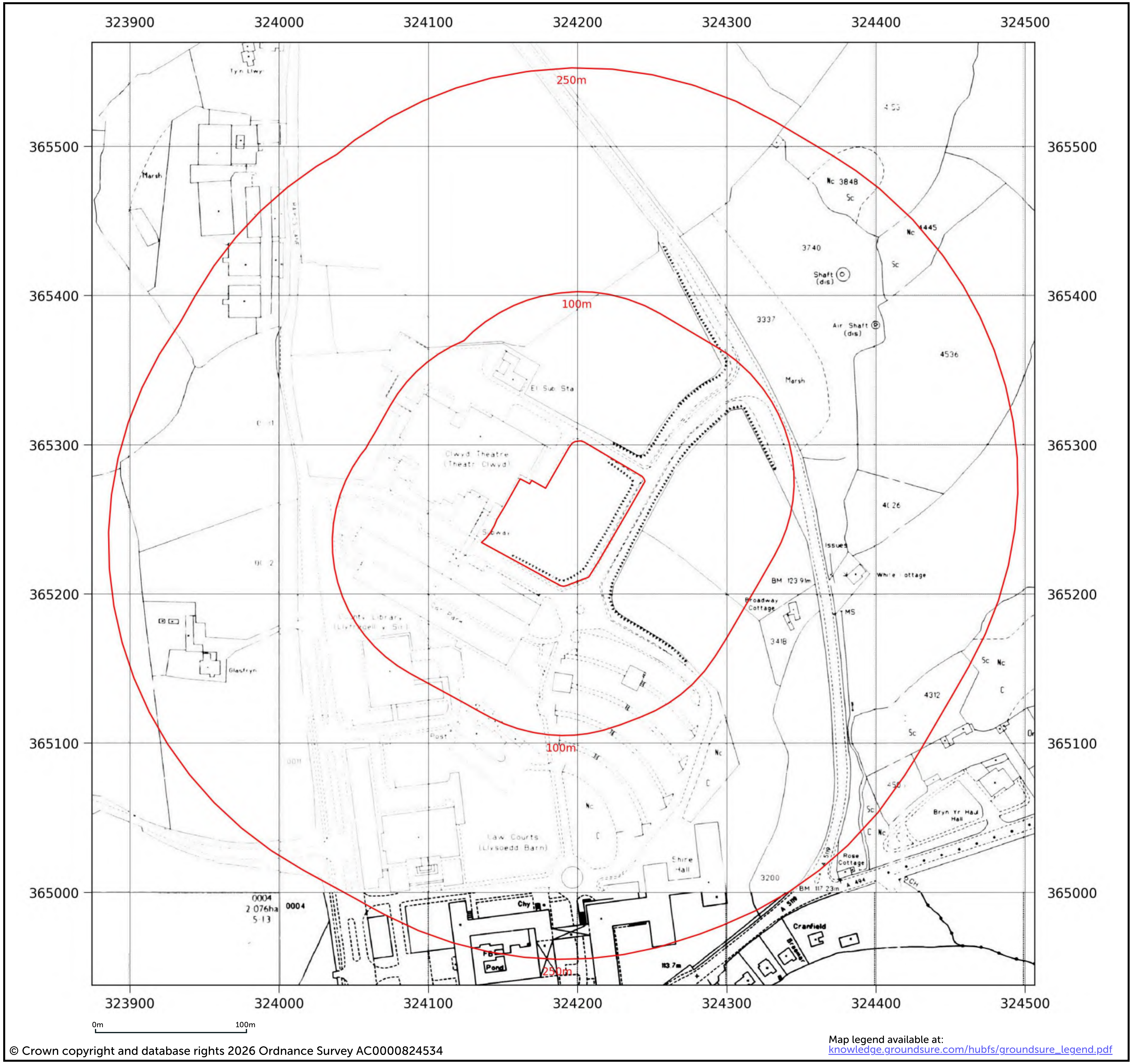

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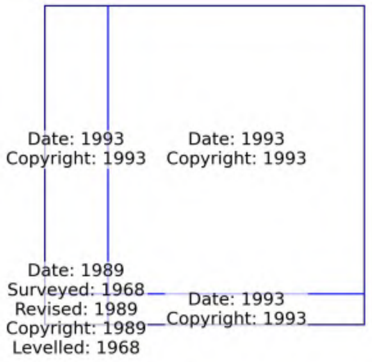
Map Insight

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

Map name:	National Grid
Map date:	1989-1993
Scale:	1:2,500
Printed at:	1:2,500



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Map legend available at:
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Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

Map name:	LandLine
Map date:	2003
Scale:	1:1,250
Printed at:	1:1,250

Date: 2003

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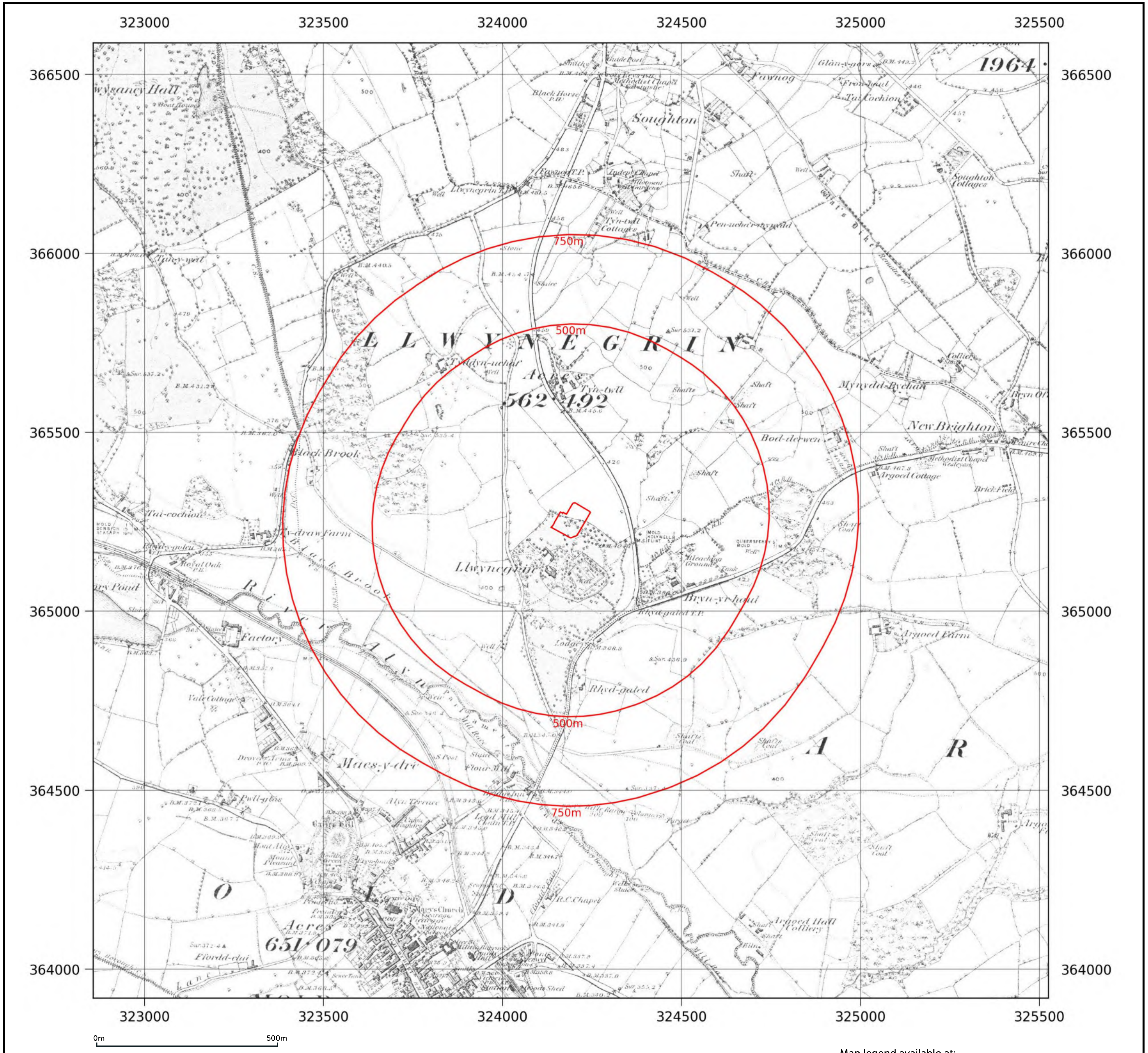

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Map Insight

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Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

Map name:	County Series
Map date:	1872
Scale:	1:10,560
Printed at:	1:10,560

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Date: 1872
Surveyed: 1872
Revised: 1872

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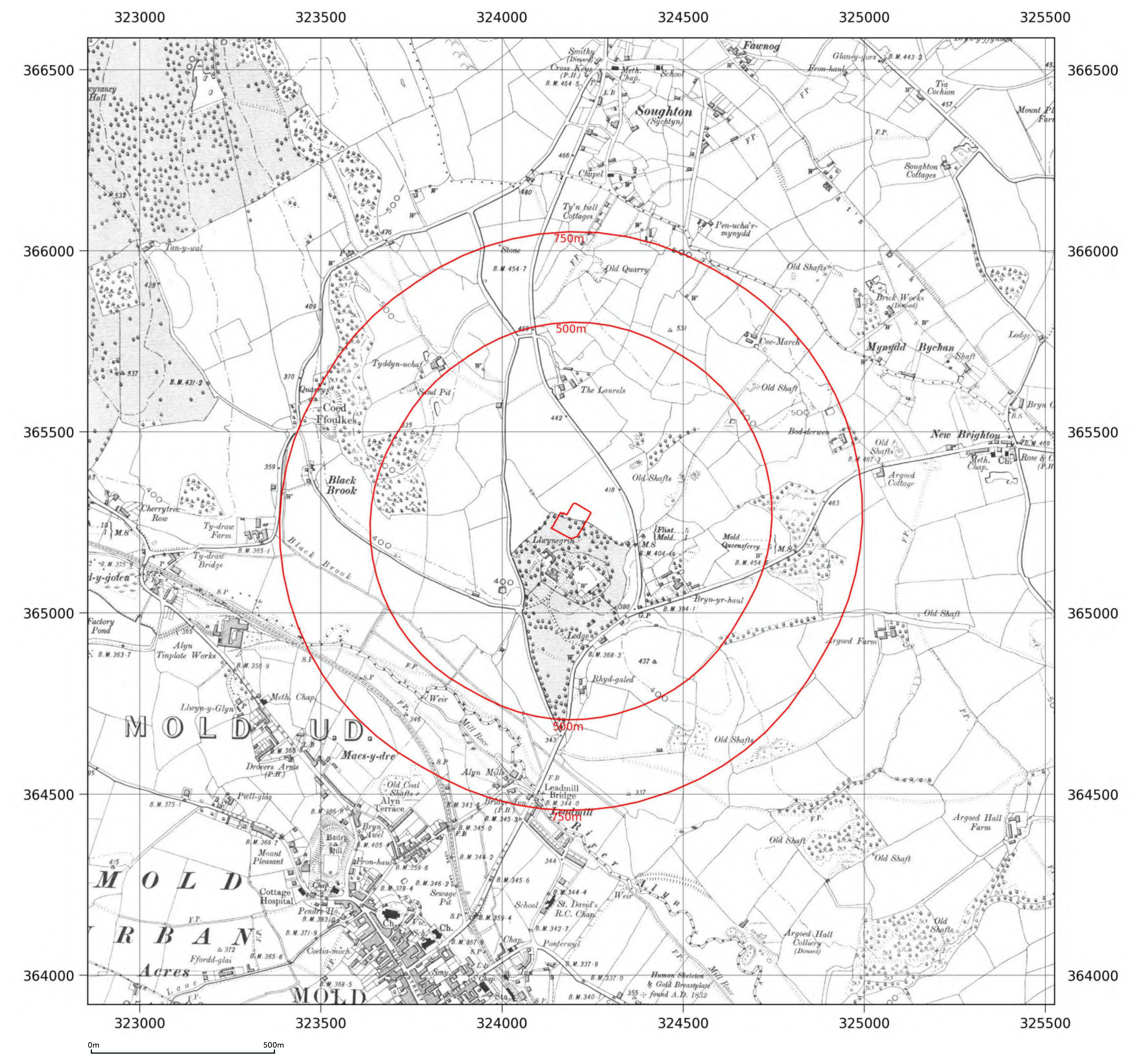

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Map Insight

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

Map name:	County Series
Map date:	1898
Scale:	1:10,560
Printed at:	1:10,560

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Date: 1898
Surveyed: 1871
Revised: 1898

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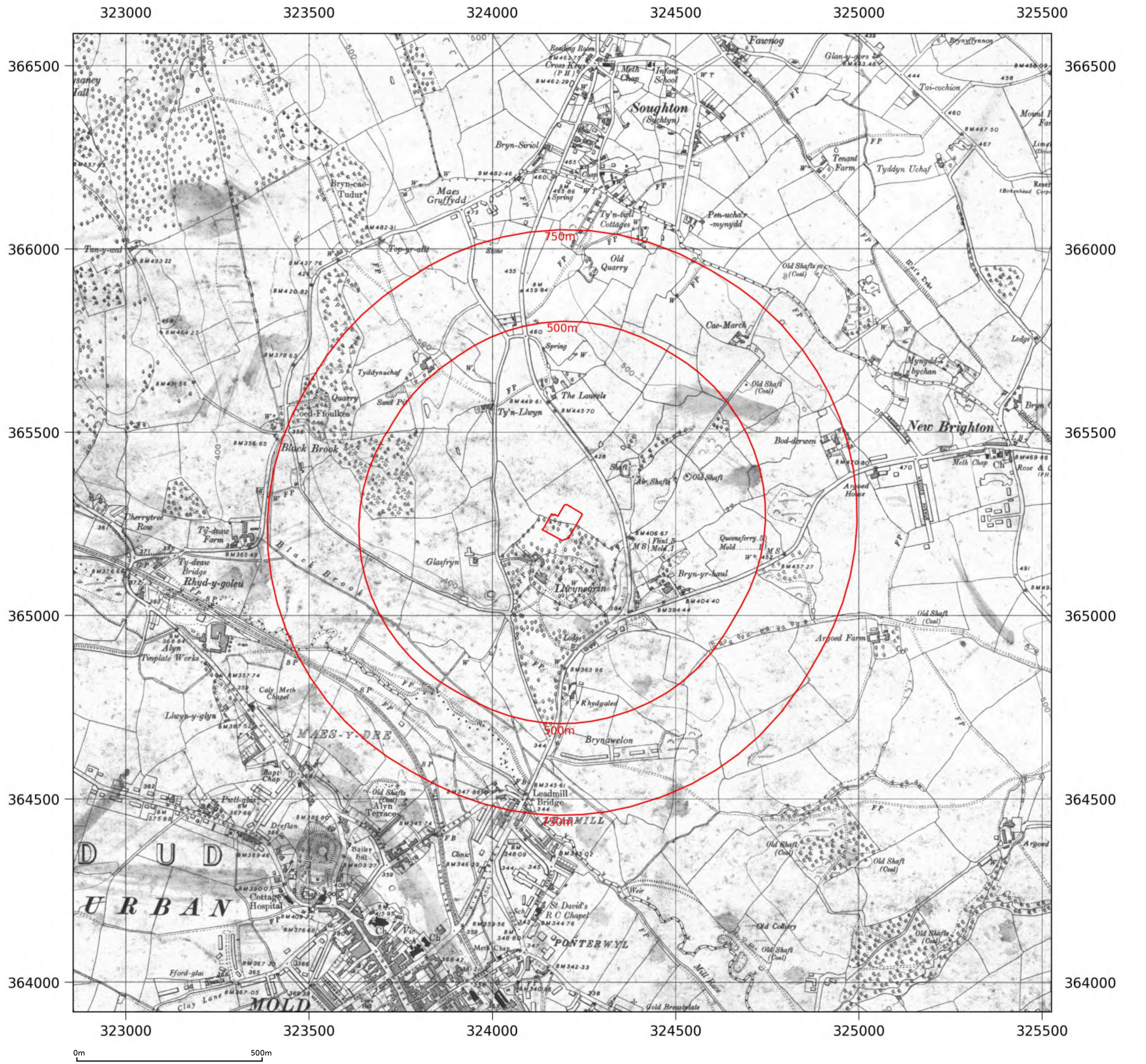

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Map Insight

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

Map name:	County Series
Map date:	1910
Scale:	1:10,560
Printed at:	1:10,560

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Date: 1910
Surveyed: 1871
Revised: 1910

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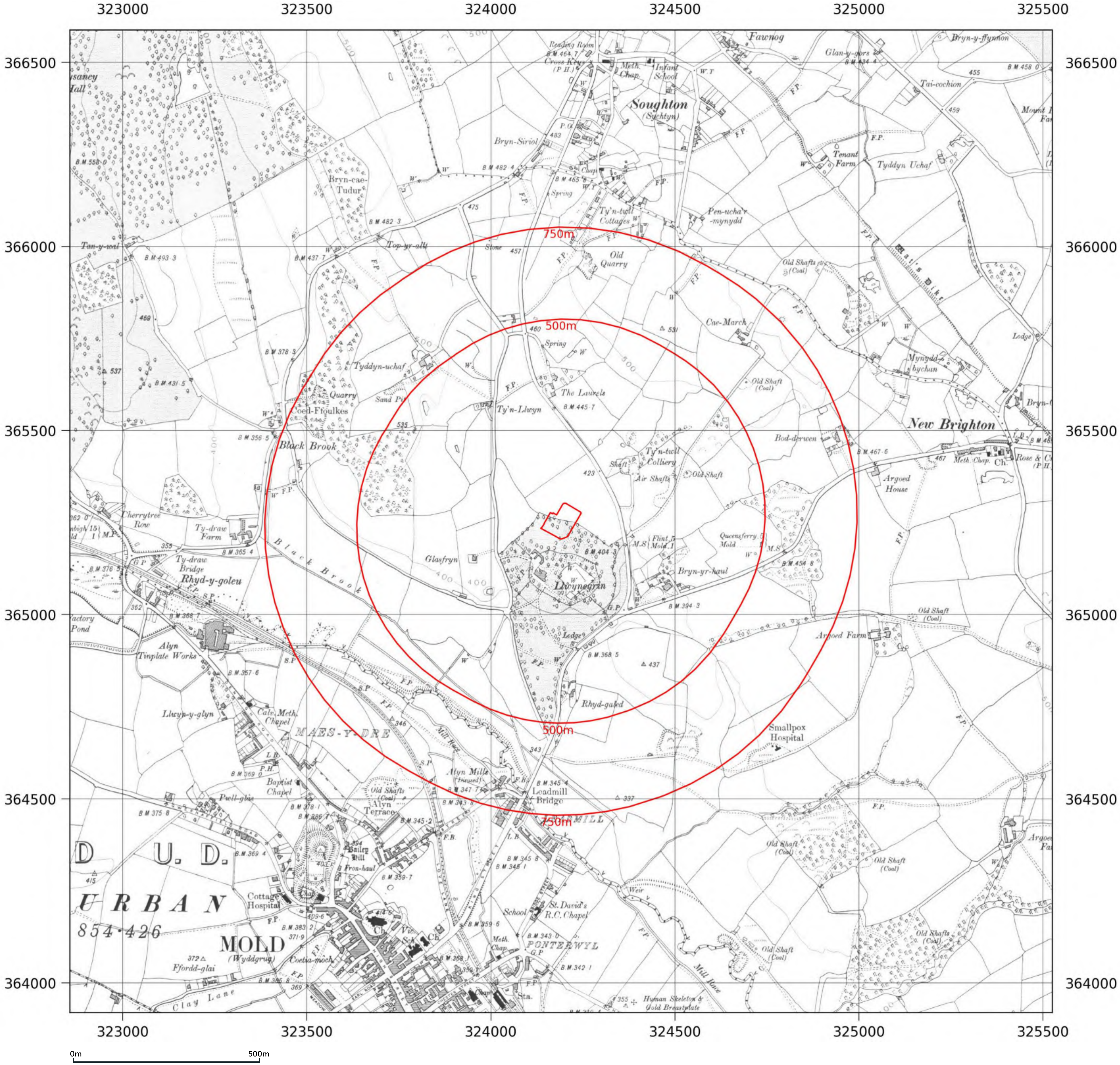

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Map Insight

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

Map name:	County Series
Map date:	1914
Scale:	1:10,560
Printed at:	1:10,560

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Date: 1914
Surveyed: 1871
Revised: 1914
Edition: 1914

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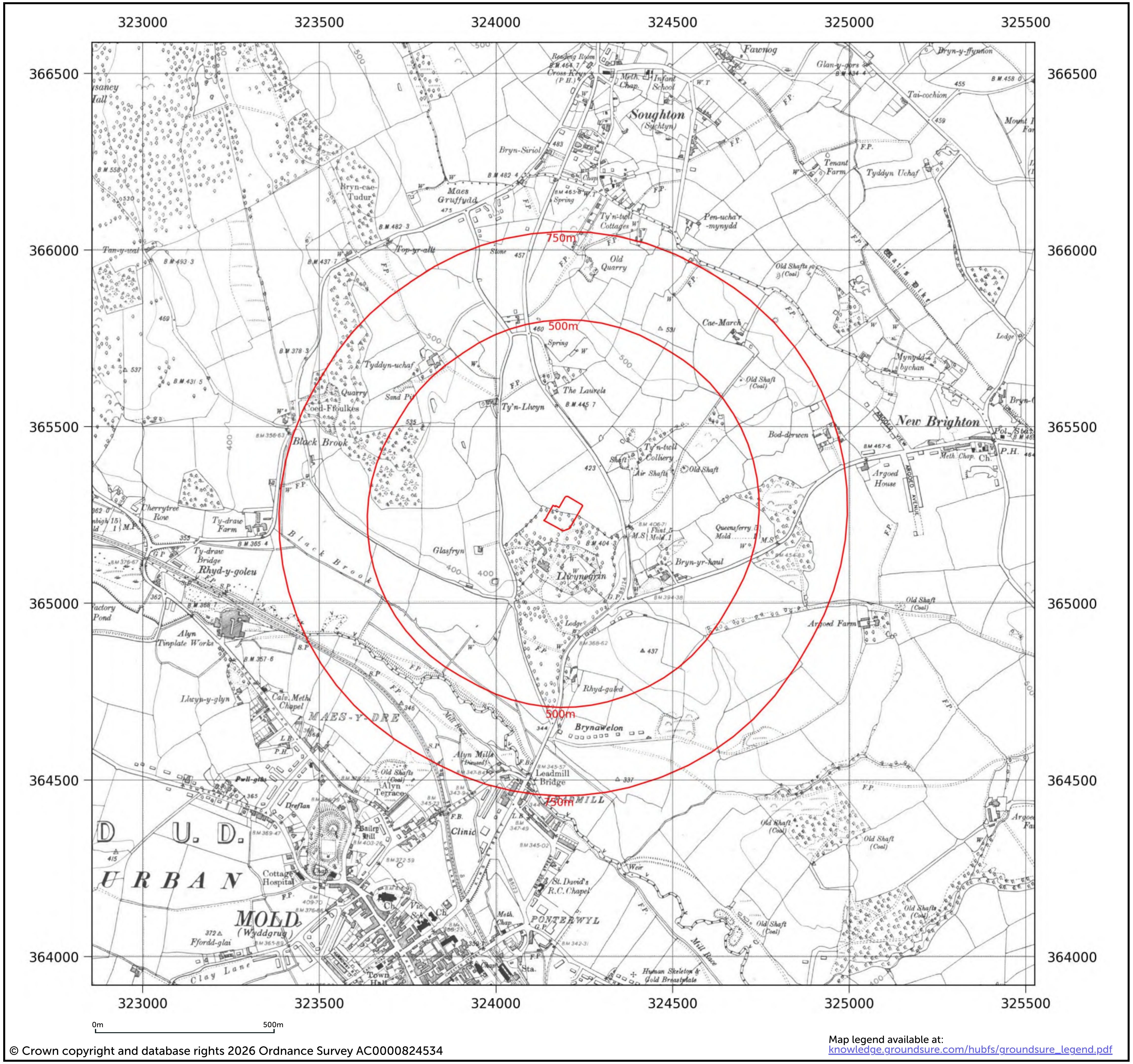

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Map Insight

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

Map name:	County Series
Map date:	1938
Scale:	1:10,560
Printed at:	1:10,560

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Date: 1938
Surveyed: 1871
Revised: 1938

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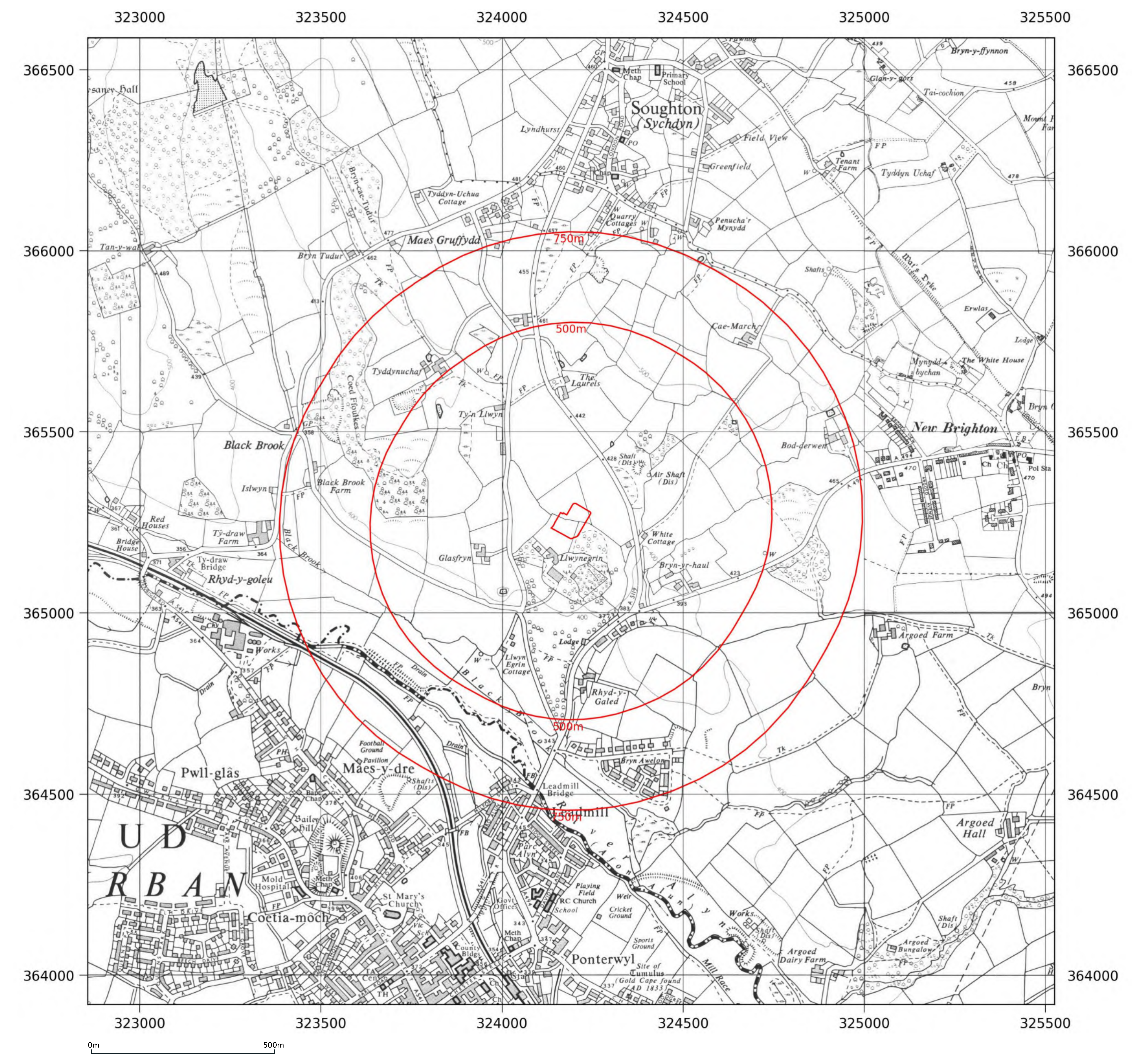
Map Insight



Map legend available at:
knowledge.groundsure.com/hubfs/groundsure_legend.pdf

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

Map name:	Provisional
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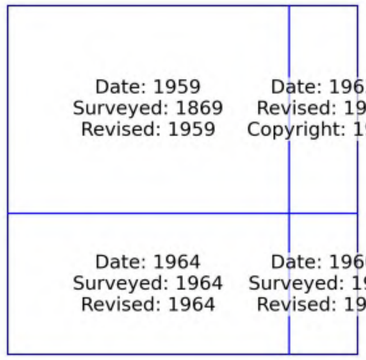

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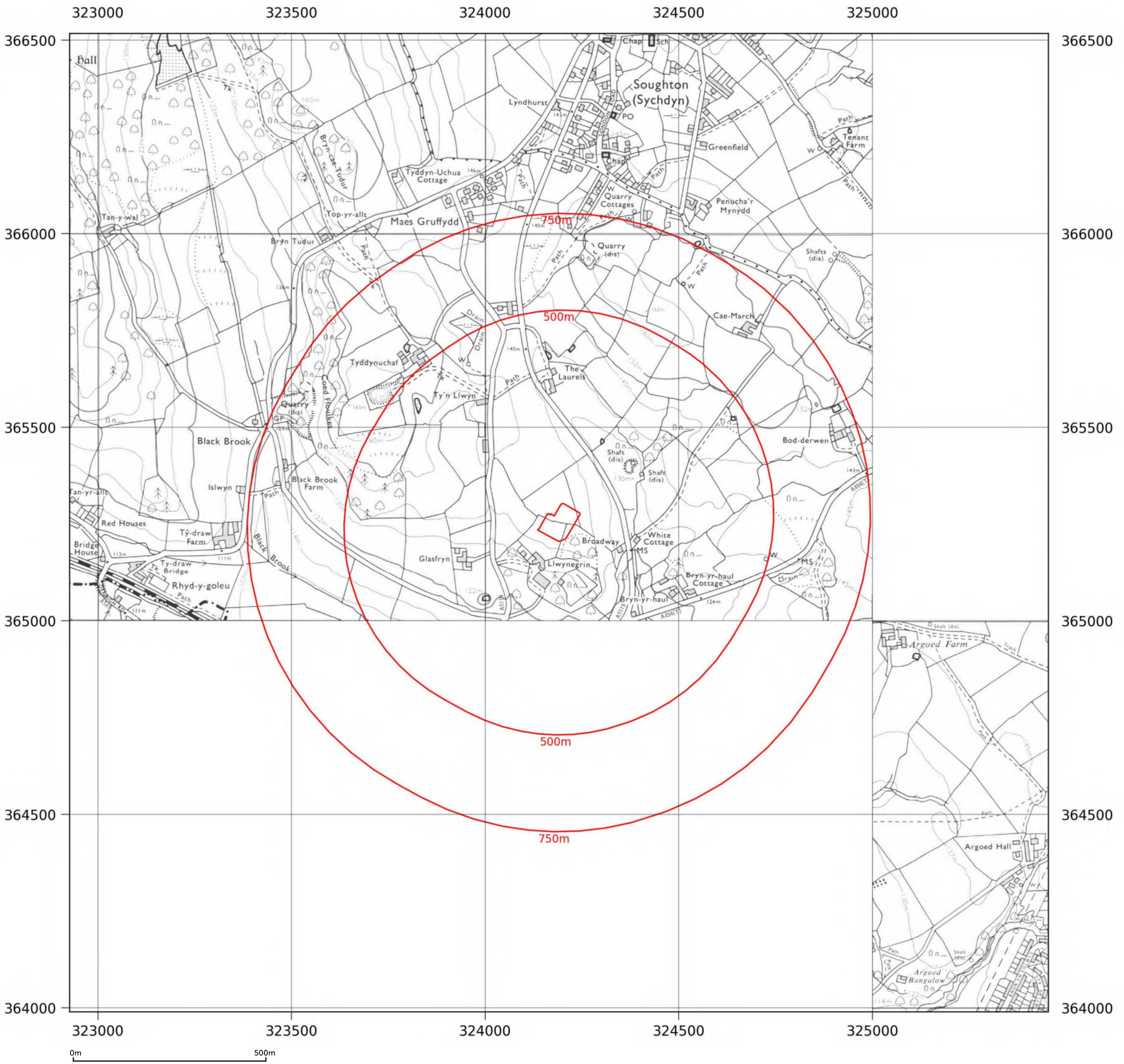

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Map legend available at:
knowledge.groundsure.com/hubfs/groundsure_legend.pdf

Map Insight

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

Map name:	National Grid
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Scale:	1:10,000
Printed at:	1:10,000

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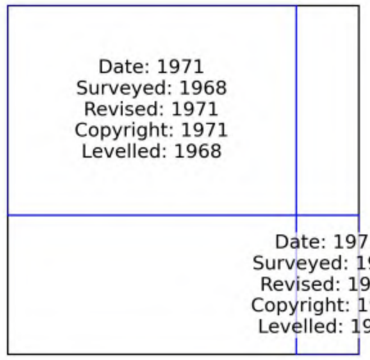

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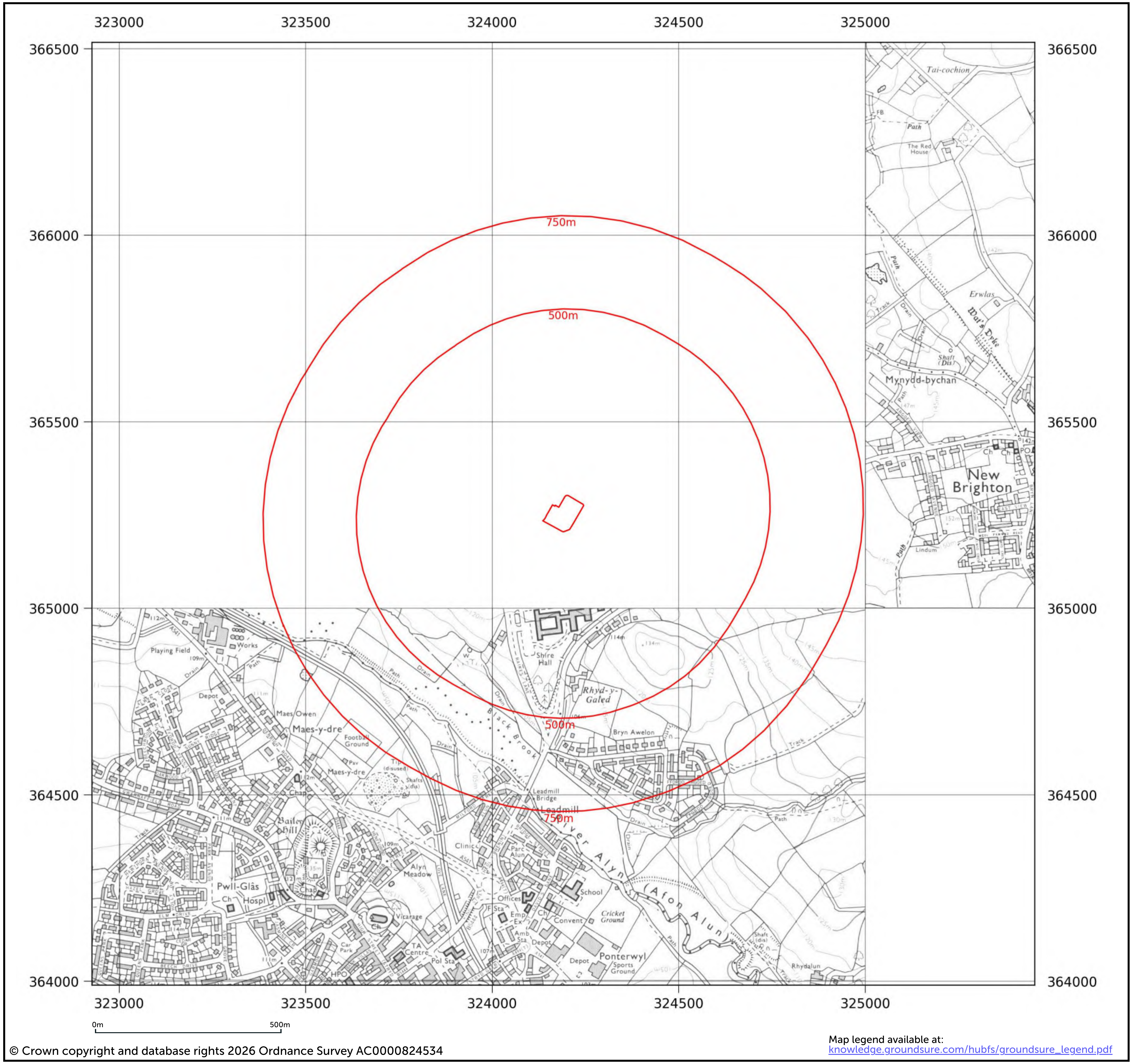

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Map Insight

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

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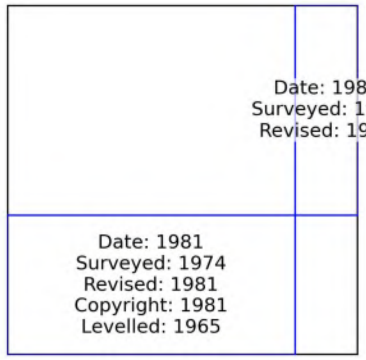

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Map Insight

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

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Scale:	1:10,000
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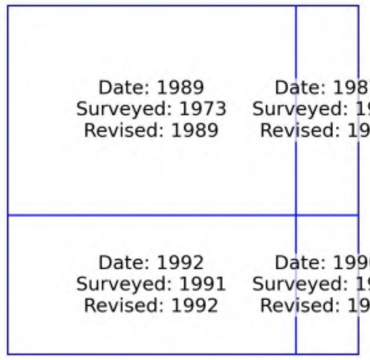

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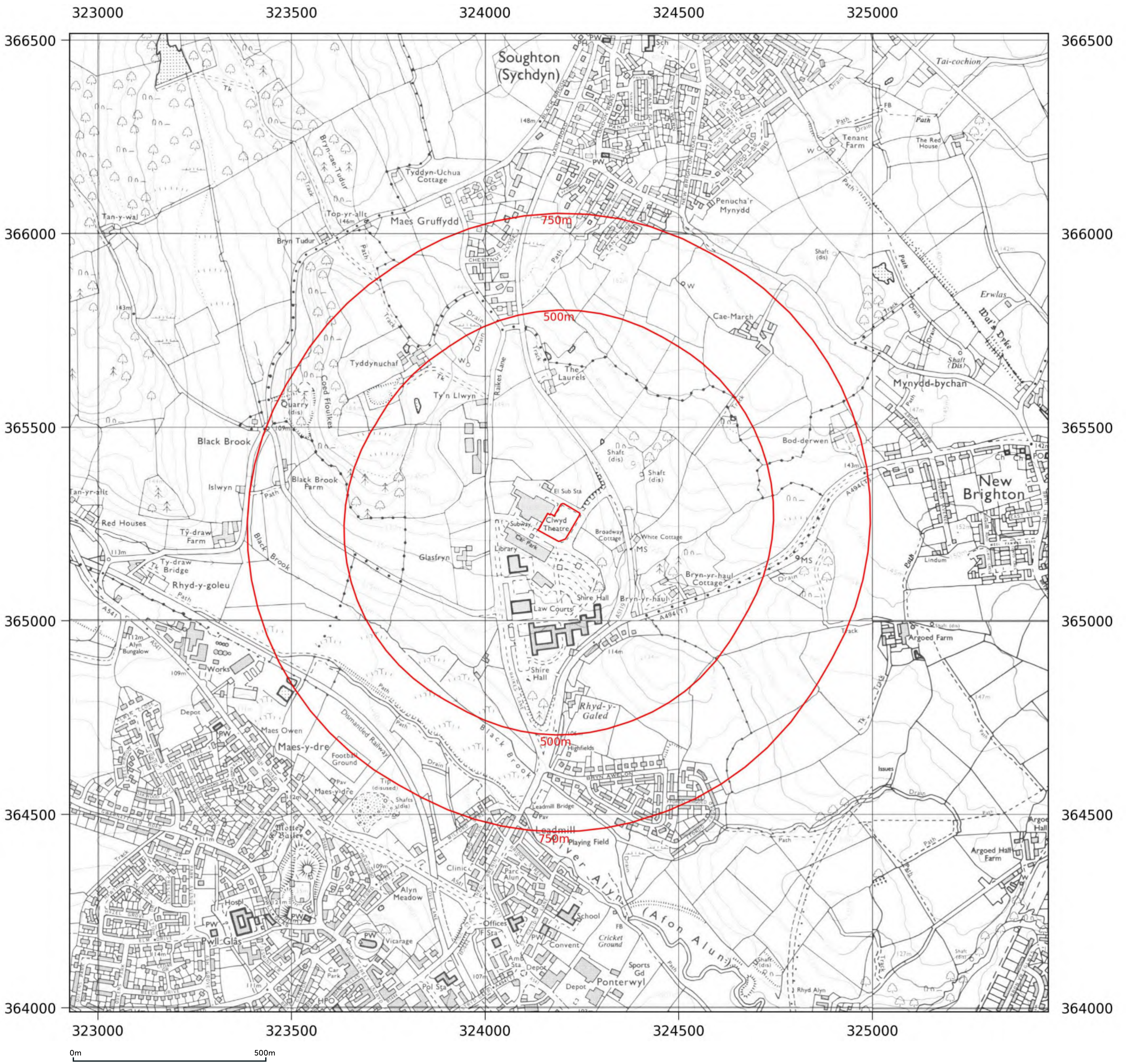

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Map Insight

Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

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Printed at:	1:10,000

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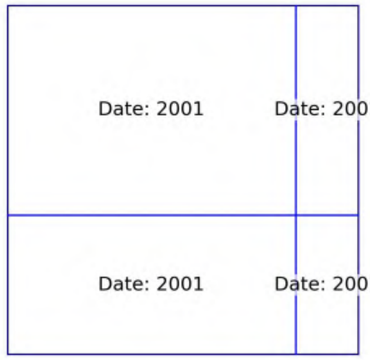

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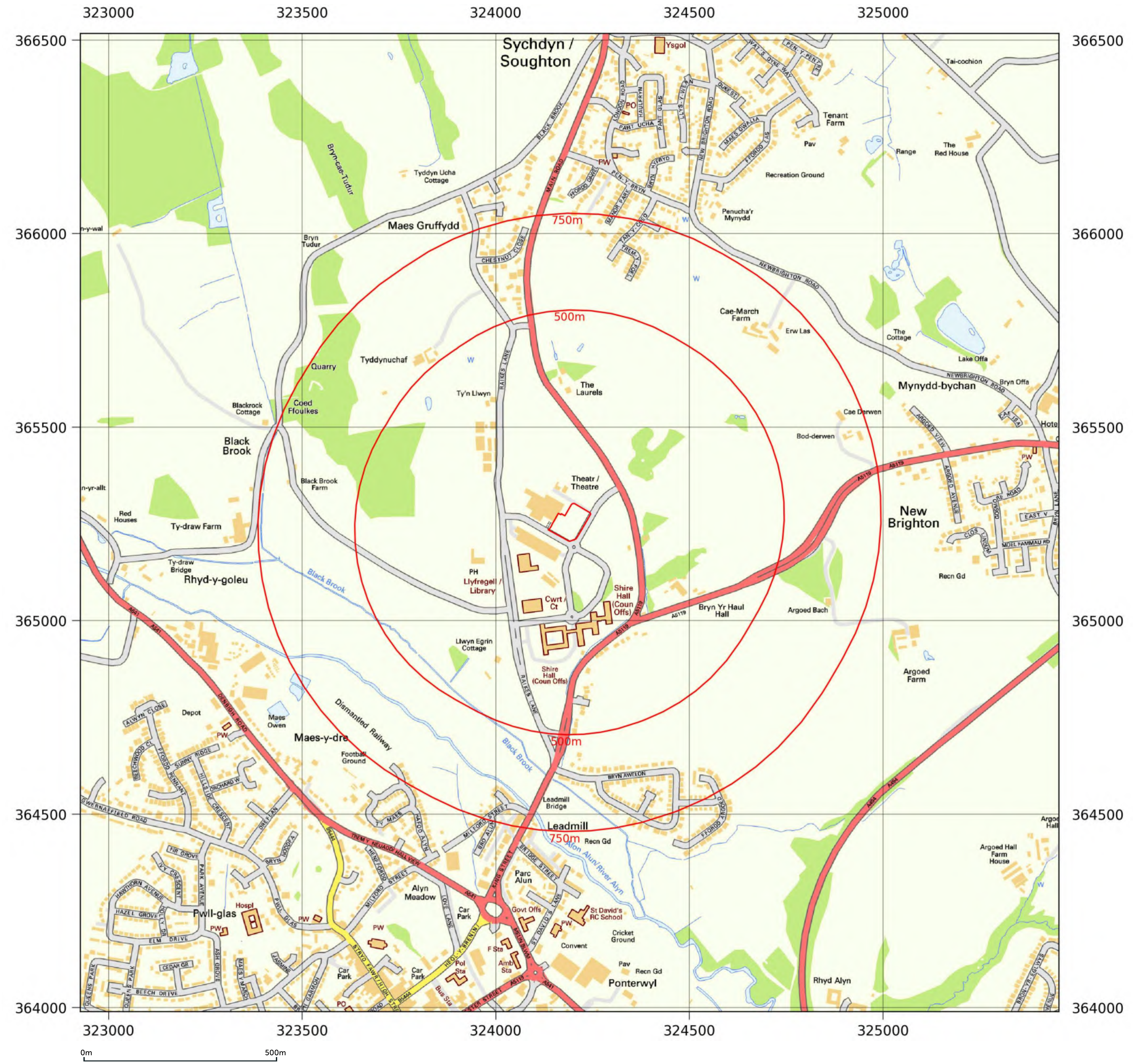

Map Insight

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Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
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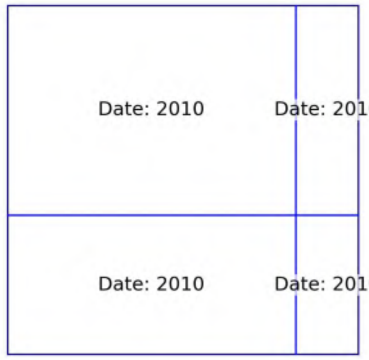

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Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

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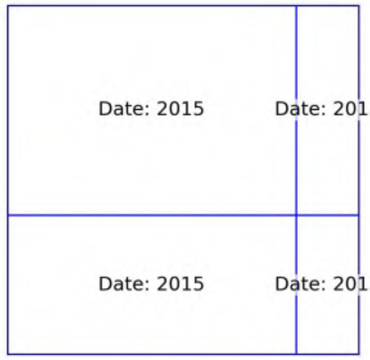

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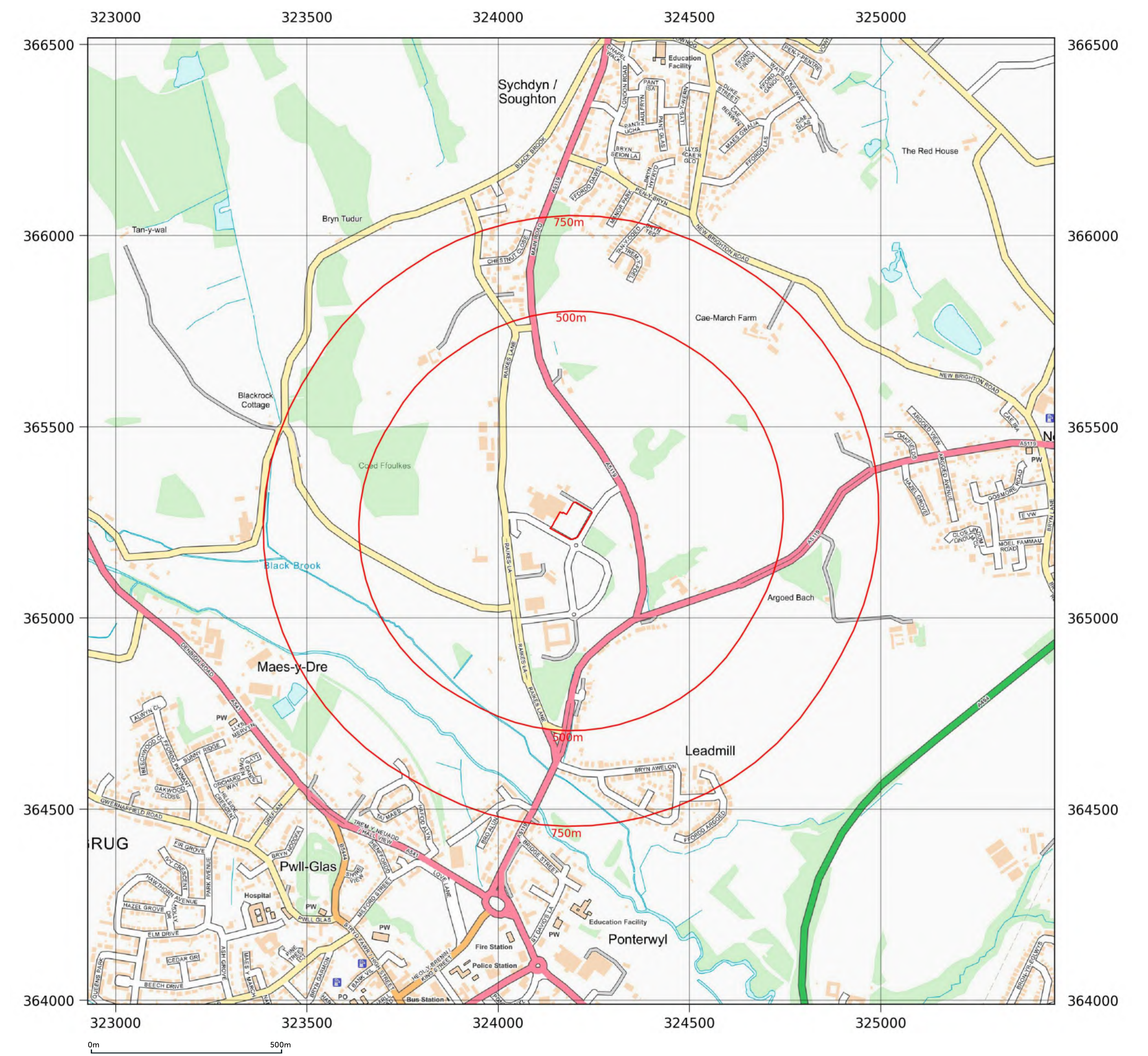

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Site details:	THEATR CLWYD, COUNTY HALL AND THEATRE CLWYD, MOLD, FLINTSHIRE, CH7 1YA
Client ref:	3455 / PO002971
Report ref:	GS-6QZ-C53-AVN-K1S
Grid ref:	324192.82, 365252.4
Production date:	30 January 2026

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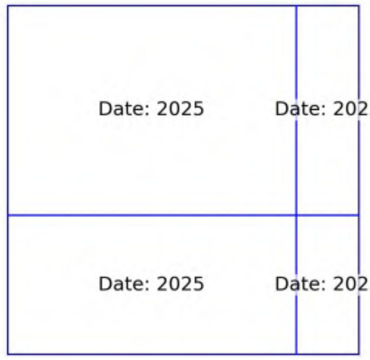

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SJ 26 NW 23 **2404 6526** **Glasfryn** 1" no. 108 **Block B**

Surface level +146 m
Water not encountered
Shell and Auger, 203 mm diameter
September 1979

Overburden 3.6 m
Mineral 3.9 m
Waste 7.2 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	1.9	1.9
Glacial Sand and Gravel	Clay, sandy, soft; few pebbles	1.7	3.6
	Sandy gravel, 'clayey' to 4.6 m Gravel: coarse and fine, mainly subrounded quartzite and sandstone Sand: mainly medium to fine	3.9	7.5
Till	Clay, silty at top, grey, stony	7.2	14.7
Coal Measures	Sandstone, buff	0.3+	15.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
9	47	44	3.6-4.6	13	27	15	6	16	23	0
			4.6-5.6	8	8	16	6	23	32	7
			5.6-7.5	7	19	28	9	16	21	0
			Mean	**9**	**18**	**22**	**7**	**18**	**24**	**2**

Institute of Geological Sciences

Industrial Minerals Assessment Unit

BOREHOLE RECORD SHEET

Registration Number

6 in. quarter sheet: SJ26NW (6)

Accn. no.: 23 (10)

Suffix: (14)

Temp. No. 17

Borehole diam. 203 mm

Water struck Not struck

Remarks: NGR 2404 6536

Classification	Thickness (m)	Lithology
OVERBURDEN	1·9	MADE GROUND + SOIL
OVERBURDEN	1·7	CLAY
MINERAL	3·9	SANDY GRAVEL
WASTE	0·5	CLAYEY SANDY SILT
WASTE	6·7	PEBBLY CLAY
BEDROCK	0·3	SANDSTONE

Lithostrat. Code	Description	Thickⁿ (m)	Depth to base (m)	Sample No.
MGR	Made Ground: Soil 0-0·3 metres clay and soil. Soil: 1·6-1·9 metres medium brown	1·9	1-9	
BOC? (MGR?)	Clay: medium brown, non calcareous, sandy in places, with occasional SR greywacke/siltstone pebbles, firm, traces of carbonaceous material	1·7	3·6	
GSG	Pebbly Clayey Sand: Red brown with silty clay layers traces of coal. Pebbles of SA light coloured sst, SR buff qtzite, SR greywacke with some volcanics and trace qtz. Increase in pebbles at the base 5/85/10	1·0	D 3·6 3·8 W/A 3·6 B 4·6 4·6	MOS 108 MO 188

Lithostrat. Code	Description	Thick^n (m)	Depth to base (m)	Sample No.
GSG	Sandy Gravel: Pebbles of SR grey + buff qtzites with some SR volcanics and trace qtz. Relatively high proportion of volcanics + qtz. clay → medium brown water colouration. 45/40/5.	1.0	U/A 4.6 B 5.6 5.6	M0189
GSG	Sandy Gravel: Similar to above becoming very sandy at the base → Red brown fine sand.	1.9	U/A 5.6 B 7.5 7.5	M0190
	Clayey Sandy Silt: Red-brown, soft to firm, calcareous, becoming more clayey and pebbly	0.5	8.0	
BOC	Pebbly Clay: Grey to brownish grey pebbly clay, firm, pebbles of SR greywacke/siltstone and buff qtzite. Med - Dark grey pebbly sandy clay becoming very sandy at 11.5 m. then clayey again at 12.0 m grey clay similar to above slightly calcareous. Pebbles of qtzite with some soft black shale	6.7	11.2 14.7	
	Sandstone: (Bedrock) Buff micaceous coal measures sandstone with traces of carbonaceous material.	0.3	14.7 15.0 15.0	MOS109

APPENDIX D: COAL CONSULTANTS REPORT

The Coal
Authority

Consultants

Coal Mining Report

Theatr Clwyd, County Hall And
Theatre Clwyd, Mold, Flintshire, Ch7
1ya
Flintshire

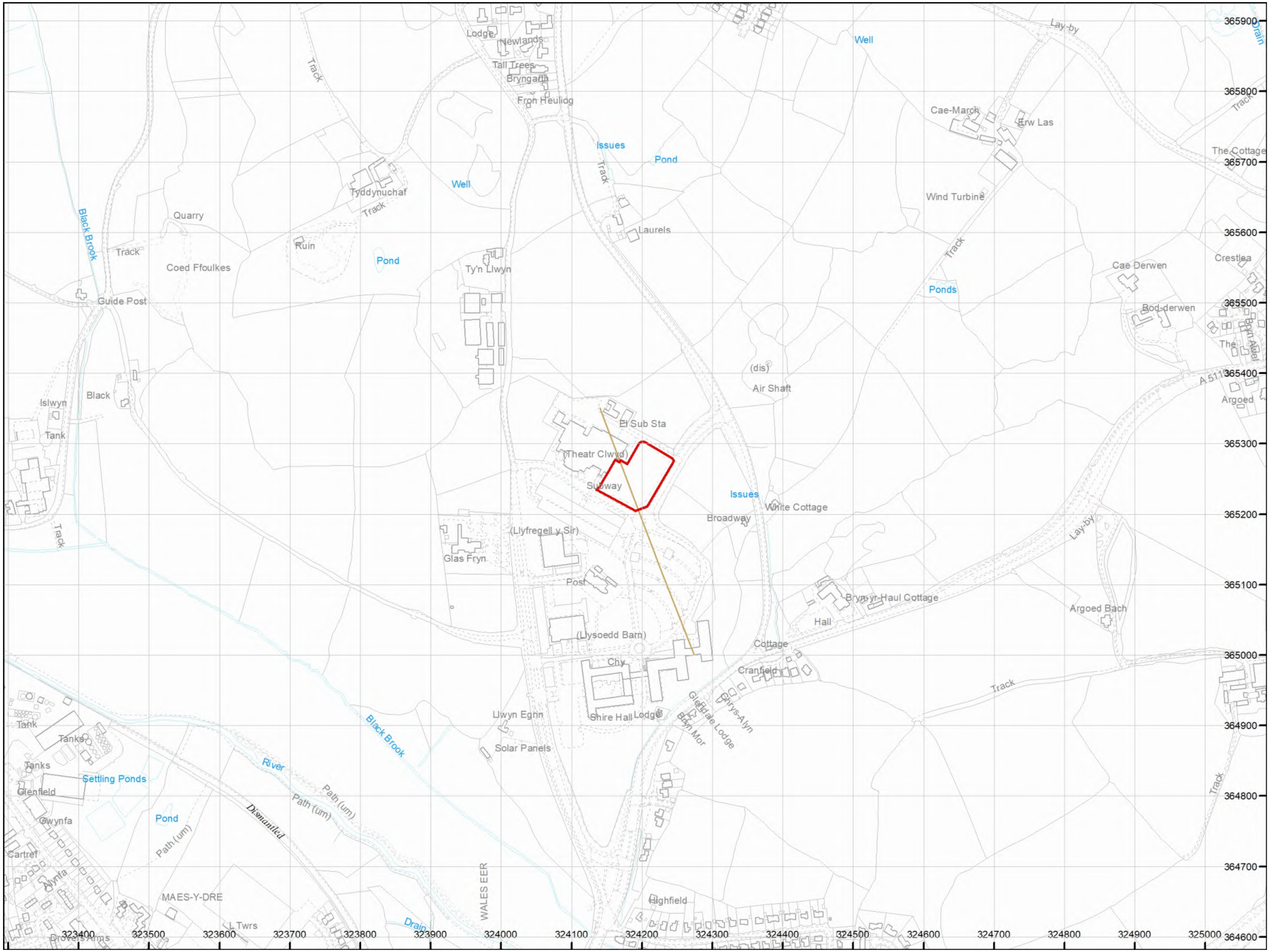
Date of enquiry:	30 January 2026
Date enquiry received:	30 January 2026
Issue date:	30 January 2026
Our reference:	51003550444001
Your reference:	GS-C5W-ZU4-SEV-G3M

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	🟥
Geological faults	/



How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)
reports@miningremediation.gov.uk

Consultants

Coal Mining Report

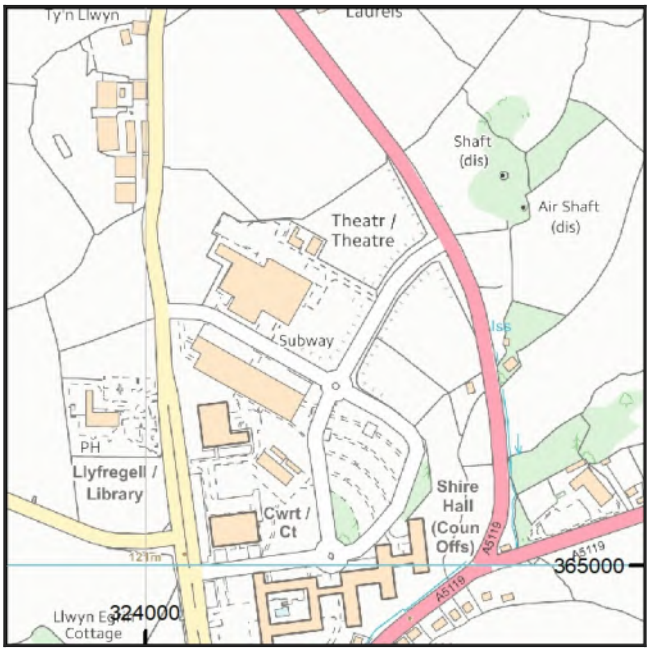
This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

GROUNDSURE LIMITED

Enquiry address

Theatr Clwyd, County Hall And Theatre Clwyd,
Mold, Flintshire, Ch7 1ya
Flintshire



Approximate position of property

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+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

reports@miningremediation.gov.uk

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

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

1783	R333A	5844

For assistance in identifying the specific abandoned mine plans relevant to your requirements, **please contact us at InformationManagers@MiningRemediation.gov.uk**.

Outcrops

No outcrops recorded.

Geological faults, fissures and breaklines

Please refer to the 'Summary of findings' map (on separate sheet) for details of any geological faults, fissures or breaklines either within or intersecting the enquiry boundary.

Fault under or close to the property 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 **email us at reports@miningremediation.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.

APPENDIX E: ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY & TERMINOLOGY

Environmental Risk Assessment Methodology & Terminology

LEGISLATION OVERVIEW

This report includes hazard identification and environmental risk assessment in line with the risk-based methods referred to in relevant UK legislation and guidance. Government environmental policy is based upon a "suitable for use approach," which is relevant to both the current use of land and also to any proposed future use. The contaminated land regime is the statutory regime for remediation of contaminated land that causes an unacceptable level of risk and is set out in Part 2A of the Environmental Protection Act 1990 ("EPA 1990"). The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health, or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

"any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

a) Significant harm is being caused or there is a significant possibility of such harm being caused;

or

b) Pollution of controlled waters is being, or is likely to be, caused."

In order to assist in establishing if there is a "significant possibility of significant harm" there must be a "contaminant linkage" for potential harm to exist. That means there must be a source(s) of contamination, sensitive receptors present and a connection or pathway between the two. This combination of contaminant-pathway-receptor is termed a "contaminant linkage or CPR linkage."

Part IIA of The Environmental Protection Act 1990 is supported by a substantial quantity of guidance and other Regulations. Key implementing legislation of the Part 2A regime includes the Contaminated Land (England) Regulations 2006 (SI 2006/1380) as amended by the overarching legislation for the contaminated land regime, which implements the provisions of Part IIA of the Environmental Protection Act 1990 (as inserted by section 57 of the Environment Act 1995), came into force on 14th July 2000 together with recent amended regulations: Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263). Revised Contaminated Land Statutory Guidance was published by DEFRA in April 2012. Part IIA defines the duties of Local Authorities in dealing with it. Part IIA places contaminated land responsibility as a part of planning and redevelopment process rather than Local Authority direct action except in situations of very high pollution risk.

In the planning process guidance is provided by National Planning Policy Framework (NPPF) of July 2018 which requires that a site which has been developed shall not be capable of being determined "contaminated land" under Part IIA. In practice, Planning Authorities require sites being developed to have a lower level of risk post development than the higher level of risk that is required in order to determine a site as being contaminated in accordance with Part IIA. This is to ensure that there is a suitable zone of safety below the level for Part IIA determination and prevent recently developed sites becoming reclassified as contaminated land if there are future legislative or technical changes (e.g., a substance is subsequently found to be more toxic than previously assessed this increases its hazard).

The criteria for assessing concentrations of contaminants and hence determining whether a site represents a hazard are based on a range of techniques, models and guidance. Within this context it is relevant to note that Government objectives are:

a) to identify and remove unacceptable risks to human health and the environment;
b) to seek to bring damaged land back into beneficial use;
c) to seek to ensure that the cost burdens faced by individuals, companies and society as a whole are proportionate, manageable and economically sustainable.

These three objectives underlie the "suitable for use" approach to risk management and remediation of contaminated land. The "suitable for use" approach focuses on the risks caused by land contamination. The approach recognises that the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Risks therefore should be assessed on a site-by-site basis.

The "suitable for use" approach then consists of three elements:

a) ensuring that land is suitable for its current use - in other words, identifying any land where contamination is causing unacceptable risks to human health and the environment, assessed on the basis of the current use and circumstances of the land, and returning such land to a condition where such risks no longer arise ("remediating" the land); the contaminated land regime provides the regulatory mechanisms to achieve this;
b) ensuring that land is made suitable for any new use, as planning permission is given for that new use - in other words, assessing the potential risks from contamination, on the basis of the proposed future use and circumstances, before official permission is given for the development and, where necessary to avoid unacceptable risks to human health and the environment, remediating the land before the new use commences; this is the role of the town and country planning and building control regimes; and
c) limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land for which planning permission is being sought - in other words, recognising that the risks from contaminated land can be satisfactory assessed only in the context of specific uses of the land (whether current or proposed), and that any attempt to guess what might be needed at some time in the future for other uses is likely to result either in premature work (thereby running the risk of distorting social, economic and environmental priorities) or in unnecessary work (thereby wasting resources).

The mere presence of contaminants does not therefore necessarily warrant action, and consideration must be given to the scale of risk involved for the use that the site has and will have in the future.

OVERALL METHODOLOGY

The work presented in this report has been carried out in general accordance with recognised best practice as detailed in guidance documents such as in the EA online guidance: Land Contamination: Risk Management (LCRM) (Environment Agency, 2020), and BS10175:2011+A2 2017. Important aspects of the risk assessment process are transparency and justification. The particular rationale behind the risk assessments presented is given in this appendix.

The first stage of a two-staged investigation and assessment of a site is the Preliminary Investigation (BS 10175:2011), often referred to as the Phase 1 Study, comprising desk study and walk-over survey, which culminates in the Preliminary Risk Assessment. A preliminary conceptual site model (CSM) is developed which identifies potential geotechnical and geo-environmental hazards and the qualitative degree of risk associated with them. From the geo-environmental perspective, the Hazard Identification process uses professional judgement to evaluate all the hazards in terms of potential contaminant linkages (of contaminant source-pathway-receptor). Potential contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and generic risk assessment.

The second stage is the Ground Investigation, Generic Risk Assessment and Geotechnical Interpretation. This represents the further assessment mentioned above. The scope of the Ground Investigation is based on the findings of the Preliminary Risk Assessment and is designed to reduce uncertainty in the geotechnical and geo-environmental hazard identification. The Ground Investigation comprises fieldwork, laboratory testing and usually also on-site monitoring. The Ground Investigation may include the Exploratory, Main and Supplementary Investigations described in BS 10175:2011+A2 2017. The results of the Ground Investigation reduces uncertainty in the geotechnical and geo-environmental risks. Depending on the findings more detailed investigations or assessments may be required.

PRELIMINARY RISK ASSESSMENT

Current practice recommends that the determination of potential liabilities that could arise from land contamination be carried out using the process of risk assessment, whereby "risk" is defined as:

> "(a) The probability, or frequency, or occurrence of a defined hazard; and
> (b) The magnitude (including the seriousness) of the consequences."

The UK's approach to the assessment of environmental risk is set out in by the Department of the Environment Transport and the Regions (2000) publication "A Guide to Risk Assessment and Risk Management for Environmental Protection" (also called Greenleaves II). This established an iterative, systematic staged process which comprises:

a) Hazard identification;
b) Hazard assessment;
c) Risk estimation;
d) Risk evaluation;
e) Risk assessment;

At each stage during the development process, the above steps are repeated as more detailed information becomes available for the site.

For an environmental risk to be present, all three of the following elements must be present:

- Source/Contaminant: hazardous substance that has the potential to cause adverse impacts;
- Receptor: target that may be affected by contamination: examples include human occupants/users of site, water resources (rivers or groundwater), or structures;
- Pathway: a viable route whereby a hazardous substance may come into contact with the receptor.

The absence of one or more of each component (contaminant, pathway, receptor) would prevent a contaminant linkage being established and there would be no significant environmental risk.

The identification of potential contaminant linkages is based on a Conceptual Model of the site, which is subject to continual refinement as additional data becomes available. As part of a Preliminary Risk Assessment (Desk Study and site walk over) a Preliminary Conceptual Site Model (PCSM) is formed. Based on the PCSM, potential contaminant linkages can be assessed. If the PCSM and hazard assessment indicate that a contaminant linkage is not of significance then no further assessment or action is required for this linkage. For each significant and potential linkage, a risk assessment is carried out. The linkages which potentially pose significant risks may require a variety of responses ranging from immediate remedial action or risk management or, more commonly, further investigation and risk assessment. This next stage is termed a Phase II Main Site Investigation and should provide additional data to allow refinement of the Conceptual Site Model and assess the level of risk from each contaminant linkage.

Definition of Risk Assessment Terminology

CIRIA Report C552, Contaminated Land Risk Assessment A Guide to Good Practice, 2001 sets out a methodology for estimating risk. The methodology for risk evaluation is a qualitative method for interpreting the output for the risk estimation stage of the assessment. It involves the classification of the:

- Magnitude of the potential consequence (severity) of risk occurring.
- Magnitude of the probability (likelihood) of the risk occurring.

The classification of consequence and probability are set out in table B1 and B2 below:

Table B1 **Classification of Consequence**

Classification	Definition	Examples
Severe (Sv)	Short term (acute) risk to human health likely to result in "significant harm" as defined by the Environment protection Act 1990, Part IIA. Short term risk of pollution of controlled waters. Catastrophic damage to buildings / property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem	High concentrations of cyanide on the surface of an informal recreation area Major spillage of contaminants from site into controlled water. Explosion causing building collapse (can also equate to a short-term human health risk if buildings are occupied.)
Medium (Md)	Chronic damage to Human Health ("significant harm"). Pollution of controlled waters. A significant change in a particular ecosystem, organism forming part such ecosystem.	Concentrations of contaminants from site exceeding generic or site-specific screening criteria. Leaching of contaminants into a major or minor aquifer. Death of species within a designated nature reserve.
Mild (Mi)	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services. Damage to sensitive buildings / structures / services or the environment.	Pollution of non-classified groundwater. Damage to building, rendering it unsafe to occupy (e.g., foundation damage resulting in instability)
Minor (Mr)	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by measures such as protective clothing etc). Easily repairable effects of damage to buildings, structures, and services.	The presence of contaminants at such concentrations that protective equipment is required during site work. The loss of plants in a landscaping scheme. Discolouration of concrete.

The classification of consequence does not take into account the probability of the consequence being realised. Therefore there may be more than one consequence for a particular pollutant linkage. Both a severe and medium classification can result in death. Severe relates to short term (acute) risk while medium relates to long term (chronic) risk. Mild relates to significant harm but to less sensitive receptors. Minor classification relates to harm which is not significant but could have a financial cost.

Table B2 **Classification of Probability**

Classification	Definition
High likelihood (Hi)	There is a pollutant linkage and an event that either appears very likely in the short term and almost inevitable in the long term, or there is evidence at the receptor or harm or pollution.
Likely (Li)	There is a pollutant linkage, and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood (Lw)	There is a pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the short term.
Unlikely (Ul)	There is a pollutant linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

The classification gives a guide as to the severity and consequence of identified risk when compared with other risk presented on the site. It should be noted that if a risk is identified it cannot be classified as “no risk” but as “very low risk”. Differing stakeholders may have a different view on the acceptability of a risk.

Once the consequence and probability have been classified these can be compared using a matrix (**Table B3**) to identify an overall risk category. These categories and the actions required are categorised in **Table B4.**

Table B3 **Risk Evaluation Matrix**

		Consequence			
		Severe (Sv)	Medium (Md)	Mild (Mi)	Minor (Mr)
Probability	High likelihood (Hi)	Very High Risk (VH)	High Risk (H)	Moderate Risk (M)	Mod/Low Risk (M/L)
	Likely (Li)	High Risk (H)	Moderate Risk (M)	Mod/Low Risk (M/L)	Low Risk (L)
	Low likelihood (Lw)	Moderate Risk (M)	Mod/Low Risk (M/L)	Low Risk (L)	Very Low Risk (VL)
	Unlikely (Ul)	Mod/Low Risk (M/L)	Low Risk (L)	Very Low Risk (VL)	Very Low Risk (VL)

Table B4 **Risk Categorisations**

Very High Risk (VH)	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risk (H)	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer-term.
Moderate Risk (M)	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low Risk (L)	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk (VL)	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

GENERIC QIANTITATIVE RISK ASSESSMENT

In the following sections the current UK guidance on risks to the following receptors are discussed: human health, plant life and controlled waters

Human Health

The overall methodology for assessing the risk to human health from potential contaminants in soil is set out in the Environment Agency's guidance "Using Soil Guideline Values" SC050021/SGV Introduction, March 2009 and using the CLEA 1.06 model software (and CLEA 1.071 for nickel). The generic assessment criteria are in accordance with the following:

- Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil;
- Science Report SC050021/SR3: Updated technical background to the CLEA model;
- Science Report SC050021/SR4: CLEA Software (Version 1.071, 2014) & Handbook;
- Toxicological reports and SGV technical notes;
- Toxicological data published by LQM/CIEH (2009) and CL:AIRE/EIC/AGS (2009);
- DEFRA Development of Category 4 Screening Levels for assessment of land affected by contamination - SP1010 (December 2013);
- LQM/CIEH Suitable 4 Use Levels (S4ULs) for Human Health Risk Assessment; and,
- Toxicology review published by the European Food Safety Authority for nickel (2015).

In March 2014 six 'proposed' Category 4 Screening Levels (pC4SL) were issued by Defra. These screening values are considered to be within Category 4 as defined in the Contaminated Land Statutory Guidance and indicate safe levels for new developments passing through the planning system. The SGV for lead has been withdrawn, and the pC4SL for lead has been derived using current best practice. In January 2015 LQM/CIEH published S4ULs for 89 contaminants in accordance with the C4SL methodology.

Note that groundwater contamination may pose a risk to human health but that there are no relevant generic assessment criteria available for comparison. GroundSolve has derived our own assessment criteria for this.

Phytotoxic Risks

Generic assessment of phytotoxicity is by comparison with guideline values presented in the British Standard for Topsoil and the MAFF document "Code of Good agricultural practice for the protection of soil", October 1998. This is in accordance with LCRM's reference to DEFRA notice CLAN 4/04.

Controlled Waters

Risks to controlled waters (groundwater and surface waters) from contaminants are assessed in accordance with the EA documents "The Environment Agency's Approach to Groundwater Protection" (2017) and Remedial Targets Methodology (RTM, 2006). Pollutant inputs from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC) (WFD) and its daughter Directives, and as such are regulated under the Environment Agency's 'limit' pollution objective. Acceptable water quality targets (WQT) are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)). The risk posed to controlled waters from total soil concentrations cannot be directly assessed. The risk is assessed either by comparison of results of leachate tests carried out on soil samples, or from the direct testing of samples of groundwater to screening criteria. Leachate testing generally forms a conservative assessment and is not appropriate for organic contaminants.

CURRENT GUIDANCE ON INTERPRETATION OF CHEMICAL ANALYSIS OF SOILS

Contaminated land is defined under law through Part IIA of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995. This supports a 'suitable for use' based approach to the risk assessment of potentially contaminated land. The site-specific risk assessment is based upon assessment of plausible contaminant linkages, referred to as the contaminant-pathway- receptor model, based upon the current or proposed use of the site.

Before undertaking a risk assessment, a conceptual site model is devised in order to identify the potential contaminants, pathways and receptors. The individual contaminants, pathways and receptors then need to be further investigated in order to refine the initial assessment and risk assessment undertaken.

In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. These reports (CLR7-10) together with associated "SGV" documents were withdrawn and the following documents have been published as revised guidance to the CLEA assessment:

- Environment Agency : 2008: Using Soil Guideline Values SC050021/SGV Introduction, March 2008.
- Environment Agency : 2008: Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil.
- Environment Agency : 2008: Science Report SC050021/SR3: Updated technical background to the CLEA model.
- Environment Agency : 2008 : Compilation of Data for Priority Organic Contaminants for Derivation of Soil Guideline Values Science report SC050021/SR7
- Environment Agency : Science Report SC050021/SR4: CLEA Software (Version 1.071, 2015) & Handbook.
- DEFRA Development of Category 4 Screening Levels for assessment of land affected by contamination - SP1010 (December 2013).
- LQM/CIEH Suitable 4 Use Levels for Human Health Risk Assessment.

Additional guidance on statistical assessment replacing CLR 7 is partly provided in:

- CL:AIRE: 2009: Guidance on Comparing Data With a Critical Concentration

A different approach to the statistical appraisal of data is required depending on whether the assessment of risk is to assess whether land is Contaminated Land in accordance with regulations, or whether the assessment is to assess whether the site is suitable for new development in according with Planning guidance. This is discussed further in CL:AIRE: 2009 "Guidance on Comparing Data With a Critical Concentration".

The introduction of the Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) reassessed the CLEA Model and the derived SGVs (and associated GACs calculated using the model). This re-assessment concluded that the SGVs/GACs were conservative screening criteria for determining the suitability of soil with regard to the risk to human health under the planning regime and defined a new upper limit for planning purposes which is the boundary between the new Category 3 and 4. In March and September 2014 DEFRA issued guidance on these new Category 4 Screening Levels (C4SL) and these are discussed further below.

__Soil Guideline Values__

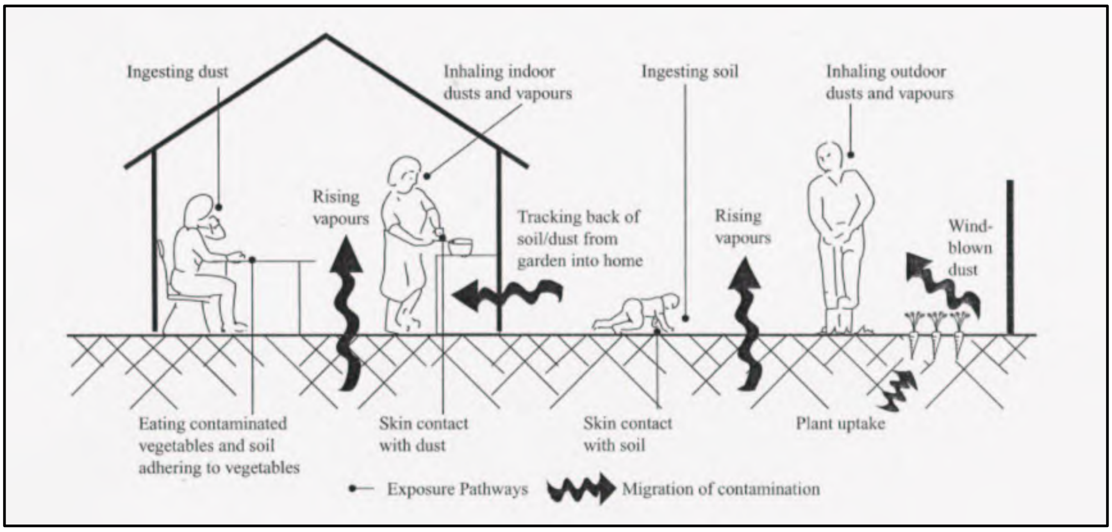
A program for the derivation of SGVs based on the above guidance is provided by the Environment Agency and is entitled "CLEA Software Version 1.06". These reports, together with supporting toxicology reviews ("Tox" or Supplementary Information Reports) for individual substances (which will be gradually updated), Soil Guideline Value Reports and other guidance referred to in the above documents, provide guidance and the scientific basis for assessing the risk to human health from potential contaminants. Soil Guideline Value Reports (SGV Reports) have been published for a number of contaminants and these are published on the Environment Agency website. Eventually the reports will include SGVs for:

- heavy metals and other inorganic compounds: arsenic, cadmium, chromium, cyanide, lead (now withdrawn), mercury nickel (now withdrawn), and selenium;
- benzene, ethylbenzene, toluene, and xylenes;
- phenol;
- dioxins and dioxin-like polychlorinated biphenyls (PCBs);
- polycyclic aromatic hydrocarbons (PAHs) – 11 substances.

In September 2015, CLEA was re-issued as 'CLEA Version 1.071'. Currently, the software has been used to produce an in-house GAC for nickel, following with withdrawal of the SGV.

In addition, CIEH through LQM and the EIC have published generic assessment criteria (GACs) for a wide variety of other parameters including metals, hydrocarbons, chlorinated aliphatic compounds, PAHs and explosive substances for three standard land uses. These have been produced to supplement the Environment Agency guidance. These GACs will be replaced by SGVs when or if the Environment Agency publishes any more SGVs.

The CLEA model has been developed to calculate an estimated tolerable daily soil intake (TDSI) for site users given a set 'default' exposure pathways. Ten human exposure pathways are covered in the CLEA model as presented below:



- Ingestion:
    - ingestion of outdoor soil;
    - ingestion of indoor dust;
    - ingestion of home-grown vegetables;
    - ingestion of soil attached to home grown vegetables.

- Dermal Contact:
    - dermal contact with outdoor soil;
    - dermal contact with indoor dust.

- Inhalation:
    - inhalation of outdoor dust;
    - inhalation of indoor dust;
    - inhalation of outdoor soil vapour;
    - inhalation of indoor soil vapour.

It should be noted that there are other potential exposure pathways on some sites not included in the CLEA model e.g., certain organic compounds can pass through plastic water pipes into drinking water supply.

The presence and/or significance of each of the above exposure pathways are dependent on the type of land use being considered and the nature of the contaminant under scrutiny. Accordingly, the CLEA model considers for principle ‘default’ land use types and makes a series of ‘default’ assumptions with regard to human exposure frequency, duration and critical human target groups for each land use considered:

- residential land use;
- allotments;
- commercial and industrial land use.

The land use categories defined in the CLEA are detailed below.

Residential: This land use category assumes that people live in a variety of dwellings including terraced, detached and semi-detached houses up to two storeys high. The structure of buildings varies. Default parameters for building materials and building design are included in CLEA documents to calculate the relevant multi-layer diffusion coefficients for vapour intrusion and to model indoor vapour intrusion. The CLEA model assumes that regardless of the style of housing the residents will have access to either a private garden or community open space nearby, and that soil tracked into the home will form indoor dust. It allows for the ingestion pathways from home grown vegetables.

Allotments: The CLEA model incorporates an assessment of land provided by local authorities specifically for people to grow fruit and vegetables for their own consumption. Consumption of such fruit and vegetables present several exposure pathways; plants absorb contaminants mainly via water uptake through roots, the contaminants move to edible portions of plants via translocation and contaminated soil particles become trapped in the skin and between leaves. At present the model fails to account for exposure through the consumption of animals, and their products (e.g., eggs), which have been reared on contaminated land.

Commercial/Industrial: Although there are a wide variety of workplaces and work-related activities, the CLEA assessment of this land-use assumes that work occurs in a permanent, three-storey structure, where employees spend most time indoors, conducting office-based or light physical work. The model assumes employees sit outside during breaks for most of the year. Limitations in applying this land-use to different industries is detailed in EA publication “Updated technical background to the CLEA model” (2011). The generic model assumes that the site would not be covered by hard standing. Risk of exposure to contaminants would be clearly less where commercial land is essentially all buildings and hard standing.

Based on the assumptions of each land use and the associated applicable exposure pathways, a ‘Soil Guideline Value’ (SGV) may be calculated for each contaminant under consideration for a particular land use in order to determine whether certain contaminant soil concentrations pose a significant risk to human health. The primary purpose of the CLEA SGVs are as ‘trigger values’ – indicators to a risk assessor that soil concentrations below this level require no further assessment as it can be assumed that the soil is suitable for the proposed use. Where soil concentrations occur above the SGV then further assessment of the results is required. The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April 2012 provides new clarity on the assessment of risk where soil concentrations exceed the SGV. The guidance introduces a four-stage classification system relating to concentration of contaminants and the assessed risk which indicates appropriate actions. Category 1 and 2 sites are classified as “Contaminated Land” as defined in Part IIA of The Environmental Protection Act (1990). Category 3 and 4 sites are not considered as “Contaminated Land” in accordance with the Act. This can be explained using the figure on the following page.

There are also difficulties in establishing soil concentrations of contaminants beyond which risks from exposure to these contaminants would be ‘unacceptable’ and that they would lead to “significant possibility of significant harm” as defined in Part IIA of The Environmental Protection Act (1990) and determine that the land is “contaminated.” This ultimately requires detailed ‘toxicological’ information of the health effects of individual contaminants and also a scientific judgement on what constitutes an ‘unacceptable’ risk. It is for local authorities or the

Environment Agency to determine whether a particular site is contaminated land, and it is for local Planning Authorities to determine whether land affected by contamination can be redeveloped.

Given the SGVs have been derived only for a limited number of contaminants and there was little prospect of further SGVs being published, two professional groupings have produced Generic Assessment Criteria (GACs) in accordance with the CLEA model for a large number of additional contaminants. These GACs were recognised in the new Contaminated Land Statutory Guidance (DEFRA, 2012) and have been produced as follows:

- *LQM/CIEH : 2009 Nathaniel CP, McCaffrey C, Ashmore MH, Cheng NPS GROUP, Gillett A, Ogden R & Scott D : 2009 . The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd edition). Land Quality Press, Nottingham.*
- *CL:AIRE/EIC/AGS: 2009 : Soil Generic Assessment Criteria (GAC) for Human Health Risk Assessment. Contaminated Land: Applications in Real Environments, Environment Industries Commission & Association of Geotechnical and Environmental Specialists. December 2009.*

Category 4 Screening Levels and LQM/CIEH Suitable 4 Use Levels

For new developments progressing through the planning regime, it is desirable that the soil concentrations are within Category 4 where there is a valid contaminant linkage. The upper boundary between Category 4 and 3 is not defined in the guidance. This boundary can also be better defined by carrying out a Detailed Quantified Risk Assessment (DQRA) and this is discussed later in this appendix.

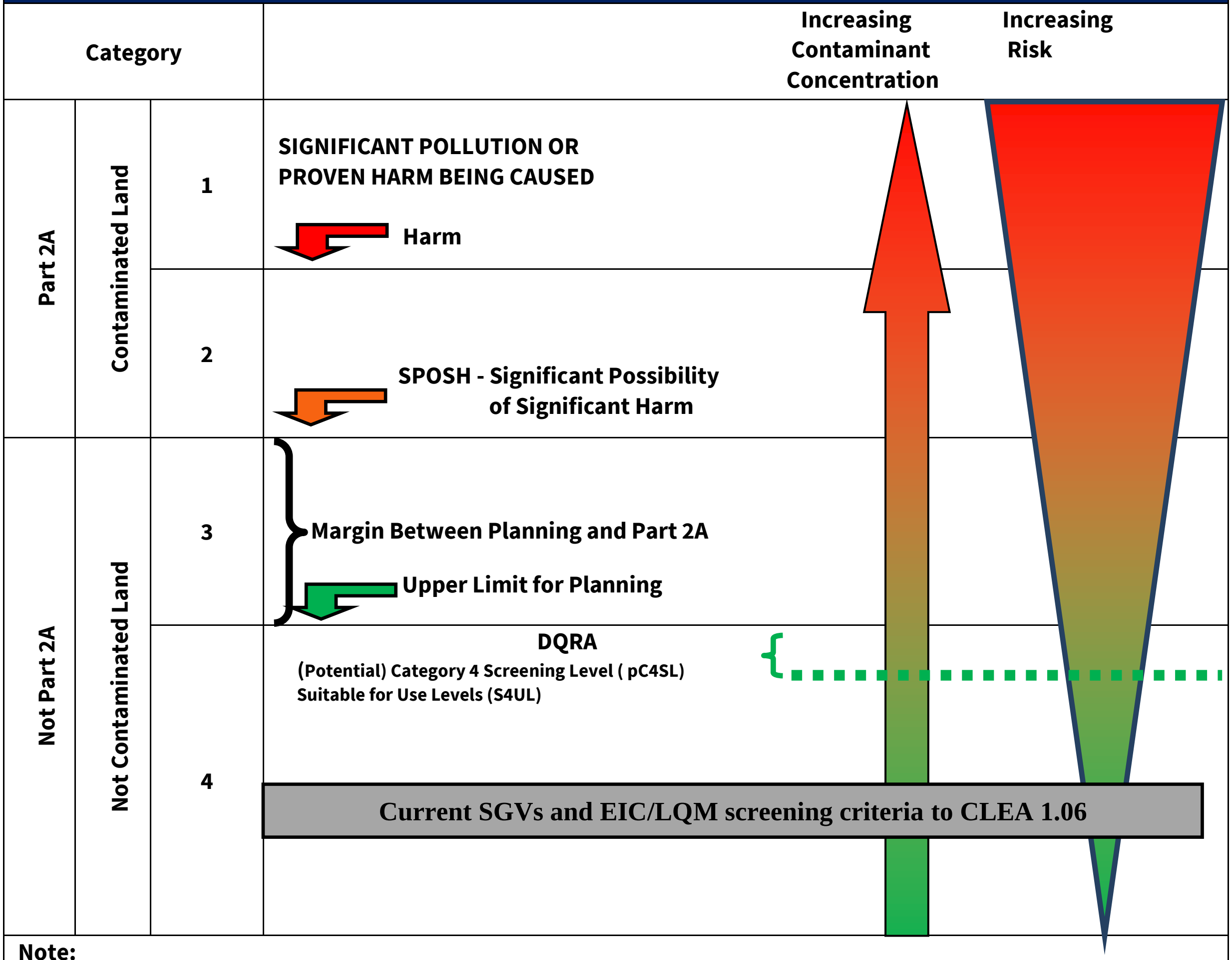
In December 2013 Defra issued the findings of a research project undertaken by CL:AIRE to set out the framework by which potential Category 4 Screening Levels (pC4SL) may be derived. The report was not designed to produce 'final' C4SL as the steering group producing the report believes that final C4SL should be set by a 'relevant authority' (e.g., Defra), the toxicological framework proposed has not been reviewed by the Committee on Toxicity and the document has yet to be subject to peer review.

In March 2014, appendices to the main Defra report were published detailing the derivation of pC4SL for 6 contaminants and other appendices regarding a review of the CIEH/CL:AIRE statistics guidance and sensitivity analysis. For each contaminant, a range of pC4SL have been produced relating to modifying toxicological parameters only, modifying exposure parameters only or by modifying both. It should be noted that the pC4SL produced for lead (the SGV was withdrawn in 2011) has undertaken a relatively large toxicological review in relation to modelling blood lead concentrations. pC4SL have been produced for:

- Arsenic;
- Benzene;
- Benzo(a)pyrene (as a surrogate marker for PAHs);
- Cadmium;
- Chromium (VI); and
- Lead

As previously discussed the values were initially published as 'potential' C4SL but have become 'final' following DEFRA having issued a policy decision letter indicating that they are to be used in the planning regime (letter of 3rd September 2014). It is considered that the pC4SL provide a simple test for deciding whether land is suitable for use without any remediation. The pC4SL represent a new set of screening levels that are more pragmatic (but strongly precautionary) compared to the existing soil guideline values (SGVs and the other GACs calculate in accordance with the existing CLEA methodology). The pC4SL provide cautious estimates of contaminant concentrations in soil that are still considered to present an acceptable level of risk, within the context of Part 2A, by combining information on toxicology, exposure assessment and normal levels of exposure to these contaminants. pC4SL values should not be seen as 'SPOH values.' Exceeding a pC4SL means that further investigation is required, not that the land is necessarily contaminated. In January 2015, LQM published Suitable 4 Use Levels (S4ULs) for a further 89 contaminants using the Defra C4SL methodology. In a similar manner to the pC4SLs, no authoritative review has been undertaken although the approach and quality of the work undertaken is widely accepted as being of high quality.

Relationship Between Contaminant Concentration, Risk and Screening Values



Note:
The vertical scale should not be considered as being linear and will be site and contaminant specific.

- SPOSH concentrations could be 10 to 100 times the SGV/EIC/LQM screening concentration.
- C4SL were issued as 'potential' but have become 'final' following DEFRA having issued a policy decision letter indicating that they are to be used in the planning regime (letter of 3rd September 2014).

Lead:

The SGV for lead was withdrawn in 2011 and is not used in this report. The pC4SL for lead provides a technically robust and conservative assessment tool using significantly updated toxicological modelling in line with current scientific understanding of lead toxicology.

Nickel

The SGV for nickel was withdrawn in 2015 and is not used in this report. In-house GACs for nickel have been produced using the updated toxicological review by the EFSA and the CLEA 1.071 software.

Public Open Space

The Defra report (December 2013) has also introduced exposure scenarios for two other commonly occurring land uses which require assessment (under the planning and Part 2A regimes) on a relatively frequent basis. These exposure scenarios are:

- Public Open Space – Space Near Residential Housing (POS_{resi}); and,
- Public Open Space – Public Park (POS_{park}).

Potential use of pC4SL relating to Public Open Space (POS) require care due to the significant variability in exposure characteristics. For example, POS may include:

- Children's play areas, public parks where children practise sport several times a week and teenagers only once a week;
- Grassed areas adjacent to residential properties which are rarely used;
- Dedicated sports grounds where exposure is only to players and groundworkers; and,
- Nature reserves or open ground with low level activity (for example, dog walking).

Within the Defra report (December 2013) the following exposure scenarios have been modelled as these are considered the most important for potential exposure for the critical receptor i.e., young children:

- Green open space close to housing, including tracking back of soil (POS_{resi}); and
- Park-type scenario where distance is considered sufficient to discount tracking back of soil (POS_{park}).

Detailed Quantified Risk Assessment (DQRA)

SGVs, GACs, pC4SL and S4ULs are based on a number of basic assumptions. There are two main options for developing Site Specific Assessment Criteria (SSAC) by adjusting the CLEA model so that they have greater relevance to the site:

- **Simple adjustment of the generic SGV / C4SL model**. Such adjustment is restricted to the choice of exposure routes selected for the generic land use, building type, soil type and soil organic matter content within the CLEA software.

- **Detailed adjustment.** It may be relevant to make greater modifications to the model due to the specific use of the land in question. This can include modification to any parameter value, including exposure assumptions, building parameters, and the choice and application of fate and transport models. This is equally relevant to site-specific modifications of existing generic land uses, the development of new land uses, and the inclusion of additional exposure pathways. Much of this can be undertaken using the CLEA software. Depending on the complexity of the detailed adjustments required, it may be necessary to use other tools either alone or in conjunction with the CLEA software. Both options should follow established protocols for DQRA and require sufficient justification and supporting information for the adjustments made. Detailed adjustments are likely to require substantially greater technical justification and supporting documentation, especially if modifications are based on information not contained within the SGV framework documents.

The two choices present the risk assessor with three options/decisions:

1. Use a published SGV/GAC/pC4SL/S4UL if it can be demonstrated that the assumptions inherent in the value are appropriate to the site in question. If they are not, proceed to either option 2 or 3 below.

2. Make simple site-specific adjustments to the generic exposure model used to derive the SSAC. Three examples of when this could be appropriate are:

    a. High density residential development with no exposed contaminated soil at surface. It is appropriate in this case to consider the relevance of direct contact pathways and consumption of homegrown produce.

    b. Soil type is significantly different (specifically when soil type is likely to be less protective e.g., made ground) to that assumed in the SGV/GAC/pC4SL/S4UL.

    c. Soil organic matter content is significantly different to that assumed in the derivation of the SGV/GAC/pC4SL/S4UL.

3. If simple adjustments are not sufficient to reflect site conditions, undertake a DQRA. This may be undertaken using the CLEA software or by using an alternative risk assessment methodology that is relevant, appropriate, authoritative, and scientifically based. Changes to toxicological end points may also be considered, although this should only be undertaken by a toxicology expert. In the context of this guidance, simple adjustments of a generic land use scenario for soil type or SOM content for example are not considered sufficient to be classed as a DQRA.

DQRAs should be conducted with the agreement of the local authority (or the Environment Agency) since it is the authority that determines whether land is Contaminated Land or whether Planning Permission for a new development may be granted.

Representative Data

The type, quantity and quality of the available soil data influence the method chosen to obtain a site representative soil concentration that is compared with an SGV/GAC/pC4SL/S4UL in the screening process. The soil data should be representative of the exposure scenario being considered. This can include factors such as:

- Averaging area over which exposure occurs;
- Sample depth; and,
- Heterogeneity of soil.

where the 'averaging area' is defined as:

> *"That area (together with a consideration of depth) of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions".*

Site investigations take discrete samples from a given area (and to a certain depth). It has to be assumed that these samples are to some degree representative of the contaminant concentration throughout that volume of soil. The critical soil volume (taking into account area and depth) which might be usefully compared with an SGV/GAC/pC4SL/S4UL is a site-specific decision, but a starting point is the generic land use scenarios used in the derivation of the SGV/GAC/pC4SL/S4UL. The critical soil volume depends on two factors:

- Contaminant distribution and vertical profile (bands of highly contaminated material or lateral hot spots should not necessarily be averaged out with more extensive cleaner areas of soil without justification)
- Contribution to average exposure underpinning the SGV. Direct contact exposure pathways depend on the adult or child coming into contact with near-surface soils and the area over which that exposure occurs is usually important (i.e., the averaging area). Vapour pathways are less dependent on surface area, for example vapour intrusion may result from a highly concentrated hot spot beneath a building leading to elevated average indoor air concentrations. For the three standard land uses for which SGVs are derived, relevant considerations are:
- For the standard **residential or allotment land use**, the critical soil volume is the area of an individual garden, communal play area or working plot from the surface to a depth of between 0.50m and 1.00m. This is the ground over which children are most likely to come into contact with soil or from which vegetable and fruit produce will be harvested. In the case of volatile contaminants, it may also be appropriate to consider the volume of soil underneath the footprint of the building although vapour intrusion may be driven by a soil volume much smaller than this if the contaminant source is highly concentrated.
- For the standard **commercial land use**, the critical soil volume has to be decided on a case-by- case basis due to the wide range of possible site layouts. However, for non-volatile contaminants, landscaped and recreational areas around the perimeter of office buildings are likely to be most important. For volatile contaminants, the footprint occupied by the building itself should also be considered.

- For **most exposure pathways**, the contamination is assumed to be at or within one metre of the surface.

The use of averaging areas must be justified on the basis of relevance to the exposure scenario. SGVs are relevant only when the exposure assumptions inherent in them are appropriate for the identified exposure averaging area. Further guidance on critical soil volumes and the consideration of averaging exposure areas can be found in:

- *Secondary model procedure for the development of appropriate soil sampling strategies for land contamination (Environment Agency, 2000);*
- *Guidance on comparing soil contamination data with a critical concentration (CIEH/CL:AIRE, 2009); and*
- *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Appendix I (Defra December 2013, March 2014)*

It is the mean soil concentration for the individual contaminant within an individual averaging area, which is compared to the SGV. However, as contaminant concentrations vary across a site, and sampling and analysis will introduce measurement errors, the comparison between measured mean concentration and the SGV must take this uncertainty into account.

There are two principal options available to obtain site representative soil concentrations from a site investigation dataset; statistical and non-statistical methods. Data objectives, quality and quantity are likely to determine which approach is most appropriate. If statistical methods such as those presented in CIEH/CL:AIRE (2011) are to be used, sufficient data need to be available or obtained. No one single statistical approach is applicable to all sites and circumstances. The wider range of robust statistical techniques developed by organisations including the US Environmental Protection Agency (USEPA) are also important tools. Risk assessors should choose an appropriate statistical approach on the basis of the specific site and the decision that is being made. For further guidance on the appropriate use of statistical approaches, refer to USEPA 2006 or good environmental monitoring statistics textbooks.

When statistical approaches are inappropriate (this will depend on the objectives of the site investigation), individual or composite samples should be compared directly to the SGV. Guidance on use of alternative data handling approaches such as the use of composite sampling can be found in documents such as:

- *Verification of remediation of land contamination* (Environment Agency, 2010);
- *Sampling and testing of wastes to meet landfill Waste Acceptance Criteria* (Environment Agency, 2005);
- *Guidance on choosing a sampling design for environmental data collection* (USEPA, 2002); and,
- *Soil Quality – Sampling, ISO 10381 series* (ISO, 2002–2007).

The statistical tests should not be used as arbiters for decisions under Part 2A. They are an additional, useful line of evidence to assist in decision-making. The implications of the basis for the derivation of the site representative soil concentration must be taken into account in any decision-making process and clearly documented.

Where the statistical tests are conducted in accordance with the method described in CL:AIRE 2009:

- For the Planning situation, it has to be demonstrated that the concentration of contaminants is low compared to the pC4SL/S4UL or SSAC. All of the test data should be below the screening criteria and no statistical analysis is required or if there are exceedances of the criteria then a statistical assessment is required. For the statistical assessment this decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is lower than the screening criteria.

- For the Part 2A scenario the regulator needs to determine whether the concentration of contaminants is greater than the SGV/GAC/pC4SL/S4UL or SSAC. This decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is higher than the SSAC. However, the regulator may proceed with determination if there is just a 51% probability, “on the balance of probabilities.”

If the screening levels are exceeded then more sophisticated quantitative risk assessment can be undertaken or remedial action may be taken to break the contaminant linkages. The benefits of undertaking a quantitative risk assessment must be weighed against the likelihood that it will bring about cost savings in the proposed remediation. Further information about the use of soil guideline values is provided in Environment Agency : 2008: Using Soil Guideline Values SC050021/SGV Introduction, March 2008.

GENERIC RISK ASSESSMENT CRITERIA FOR RISK TO PLANTS

Soil contaminants, if present at sufficient concentrations, can have an adverse effect on the plant population. Phytotoxic effects can be manifested by a variety of responses, such as growth inhibition, interference with plant processes, contaminant-induced nutrient deficiencies and chlorosis (yellowing of leaves). All chemicals are probably capable of causing phytotoxic effects. Thus, the phytotoxic potential of substances is dependent on the concentrations capable of having adverse effects on plants and the concentrations likely to be found at contaminated sites. Phytotoxicity is a difficult parameter to quantify given that experimental techniques vary widely, and variations exist in plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals. Contaminants may be taken up and accumulated by plants through a range of mechanisms. The principal pathways are active and/or passive uptake through the plant root, adsorption to root surfaces and volatilisation from the soil surface followed by foliar uptake. After plant uptake, contaminants may be metabolised or excreted, or they may be bioaccumulated and this is highly species dependant. Many of the substances capable of adversely affecting vegetation exert this effect because of their water solubility, a characteristic that could result in their transport from contaminated sites into adjacent locations where the chemical may generate a phytotoxic response. This could be important if, for example, the adjacent site has important conservation status.

The concentration in soil at which substances become phytotoxic depend on a range of factors including plant type, soil type, pH, the form and availability of the contaminant and other vegetation stress factors that may be present (such as drought). Some plants (including some rare plants will only grow in soils where there are relatively high concentrations which would be phytotoxic to other species. Whilst many contaminants may be phytotoxic, data are limited. Some heavy metals are essential as trace elements for plant growth but may become toxic at higher concentrations.

GroundSolve has carried out a review of a number of current and former guidance documents and other texts on phytotoxicity. It is not possible to produce a definitive list of phytotoxic substances on account of the variables mentioned above. However, a number of metals are repeatedly cited as commonly occurring priority pollutants. As a result, the following list is adopted by GroundSolve as indicators of the potential for phytotoxicity: As, Cr, Cu, Ni and Zn (note that Boron has been excluded from this list because the more modern studies do not assess this).

As the CLEA framework is a risk-based approach, applied to humans, an alternative strategy is required to assess the risk to plants from substances that are phytotoxic. Reference to published criteria and background concentrations can help put site data into context. Published assessment criteria for the protection of plant life from a number of countries are given in the following Table. The most authoritative source is the British Standard for topsoil, but this only lists three elements. LCRM states that the ICRCL Guidance Note 70/90 can be used for initial screening criteria. This approach has been adopted by GroundSolve where BS3882 is lacking, but where an ICRCL 70/90 criterion is lacking, the lowest criterion in Table below from, firstly UK, and, secondly, European and then other worldwide criteria. The adopted criteria are highlighted in the table 3.8. The MAFF value of 250 mg/kg has been chosen for As over the ICRCL value of 50 mg/kg as MAFF explains the 50 is applicable to vegetables and human health, whereas 250 is applicable to the plants themselves.

Table B.5: Published Assessment Criteria for Phytotoxic Elements (mg/kg)

Reference	As	CR (Total)	Cr (III)	Cr (VI)	Cu	Ni	Zn
British Standard for topsoil (BS3882:2007)	-	-	-	-	200 (pH >7) 135 (pH 6-7) 100 (pH 5.5-6.0)	110 (pH >7) 75 (pH 6-7) 60 (pH 5.5-6.0)	300 (pH >7) 200 (pH 6-7) 200 (pH 5.5-6.0)
MAFF Code of Good Agricultural Practice for the Protection of Soil (1998)	250	-	400 for sites containing sewage and sludge	-	500 (grass) but may fall to 250 for clover and sensitive species (at pH>6)	110 (pH>7) 75 (pH 6-7) 60 (pH 5.5-6.0)	1000 (clover & grass at pH 6), may fall to 300 for sensitive species (at pH 6-7)
ICRCL 59/83 (1987) now withdrawn for human health assessment	-	-	-	-	130	70	300
ICRCL 70/90 (1990) threshold trigger value	50	-	-	25 *	250	-	1000
Dutch ecotoxicological intervention value (Swartjes 1993 & 1994)	40	230	-	7	190	-	-
Australian Guideline B(1) (1999), Interim Urban Ecological Investigation Level (EIL). Soils not generally considered phytotoxic below these EILs.	20	-	400	1	100	60	200
New Zealand guidelines for timber treatment sites (1977), estimated based on Cu bioavailability *	-	-	-	-	500 - 1000 clay soils	-	-
New Zealand guidelines for timber treatment sites (1977), soil criteria for protection of plant life (residential/ agricultural setting)	10-20	-	600	25	130	-	-

Note: * Cr (VI) is only likely to be present in as a significant proportion of total Cr where pH >12 so this does not routinely need to be tested for regarding plant health.

CURRENT GUIDANCE FOR CONTROLLED WATERS RISK ASSESSMENT

Summary of Regulatory Context

Government policy is based upon a "suitable for use approach," which is relevant to both the current use of land and also to any proposed future use. When considering the current use of land, Part IIA of the Environment Protection Act 1990 [4] (EPA 1990) provides the regulatory regime, which was introduced by Section 57 of the Environment Act 1995 [5], which came into force in England on 1 April 2000. The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health, controlled waters or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

> *"any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:*
>
> a) *Significant harm is being caused or there is a significant possibility of such harm being caused; or,*
>
> b) *Pollution of controlled waters is being, or is likely to be, caused."*

Part IIA provides a statutory definition of the pollution of controlled waters under Section 78A(9) as:

> *"the entry into controlled waters of **any** poisonous, noxious or polluting matter or **any** solid waste matter"*

Part IIA is supported by a substantial quantity of guidance and other Regulations, especially for England, The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April 2012. The document re-confirms the duties of Enforcing Authorities in dealing with contamination including the role of the Environment Agency which has powers under Part 7 of The Water Resources Act (1991) to take action to prevent or remedy the pollution of controlled waters, including circumstances where the pollution arises from contamination in the land.

Part IIA introduces the concept of a contaminant linkage; where for potential harm to exist, there must be a connection between the source of the hazard and the receptor via a pathway. Risk assessment in contaminated land is therefore directed towards identifying the contaminants, pathways and receptors that can provide contaminant linkages. This is known as the contaminant-pathway-receptor link (CPR or contaminant linkage).

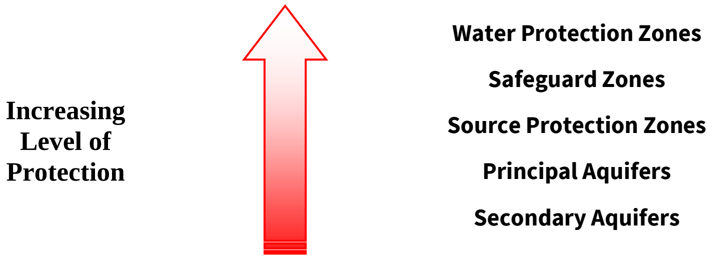
Part IIA places contaminated land responsibility as a part of the planning and redevelopment process rather than Local Authority or Environment Agency taking direct action except in situations of very high pollution risk or where harm is occurring. In the planning process guidance is provided by National Planning Policy Framework (NPPF) of March 2012. This requires that a site which has been developed shall not be capable of being determined "contaminated land" under Part IIA. Therefore, appropriate risk-based investigation is required to identify the contaminant linkages that can then be assessed, and then mitigated using methods that can be readily agreed with the planners.

Environment Agency Guidance

Legislation and guidance surrounding the protection of controlled waters in the UK is numerous and can be complex. The Environment Agency's overall position on groundwater is *"To protect and manage groundwater resources for present and future generation in ways that are appropriate for the risks that we identify"* (The Environment Agency's Approach to Groundwater Protection, 2017). In brief, the core objectives of the existing legislation serve to enforce this position.

In 1992, the National Rivers Authority published their Policy and Practice for the Protection of Groundwater (PPPG), this document was influential as it provided a focus for key developments such as Source Protection Zones (SPZs) and Groundwater Vulnerability Maps. The Policy was then revised in 1998, since which there have been substantial changes in legislation, driven by Europe. Key European Directives relating to groundwater include the Groundwater Directive (80/68/EEC) and the Water Framework Directive (2000/60/EC). Aspects of these directives are controlled by primary UK legislation such as the Water Resources Act 1991 as amended by the Water Act 2003. Further to legislative changes, gaps identified in the 1998 PPPG required addressing. These changes are reflected in the Environment Agency Policy document *The Environment Agency's Approach to Groundwater Protection"* of March 2017.

The Environment Agency follows a tiered, risk-based approach to drinking water protection, and this should be taken into account when carrying out controlled waters risk assessment:



Tools available for Risk Assessment of Controlled Waters

In order for a developer of a potentially contaminated site to fulfil their obligations under the legislation, a site assessment would be required to be undertaken in order to identify any potential risks to controlled waters and to derive suitable clean-up criteria if necessary to ensure the protection of controlled waters. A number of tools are available for this purpose.

Three main stages apply to any risk assessment of controlled waters, these are:

i. Risk Screening (devise Conceptual Site Model, making reference to groundwater vulnerability maps, site setting etc)

ii. Generic Risk Assessment (using the EA Remedial Targets Methodology – Tier 1 - Comparison of groundwater data with relevant standards)

iii. Detailed Quantitative Risk Assessment (Consideration of aquifer properties and site-specific parameters, using the EA Remedial Targets Methodology - Tiers 2 & 3)

The process is summarised below (Taken from the Environment Agency GP3 consultation document, 2006):

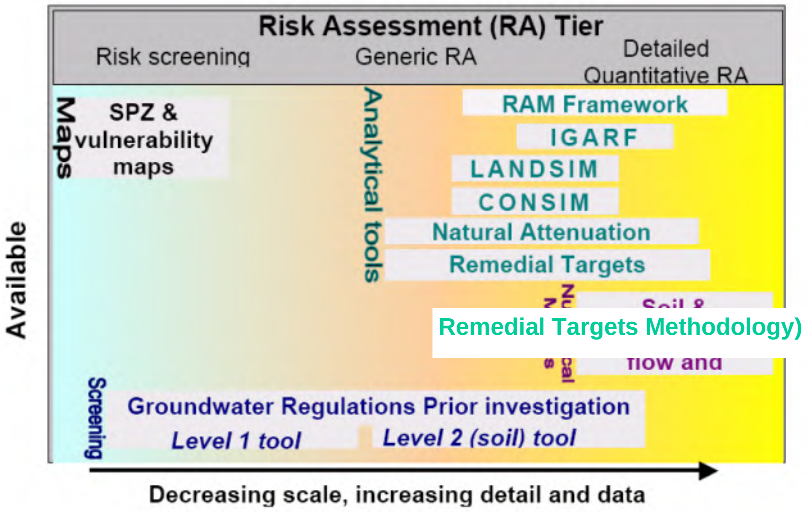


Figure 1-1 Environment Agency groundwater assessment tools, mapped against the different levels of risk assessment.

When assessing groundwater impact the Environment Agency advocate the application of their framework methodology "Remedial Targets Methodology – Hydrogeological Risk Assessment for Land Contamination" Environment Agency (2006). The methodology has four tiers of assessment:

> **Tier 1** utilises either a soil concentration (calculation of pore water concentrations based on partitioning calculations), leaching test or pore-water concentration of perched water as a source concentration input and these are contrasted directly to water quality standards. No dilution or attenuation is considered at Level 1.
>
> **Tier 2 (groundwater)** considers dilution of the contaminant within the underlying receiving groundwater or surface water body. To determine a dilution, factor the infiltration rate of pore water and the discharge of groundwater beneath the source must be determined. Level 2 Assessment comprises a comparison between measured groundwater concentrations with to water quality standards.
>
> **Tier 3** considers natural attenuation in the form of dispersion, retardation and degradation of the contaminant. As the levels are progressed, the assessment becomes increasingly more detailed and less conservative as the data requirements are increased with each successive tier. The Environment Agency has released Excel Worksheets to carry out basic calculations using a conservative approach up to Tier 3. However, in this case the conceptual model is a simple one and assumes there is a simple migration of contaminants from the source zone into the aquifer receptor. Using these worksheets requires a sensitivity analysis showing how by varying each parameter, what effect it might have on the outcome of the assessment. Groundwater conceptual models are not always this simple.
>
> **Tier 4** is for more complex conceptual models where multiple sources, multiple pathways, multiple receptors and complex water balances can be assessed.

The Environment Agency developed a spreadsheet-based code to support the Remedial Target Methodology, and the code is capable of undertaking assessments for Tiers 1 to 3. Tier 4 assessment is not supported by the spreadsheet-based code.

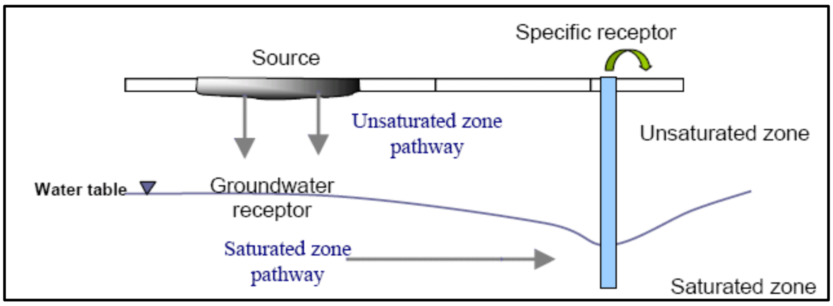
A more advanced code, ConSim 2, developed on behalf of the Environment Agency to support the Remedial Targets Methodology, allows for the introduction of additional geological horizons and is used mainly to determine the concentrations reaching a receptor and the timescales over which this may happen.

The codes assess only the dissolved phase contaminants. There are many further codes commercially available for use in controlled waters risk assessment, particularly for more complex situations, however, these should be used with caution and only once agreement has been obtained from the Environment Agency. All have the overall aim of the estimation of risk from contaminant linkages and the protection of controlled waters.

General notes on each stage of the controlled waters risk assessment process

Risk Screening

The understanding of the Conceptual Site Model (CSM) is the key to assessing any site. Using a robust CSM, potential pathways or receptors may be screened out from any further assessment at an early stage. For example, if the pathway through the unsaturated zone is blocked by the presence of a significant thickness of low permeability clay. A greater understanding of the CSM is achieved with each tier of risk assessment. An example of a basic Source-Pathway-Receptor concept is given below (taken from the Environment Agency GP3, 2006):



Generic Risk Assessment

When undertaking the Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Tier 1), comparison of chemical analytical results is made with screening criteria. Published values of screening criteria with which chemical test results can be compared are published in the following guidance:

There is a hierarchy of screening criteria which is as follows:

- Updated Recommendations on Environmental Technical Standards, River Basin Management (2015-21), April 2012 by the UK Technical Advisory Group on the Water Framework Directive;
- Environmental Quality Standards (EQS) for freshwaters based on The EC Dangerous Substances Directive (76/464/EEC and Daughter Directives);

- Surface Waters (Abstraction for Drinking Water)(Classification) Regulations (1996)
- Surface Waters (Fishlife) (Classification) Regulations (1997)
- UK Drinking Water Standards (DWS) (Water Supply (Water Quality) Regulations 2000);
- Dutch Ministry of Housing, Spatial Planning and Environment (2001) Intervention Values and Target Values – soil quality standards;
- World Health Organisation Guidelines for Drinking Water (2004)

Should the Level 1 or 2 assessments indicate threshold levels to be exceeded, then there are three alternative ways in which to proceed:

- To devise suitable remedial solutions;
- To carry out more investigation, sampling and analysis;
- To conduct a site-specific Detailed Quantitative Risk Assessment (DQRA) to whether or not the soil materials are suitable for their site-specific intended use or to devise a site-specific clean-up level.

Detailed Quantitative Risk Assessment (DQRA)

The decision to carry out a DQRA will be dependent on the extent and implications of the initial qualitative and generic assessment. The scope of any such assessment will be accurately defined by the outcomes of the former two stages. The CSM will be sufficiently refined by this stage that only certain contaminants of concern, certain pathways and certain receptors will require further assessment, the remainder having been screened out.

Additional site-specific data is normally required for this stage of assessment, as explained above, more processes that are capable of affecting contaminant concentrations are considered (such as dilution and attenuation).

Remediation criteria derived will therefore be specific to each site and will be based on a detailed assessment of the potential impact at the identified receptor or *compliance point*. A greater level of confidence can be placed on the predicted impact on the compliance point following a DQRA.

Definition of Controlled Waters

The term ‘controlled waters’ is defined in Section 104 of the Water Resources Act 1991 as:

> *“Territorial Waters…which extend seawards for three miles…, coastal waters…, inland freshwaters, waters in any relevant lake or pond or of so much of any relevant river or watercourse as is above the freshwater limit, and ground waters, that is to say, any waters contained in underground strata.”*

Note that the definition of groundwater under the Water Resources Act 1991 includes all water within underground strata (including soil / pore water in the unsaturated zone). The definition of groundwater under the Groundwater Directive however is limited to water in the saturated zone. For the purposes of Part IIA of the Environmental Protection Act 1990, the Environment Agency recommends that the groundwater within the saturated zone only is considered as the receptor (rather than soil / pore water).

Environment Agency's Aquifer Designations

The Environment Agency have classified different types of aquifers from which groundwater can be extracted. The aquifer 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.
- **Bedrock (Solid)** – solid permeable formations e.g., sandstone, chalk, limestone.

The aquifer designations displayed on the Environment Agency maps are as follows:

- **Principal Aquifers (formerly termed Major Aquifers) –** These are layers of rock or drift 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 a major aquifer.
- **Secondary Aquifers (formerly termed Minor Aquifers) –** These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two 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** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- **Unproductive Strata (formerly termed Non-Aquifer) –** These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Hazardous and Non-Hazardous Substances

The Groundwater (England and Wales) Regulations 2009 control the disposal to the hydrogeological environment of potentially polluting substances which are divided into Hazardous Substances and Non-hazardous Contaminants (this roughly approximates to the former List 1 and List 2 substances).

Hazardous Substances are the most damaging and toxic and must be prevented from directly or indirectly entering the groundwater environment. Hazardous Substances include mineral oils and hydrocarbons, pesticides, biocides, herbicides, solvents and some metals. Discharge of Hazardous Substances to Controlled Waters must be prevented.

Non-hazardous Pollutants are any contaminants other than Hazardous Substances. Non-hazardous Pollutants are potentially toxic but are less harmful than Hazardous Substances, but their direct discharge to groundwater is generally not permitted and any indirect discharge to groundwater must be limited and be controlled by technical precautions in order to prevent pollution. Non-hazardous Pollutants include ammonia and nitrites, many metals and fluorides.

MANAGEMENT OF CONTAMINATED LAND

When risk assessment of the site has been completed and this indicates that remedial works are required, the main guidance in managing this process is set out in the DEFRA/EA online guidance LCRM (2020) “Land Contamination: Risk Management” The stages of managing remediation are as follows:

(a) Options Appraisal and develop Remediation Strategy;
(b) Develop Implementation Plan and Verification Plan;
(c) Remediation, Verification and Monitoring.

The Remediation Strategy sets out the remediation targets, identifies technically feasible remedial solutions and presents an evaluation of the options so that these can be assessed enabling that the most suitable solution is adopted. An outline of the proposed remedial method should be presented. Agreement should be sought of the appropriate statutory bodies for the Remediation Strategy before proceeding to the next stage.

The Implementation Plan is a detailed method statement setting out how the remediation is to be carried out including stating how the site will be managed, welfare procedures, health and safety considerations together with practical measures such as details of temporary works, programme of works, waste management licences and regulatory consents required. Agreement should again be sought of the appropriate statutory bodies for this Plan.

The Verification Plan sets out the requirements for gathering data to demonstrate that the remediation has met the required remediation objectives and criteria. The Verification Plan presents the requirements for a wide range of issues including the level of supervision, sampling and testing regimes for treated materials, waste and imported materials, required monitoring works during and post remediation, how compliance with all licenses and consents will be checked etc. Agreement should again be sought of the appropriate statutory bodies for the Verification Plan. On completion of the remediation a Verification Report should be produced to provide a complete record of all remediation activities on-site and the data collected as required in the Verification Plan. The Verification Report should demonstrate that the remediation has met the remedial targets to show that the site is suitable for the proposed use.

GLOSSARY

TERMS	
AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
OD	Ordnance Datum
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
PCSM	Preliminary Conceptual Site Model
SGV	Soil Guideline Value
TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VSCs	Vibro Stone Columns
VOC	Volatile Organic Compound

UNITS	
m	Metres
km	Kilometres
%	Percent
%v/v	Percent volume in air
mb	Milli Bars (atmospheric pressure)
l/hr	Litres per hour
ha	Hectare (10,000m^2)
µg/l	Micrograms per Litre (parts per billion)
ppb	Parts Per Billion
mg/kg	Milligrams per kilogram (parts per million)
ppm	Parts Per Million
mg/m^3	Milligram per metre cubed
Mg/m^3	Megagram per metre cubed
µg/m^3	Microgram per metre cubed
m bgl	Metres Below Ground Level
m bcl	Metre Below Cover Level
mOD	Metres Above Ordnance Datum (sea level)
kN/m^2	Kilo Newtons per metre squared
kPa	Kilo Pascal – same as kN/m^2
µm	Micro metre

APPENDIX F: EXPLORATORY HOLE RECORDS

GroundSolve Ltd

Cable Percussion Drilling Record

CP101

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 02/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324199.00 N365238.00
Project No. : 3455	Crew Name: Macklin Geotech	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
CP101	CP	141.20m AoD	AR	1:50	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.00 - 0.40 0.20	B ES					Grass over soft brown slightly sandy slightly gravelly CLAY. Gravels are subrounded fine to coarse of mudstone and shale. (TOPSOIL)	
					0.55	140.65		Loose brown gravelly fine to medium SAND. Gravels are subrounded fine to coarse sandstone and siltstone. (FLUVIOGLACIAL DEPOSITS)	
		0.80	ES						1
		1.20 - 1.50 1.20	B SPT (C)	N=8 (1,2/2,2,2,2)					
		2.00 - 3.00 2.00	B SPT (C)	N=10 (2,2/2,3,2,3)	2.00	139.20		Medium dense brown slightly clayey slightly gravelly fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)	2
		3.00 - 4.00 3.00	B SPT (C)	N=11 (1,2/2,3,3,3)					3
		4.00 - 5.00 4.00	B SPT (S)	N=10 (1,2/2,2,3,3)					4
		5.00 - 6.00 5.00	B SPT (C)	N=10 (2,1/2,2,3,3)					5
		6.00 - 7.50 6.00	B SPT (C)	N=9 (1,1/2,2,2,3)				*Locally loose SAND at 6.00m bgl.*	6
					7.30	133.90		Firm brown silty CLAY. (FLUVIOGLACIAL DEPOSITS)	7
		7.50 - 9.00 7.50	B SPT (C)	N=17 (1,3/5,5,4,3)					8
		9.00 9.00 - 10.00	UT B	Ublow=45					9
					9.55	131.65		Medium dense brown slightly silty gravelly fine to medium SAND. Gravels are subrounded fine to coarse sandstone and siltstone. (FLUVIOGLACIAL DEPOSITS)	10

Hole Diameter		Casing Diameter		Chiselling				Progress			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth of Hole	Depth Casing	Depth Water	Date
1.20 13.83	300 152	13.50	152								

Remarks

Hand pit excavated to 1.20m. No groundwater

GroundSolve Ltd

Cable Percussion Drilling Record

CP101

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 02/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324199.00 N365238.00
Project No. : 3455	Crew Name: Macklin Geotech	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
CP101	CP	141.20m AoD	AR	1:50	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					10.20	131.00		Medium dense brown slightly silty gravelly fine to medium SAND. Gravels are subrounded fine to coarse sandstone and siltstone. (FLUVIOGLACIAL DEPOSITS)
		10.50 - 11.00 10.50	B SPT (C)	 N=38 (6,7/7,9,10,12)				Very stiff very thinly laminated brown silty sandy CLAY. (GLACIAL TILL)
		12.00 12.00 - 12.50	UT B	Ublow=100	12.00	129.20		Very stiff brownish grey slightly gravelly CLAY. Gravels are fine to medium subrounded of sandstone and siltstone. (GLACIAL TILL)
		13.50	SPT()	50 (7,10/50 for 260mm)				
					13.87	127.33		End of Borehole at 13.870m

Hole Diameter		Casing Diameter		Chiselling				Progress			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth of Hole	Depth Casing	Depth Water	Date
1.20 13.83	300 152	13.50	152								

Remarks

Hand pit excavated to 1.20m. No groundwater

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Cable Percussion Drilling Record

CP102

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324217.00 N365253.00
Project No. : 3455	Crew Name: Macklin Geotech	Drilling Equipment: Dando 2000

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
CP102	CP	141.59m AoD	AR	1:50	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.25	141.34		Grass over soft brown slightly sandy slightly gravelly CLAY. Gravels are subrounded fine to coarse of mudstone and shale. (TOPSOIL)
		0.40 - 0.70	B					Firm brown slightly sandy slightly gravelly CLAY. Gravels are subangular to subrounded fine to coarse sandstone. (FLUVIOGLACIAL DEPOSITS)
		1.20 - 1.50 1.20	B SPT (C)	N=10 (2,2/2,3,2,3)				
					1.80	139.79		Loose brown slightly gravelly fine to medium SAND. Gravels are subangular fine to coarse of coal. (FLUVIOGLACIAL DEPOSITS)
		2.00 - 2.50 2.00	B SPT (C)	N=5 (1 for 225mm/1,1,1,2)				
		3.00 - 4.00 3.00	B SPT (C)	N=8 (1,2/2,2,2,2)	3.00	138.59		Loose becoming medium dense brown gravelly fine to medium SAND. Gravels are subrounded fine to coarse sandstone and siltstone. (FLUVIOGLACIAL DEPOSITS)
		4.00 - 4.50 4.00	B SPT (C)	N=12 (2,2/2,3,3,4)				
		5.00 - 5.50 5.00	B SPT (C)	N=17 (2,2/3,4,5,5)				
					5.60	135.99		Medium dense brown clayey gravelly fine to medium SAND. Gravels are subangular to subrounded fine to coarse sandstone. (FLUVIOGLACIAL DEPOSITS)
		6.00 - 6.50 6.00	B SPT (C)	N=24 (1,2/4,4,6,10)				
		7.50 - 8.00 7.50	B SPT (C)	N=17 (2,3/4,4,5,4)				
		9.00 - 9.50 9.00	B SPT (C)	N=16 (7,6/5,4,3,4)				

Hole Diameter		Casing Diameter		Chiselling				Progress			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth of Hole	Depth Casing	Depth Water	Date
1.20 14.05	300 151	13.50	152								

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Cable Percussion Drilling Record

CP102

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324217.00 N365253.00
Project No. : 3455	Crew Name: Macklin Geotech	Drilling Equipment: Dando 2000

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
CP102	CP	141.59m AoD	AR	1:50	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Medium dense brown clayey gravelly fine to medium SAND. Gravels are subangular to subrounded fine to coarse sandstone. (FLUVIOGLACIAL DEPOSITS)
		10.50 - 11.00 10.50	B SPT (C)	N=30 (2,4/6,7,8,9)	10.50	131.09		Stiff brown sandy slightly gravelly CLAY. Gravels are subrounded fine to medium of sandstone, quartz and siltstone. (GLACIAL TILL)
		12.00 12.00 - 12.50	UT B		11.70	129.89		Vert stiff very thinly to thinly laminated brown silty CLAY. (GLACIAL TILL)
		13.50 - 14.00 13.50	B SPT()	50 (15 for 110mm/50 for 295mm)				
					14.05	127.54		End of Borehole at 14.050m

Hole Diameter		Casing Diameter		Chiselling				Progress			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth of Hole	Depth Casing	Depth Water	Date
1.20	300	13.50	152								
14.05	151										

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Cable Percussion Drilling Record

CP103

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 10/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324205.00 N365290.00
Project No. : 3455	Crew Name: Macklin Geotech	Drilling Equipment: Dando 2000

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
CP103	CP	142.18m AoD		1:50	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing		
		Depth (m)	Type	Results
		0.10	B	
		0.20 - 0.40	B	
		0.50 - 0.70	B	
		0.70 - 1.00	B	
		1.20 - 1.50	B	
		1.20	SPT (S)	N=11 (2,2/2,3,3,3)
		2.00 - 2.50	B	
		3.00 - 3.50	B	
		3.00	SPT (S)	N=8 (1,1/2,2,2,2)
		4.00	UT	
		4.00	UT	Ublow=90
		4.00 - 5.00	B	
		5.00	SPT (S)	N=13 (1,2/2,3,4,4)
		6.00	UT	
		6.00	UT	Ublow=50
		6.00 - 6.50	B	
		7.50 - 8.00	B	
		7.50	SPT (S)	50 (25 for 125mm/50 for 295mm)
		9.00	B	
		9.00 - 9.50	B	
		9.00	SPT (S)	N=10 (2,2/2,2,3,3)

Depth (m)	Level (m)	Legend	Stratum Description
0.20	141.98		Grass over soft brown slightly sandy slightly gravelly CLAY. Gravels are subrounded fine to coarse of mudstone and shale. (TOPSOIL)
1.00	141.18		Loose brown gravelly fine to medium SAND. Gravels are subrounded fine to coarse sandstone and siltstone. (MADE GROUND)
2.00	140.18		Medium dense brown slightly gravelly fine to medium SAND. Gravels are subangular fine to coarse of coal. (FLUVIOGLACIAL DEPOSITS)
4.00	138.18		Firm locally stiff brown sandy slightly gravelly CLAY. Gravels are subrounded fine of siltstone and occasional coal fragments. (FLUVIOGLACIAL DEPOSITS)
6.00	136.18		Firm brown slightly silty sandy slightly gravelly CLAY. Gravels are subangular to subrounded fine to coarse of sandstone. (FLUVIOGLACIAL DEPOSITS)
8.10	134.08		Medium strength brown slightly silty sandy slightly gravelly CLAY. Gravels are subangular to subrounded fine to coarse of sandstone. (FLUVIOGLACIAL DEPOSITS) *SPT refusal associated with assumed cobble.*
			Loose becoming medium dense brown slightly clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone. (FLUVIOGLACIAL DEPOSITS)

Hole Diameter		Casing Diameter		Chiselling				Progress			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth of Hole	Depth Casing	Depth Water	Date
1.20 13.87	300 152	13.50	152								

Remarks

12.00m UT 100 blows over 200mm. Hand pit excavated to 1.20m. No groundwater

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Cable Percussion Drilling Record

CP103

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 10/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324205.00 N365290.00
Project No. : 3455	Crew Name: Macklin Geotech	Drilling Equipment: Dando 2000

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
CP103	CP	142.18m AoD		1:50	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.50 - 11.00 10.50	B SPT (S)	 N=16 (2,2/3,4,4,5)				Loose becoming medium dense brown slightly clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone. (FLUVIOGLACIAL DEPOSITS)
					11.00	131.18		Stiff brown very sandy slightly gravelly CLAY. Gravels are subrounded fine to medium of sandstone, quartz and siltstone. (GLACIAL TILL)
		12.00 12.00 - 12.50	UT B	Ublow=100	12.00	130.18		Very stiff brown very sandy slightly gravelly cobbly CLAY. Gravels are subrounded fine to medium of sandstone, quartz and siltstone. Cobbles are subangular of sandstone. (GLACIAL TILL)
		13.50	SPT (S)	50 (8,12/50 for 295mm)				
					13.95	128.23		End of Borehole at 13.950m

Hole Diameter		Casing Diameter		Chiselling				Progress			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth of Hole	Depth Casing	Depth Water	Date
1.20	300	13.50	152								
13.87	152										

Remarks

12.00m UT 100 blows over 200mm. Hand pit excavated to 1.20m. No groundwater

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Cable Percussion Drilling Record

CP103b

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 09/02/2026 - 09/03/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324201.00 N365288.00
Project No. : 3455	Crew Name: Macklin Geotech	Drilling Equipment: Hand Tools

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
CP103b	CP	142.10m AoD	AR	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
▨					0.30	141.80	▨	Grass over soft brown slightly sandy slightly gravelly CLAY. Gravels are subrounded fine to coarse mudstone and shale. (TOPSOIL)
▨					0.69	141.41	▨	Soft brown slightly sandy gravelly CLAY with cobbles. Gravels are subangular fine to coarse of sandstone, mudstone and concrete. Cobbles are subangular of brick and concrete. (MADE GROUND)
					0.70	141.40		Concrete slab. (MADE GROUND)
								End of Borehole at 0.700m

Hole Diameter		Casing Diameter		Chiselling				Progress			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth of Hole	Depth Casing	Depth Water	Date

Remarks

Concrete slab encountered at 0.70m bgl.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

Windowless Sample Record

WS101

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324203.000 N365253.000
Project No. : 3455	Crew Name: D&I Drilling	Drilling Equipment: Archway Dart

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS101	WLS	141.78m AoD	AR	1:25	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Grass over soft brown slightly sandy slightly gravelly CLAY. Gravels are subrounded fine to coarse of mudstone and shale. (TOPSOIL)
					0.30	141.48		Dense grey silty slightly sandy slightly cobbly subangular fine to coarse GRAVEL of sandstone and concrete. Cobbles are subangular of concrete. (MADE GROUND)
		0.50	ES		0.35	141.43		Loose brown clayey gravelly fine to medium SAND. Gravels are subangular to subrounded fine to coarse sandstone. (FLUVIOGLACIAL DEPOSITS)
					0.90	140.88		Medium dense brown slightly gravelly fine to medium SAND. Gravels are subangular fine to coarse of coal. (FLUVIOGLACIAL DEPOSITS)
		1.20	SPT (C)	N=11 (2,2/2,3,3,3)				
					1.40	140.38		Loose dense brown silty fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)
		1.50	ES					
		2.00	SPT (C)	N=8 (2,2/2,2,2,2)				
		3.00 - 5.00 3.00	B SPT (C)	 N=9 (2,2/2,2,2,3)	3.00	138.78		Firm brown sandy CLAY (FLUVIOGLACIAL DEPOSITS)
		4.00	SPT (C)	N=10 (2,2/2,3,3,2)				

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.20	300										
2.00	101										
3.00	92										
4.00	78										
5.00	72										

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Windowless Sample Record

WS101

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324203.000 N365253.000
Project No. : 3455	Crew Name: D&I Drilling	Drilling Equipment: Archway Dart

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS101	WLS	141.78m AoD	AR	1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
▨		5.00	SPT (C)	N=8 (1,1/1,2,2,3)	5.45	136.33	▨	Firm brown sandy CLAY (FLUVIOGLACIAL DEPOSITS)
								End of Borehole at 5.450m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.20 2.00 3.00 4.00 5.00	300 101 92 78 72										

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Windowless Sample Record

WS102

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324193.000 N365248.000
Project No. : 3455	Crew Name: D&I Drilling	Drilling Equipment: Archway Dart

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS102	WLS	141.44m AoD	AR	1:25	Sheet 1 of 2

Sample and In Situ Testing

Depth (m)	Type	Results
0.10	ES	
0.45	ES	
0.80 - 1.20	B	
1.20	SPT (C)	N=11 (2,2/2,3,3,3)
2.00 - 4.00	B	
2.00	SPT (C)	N=8 (2,2/2,2,2,2)
3.00	SPT (C)	N=8 (2,2/2,2,2,2)
4.00	SPT (C)	N=10 (2,2/2,3,3,2)

Depth (m)	Level (m)	Stratum Description
		Grass over soft brown slightly sandy slightly gravelly CLAY. Gravels are subrounded fine to coarse of mudstone and shale. (TOPSOIL)
0.35	141.09	Dense grey silty slightly sandy slightly cobbly subangular fine to coarse GRAVEL of sandstone and concrete. Cobbles are subangular of concrete. (MADE GROUND)
0.40	141.04	Medium dense brown slightly clayey sandy subrounded fine to coarse GRAVEL of sandstone and siltstone. (FLUVIOGLACIAL DEPOSITS)
1.00	140.44	Medium dense brown slightly gravelly fine to medium SAND. Gravels are subangular fine to coarse of coal. (FLUVIOGLACIAL DEPOSITS)
1.20	140.24	Loose dense brown silty fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)

1
2
3
4
5

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.20	300										
2.00	92										
2.00	101										
3.00	78										
4.00	72										

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Windowless Sample Record

WS102

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324193.000 N365248.000
Project No. : 3455	Crew Name: D&I Drilling	Drilling Equipment: Archway Dart

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS102	WLS	141.44m AoD	AR	1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		5.00	SPT (C)	N=7 (1,1/1,2,2,2)	5.45	135.99		Loose dense brown silty fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)
								End of Borehole at 5.450m

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Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.20 2.00 2.00 3.00 4.00	300 92 101 78 72										

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd	Windowless Sample Record	WS103

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324202.000 N365264.000
Project No. : 3455	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS103	WLS	141.85m AoD		1:25	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	141.65		Grass over soft brown slightly sandy slightly gravelly CLAY. Gravels are subrounded fine to coarse of mudstone and shale. (TOPSOIL)
		0.50 0.50 - 0.70	ES B					Dense grey silty slightly sandy slightly cobbly subangular fine to coarse GRAVEL of sandstone and concrete. Cobbles are subangular of concrete and siltstone. (MADE GROUND)
					0.90	140.95		Loose brown clayey gravelly fine to medium SAND. Gravels are subangular to subrounded fine to coarse sandstone. (FLUVIOGLACIAL DEPOSITS)
		1.20 - 2.20 1.20	SPT (C)	N=7 (1,1/2,2,1,2)				
		2.00	SPT (C)	N=7 (1,2/2,2,2,1)				
					2.30	139.55		Loose brown slightly gravelly fine to medium SAND. Gravels are subangular fine to coarse of coal. (FLUVIOGLACIAL DEPOSITS)
					2.60	139.25		Loose brown silty fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)
		3.00	SPT (C)	N=9 (1,2/2,2,3,2)				
		4.00	SPT (C)	N=7 (1,1/1,2,2,2)				

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd	Windowless Sample Record	WS103

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324202.000 N365264.000
Project No. : 3455	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS103	WLS	141.85m AoD		1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		5.00	SPT (C)	N=7 (1,1/1,2,2,2)	5.45	136.40		Loose brown silty fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)
								End of Borehole at 5.450m

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Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Windowless Sample Record

WS104

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324224.000 N365277.000
Project No. : 3455	Crew Name: D&I Drilling	Drilling Equipment: Archway Dart

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS104	WLS	140.69m AoD	AR	1:25	Sheet 1 of 1

Sample and In Situ Testing

Depth (m)	Type	Results
0.10	ES	
0.60 - 1.00	B	
0.90	ES	
1.20	SPT (C)	N=8 (1,1/2,2,2,2)
1.50 - 2.50	B	
2.00	SPT (C)	N=10 (2,2/2,3,3,2)
3.00	SPT (C)	N=11 (2,2/2,3,3,3)
4.00	SPT (C)	N=10 (2,2/2,2,3,3)

Depth (m)	Level (m)	Stratum Description
		Grass over soft brown slightly sandy slightly gravelly CLAY. Gravels are subrounded fine to coarse of mudstone and shale. (TOPSOIL)
0.35	140.34	Dense grey silty slightly sandy slightly cobbly subangular fine to coarse GRAVEL of sandstone and concrete. Cobbles are subangular of concrete and siltstone. (MADE GROUND)
0.40	140.29	Soft becoming firm brownish grey sandy slightly gravelly CLAY. Gravels are subangular to subrounded fine to coarse of sandstone, siltstone and brick. (MADE GROUND)
2.60	138.09	Loose to medium dense brown silty fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)
4.45	136.24	End of Borehole at 4.450m

1
2
3
4
5

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.20 2.00 3.00 4.00	300 101 92 78										

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

GroundSolve Ltd

Windowless Sample Record

WS105

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324175.000 N365239.000
Project No. : 3455	Crew Name: D&I Drilling	Drilling Equipment: Archway Dart

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS105	WLS	140.10m AoD	AR	1:25	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.15	ES					Grass over soft brown slightly sandy slightly gravelly CLAY. Gravels are subrounded fine to coarse of mudstone and shale. (TOPSOIL)
					0.40	139.70		Loose brown slightly clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone. (FLUVIOGLACIAL DEPOSITS)
		0.70	ES					
		1.20	SPT (C)	N=9 (1,2/2,2,3,2)				
		1.40 - 2.60	B		1.40	138.70		Loose brown silty fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)
		2.00	SPT (C)	N=8 (2,2/2,2,2,2)				
					2.60	137.50		Medium dense brown slightly gravelly fine to medium SAND. Gravels are subangular fine to coarse of coal. (FLUVIOGLACIAL DEPOSITS)
		3.00	SPT (C)	N=14 (2,3/3,4,4,3)				
					3.60	136.50		Loose brown silty fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)
		4.00	SPT (C)	N=9 (2,2/2,3,2,2)				

1
2
3
4
5

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.20	300										
2.00	92										
3.00	78										
4.00	72										
5.00	62										

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd	Windowless Sample Record	WS105

Project Name: Joint Archive Building - Theatre Clywd, Mold	Client: Wynne Construction	Date: 04/02/2026
Location: Raikes Ln, Mold CH7 1YA	Contractor: Groundsolve Ltd	Co-ords: E324175.000 N365239.000
Project No. : 3455	Crew Name: D&I Drilling	Drilling Equipment: Archway Dart

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS105	WLS	140.10m AoD	AR	1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
▨		5.00	SPT (C)	N=7 (1,2/2,1,2,2)	5.45	134.65	▨	Loose brown silty fine to medium SAND. (FLUVIOGLACIAL DEPOSITS)
								End of Borehole at 5.450m

6

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Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.20	300										
2.00	92										
3.00	78										
4.00	72										
5.00	62										

Remarks

Hand pit excavated to 1.20m. No groundwater.

GroundSolve Ltd
Unit 1, 85 Station Road,
Queensferry,
CH5 2TB

APPENDIX G: IN SITU TESTING CBR / FALLING HEAD PERMEABILITY RESULTS

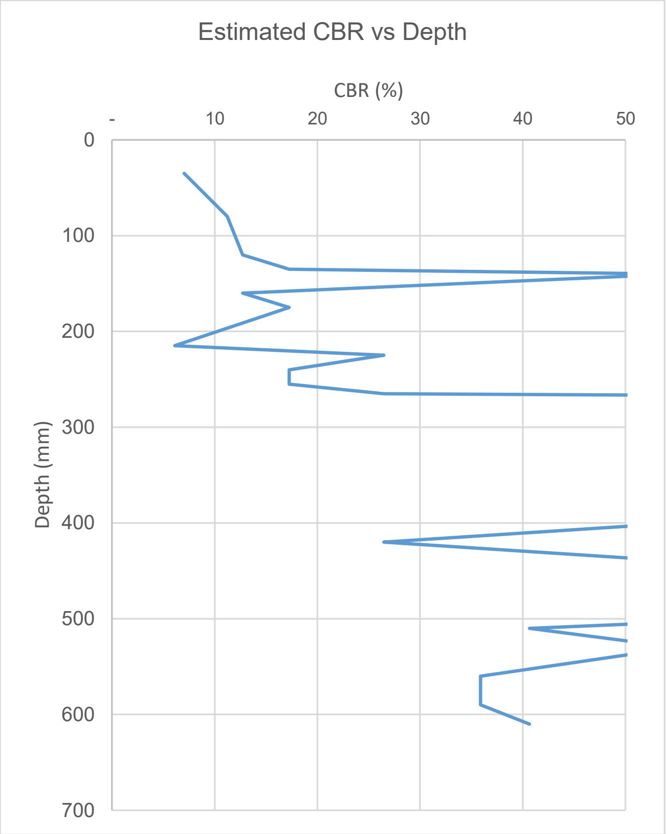
IN SITU CBR (TRRL DCP)

GroundSolve Ltd

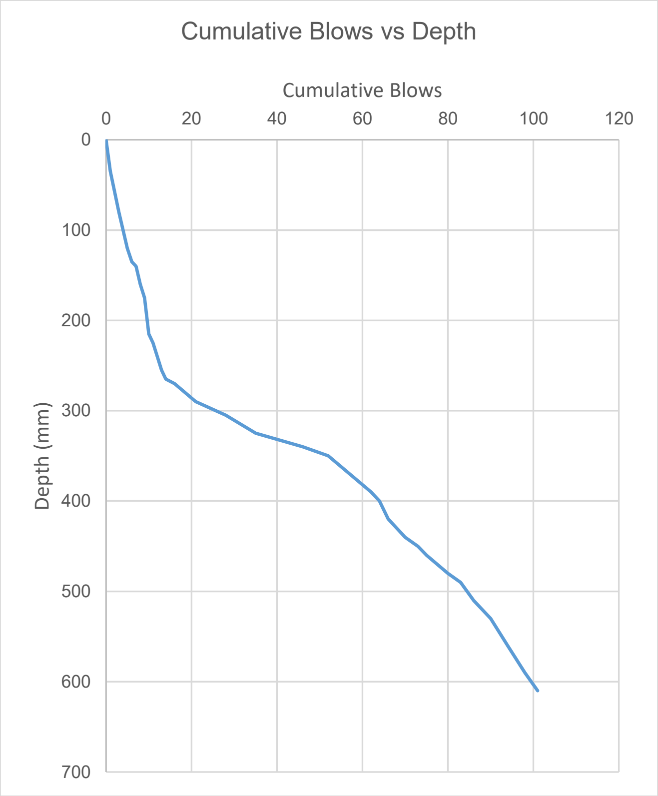
Operator:	Date:	Weather:		Remarks:	Location:	
AR	04/02/2026	Overcast			mE:	324192
					mN:	365277
Chkd by:	Start depth:	Surface layer:	Zero reading (mm):	Termination reason:	mAOD:	-
JT	0.01	Topsoil	100	Refusal	Grid:	OSGB

Depth to top of increment:	Cumulative blows:	Cumulative pen (mm):	Increment blows:	Increment pen (mm):	mm per blow:	Layer CBR (%)
100	0	0	0	0		
135	1	35	1	35	35.0	7
180	3	80	2	45	22.5	11
220	5	120	2	40	20.0	13
235	6	135	1	15	15.0	17
240	7	140	1	5	5.0	55
260	8	160	1	20	20.0	13
275	9	175	1	15	15.0	17
315	10	215	1	40	40.0	6
325	11	225	1	10	10.0	26
340	12	240	1	15	15.0	17
355	13	255	1	15	15.0	17
365	14	265	1	10	10.0	26
370	16	270	2	5	2.5	>100
390	21	290	5	20	4.0	>100
405	28	305	7	15	2.1	70
425	35	325	7	20	2.9	>100
440	46	340	11	15	1.4	100
450	52	350	6	10	1.7	>100
490	62	390	10	40	4.0	>100
500	64	400	2	10	5.0	70
520	66	420	2	20	10.0	55
540	70	440	4	20	5.0	26
550	73	450	3	10	3.3	55
560	75	460	2	10	5.0	85
580	80	480	5	20	4.0	55
590	83	490	3	10	3.3	70
610	86	510	3	20	6.7	85
630	90	530	4	20	5.0	41
660	94	560	4	30	7.5	55
690	98	590	4	30	7.5	36
710	101	610	3	20	6.7	36
740	0	640	5	30	6.0	41
740	0	640	25	0	-	-

Layer	Estimated CBR %	Layer Depth (mm)		
1	8	0	265	
2	15	265	740	
3				
4				



Estimated CBR vs Depth



Cumulative Blows vs Depth

AGS

Notes: For explanation of symbols and abbreviations see Key Sheet.
All depths in meters.

Issue: FINAL

Project: Joint Archive Building
Project No: 3455
Client: Wynne Construction

Test reference:

DCP01

IN SITU CBR (TRRL DCP)

GroundSolve Ltd

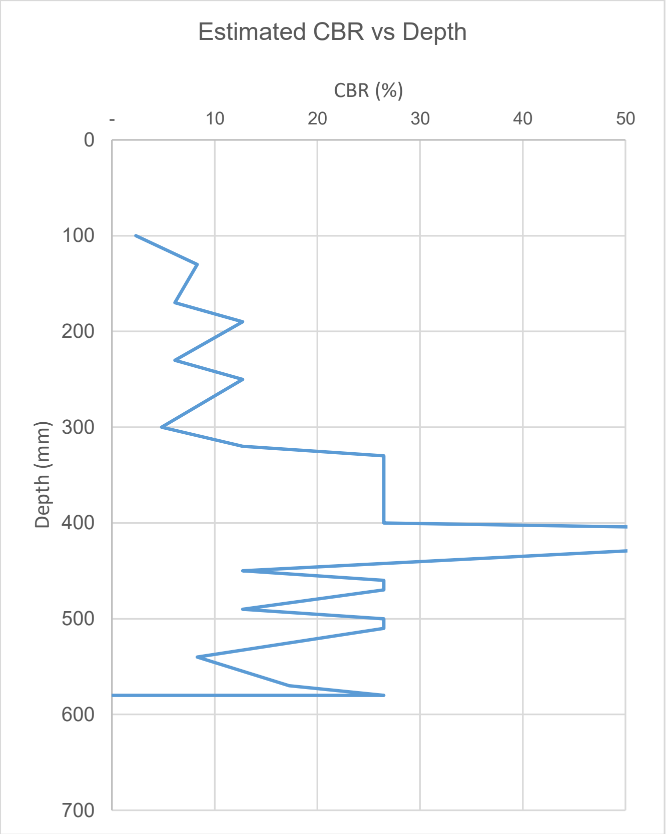
Operator:	Date:	Weather:	Remarks:	Location:
AR	04/02/2026	Overcast		mE: 324198
				mN: 365291
Chkd by:	Start depth:	Surface layer:	Zero reading (mm):	mAOD: -
JT	0.01	Topsoil	60	

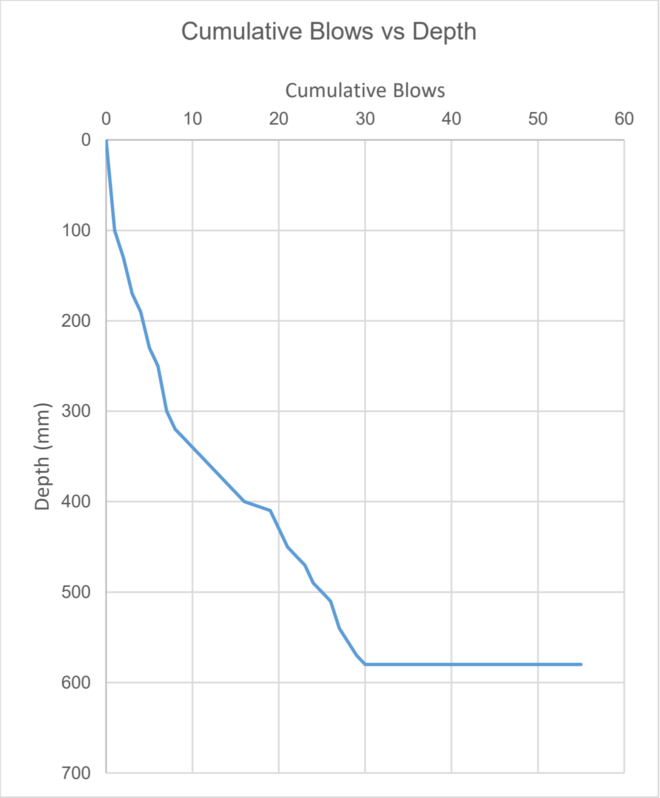
Termination reason: Refusal

Grid: OSGB

Depth to top of increment:	Cumulative blows:	Cumulative pen (mm):	Increment blows:	Increment pen (mm):	mm per blow:	Layer CBR (%)
60	0	0	0	0		
160	1	100	1	100	100.0	2
190	2	130	1	30	30.0	8
230	3	170	1	40	40.0	6
250	4	190	1	20	20.0	13
290	5	230	1	40	40.0	6
310	6	250	1	20	20.0	13
360	7	300	1	50	50.0	5
380	8	320	1	20	20.0	13
390	9	330	1	10	10.0	26
400	10	340	1	10	10.0	26
410	11	350	1	10	10.0	26
420	12	360	1	10	10.0	26
440	14	380	2	20	10.0	26
460	16	400	2	20	10.0	26
470	19	410	3	10	3.3	26
510	21	450	2	40	20.0	85
520	22	460	1	10	10.0	13
530	23	470	1	10	10.0	26
550	24	490	1	20	20.0	26
560	25	500	1	10	10.0	13
570	26	510	1	10	10.0	26
600	27	540	1	30	30.0	26
630	29	570	2	30	15.0	8
640	30	580	1	10	10.0	17
640	55	580	25	0	-	26

Layer	Estimated CBR %	Layer Depth (mm)	
1	5	0	300
2	20	300	340
3	20	340	580





AGS

Notes: For explanation of symbols and abbreviations see Key Sheet.
All depths in meters.

Issue: FINAL

Project: Joint Archive Building
Project No: 3455
Client: Wynne Construction

Test reference:

DCP02

Falling Head Permeability Test Results

GroundSolve Ltd
Consulting Geotechnical Engineers

Date:	21.04.2026
Test no:	1
Carried out by:	CMcS
Ground level: (m OD)	141.85
Test type:	Falling
Cavity type:	Cylindrical

Static water level (m)	4.70
Internal diameter *(D)* (m)	0.05
Length of standpipe below ground level (m)	4.92
Height of water above ground level (m)	0.00
Length of standpipe above ground level (m)	0.00
Water level at start of test (m)	0.00
Top of response zone (m)	1.00
Bottom of response zone (m)	4.92

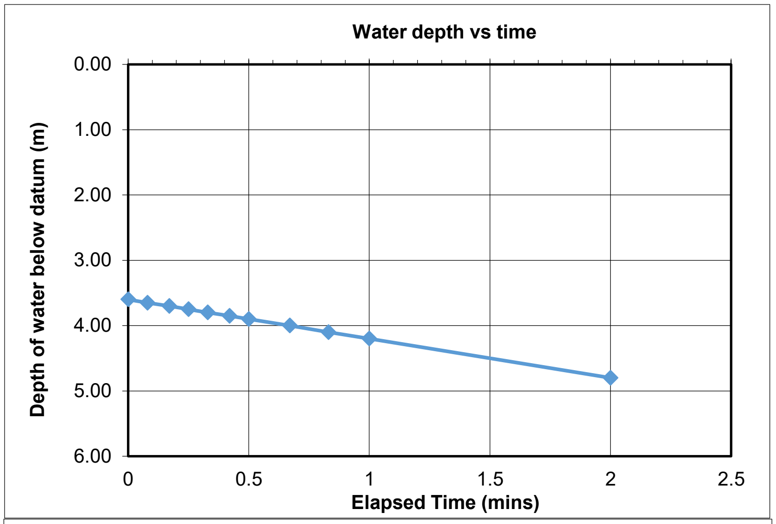
Time (t_0)	0	mins
Time (t)	2	mins

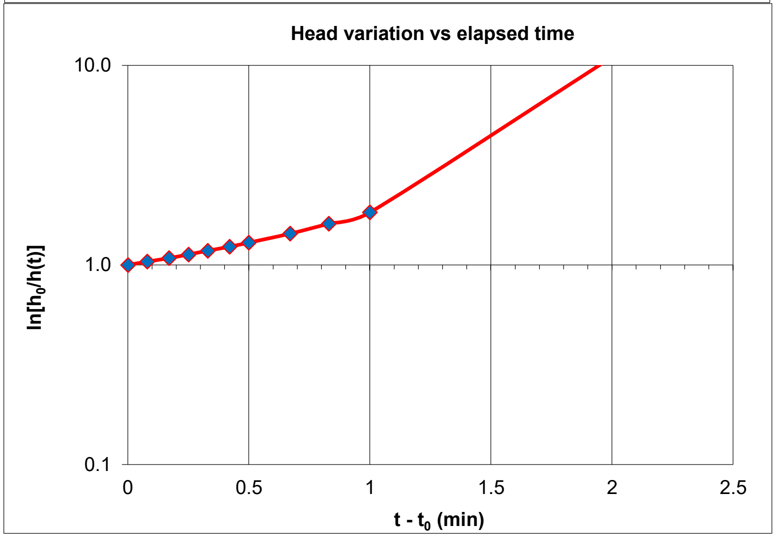
Head of water

Initial head (h_0) at (t_0)	1.32	m
Final head (h(t)) at (t)	0.12	m
Length of response zone *(L)*	3.92	m
Cross sectional area *(S)*	0.002	m^2

Strata description at test depth:	See log for full details

Elapsed time (mins)	Water below datum	Head of water
0	3.60	1.32
0.08	3.65	1.27
0.17	3.70	1.22
0.25	3.75	1.17
0.33	3.80	1.12
0.42	3.85	1.07
0.5	3.90	1.02
0.67	4.00	0.92
0.83	4.10	0.82
1	4.20	0.72
2	4.80	0.12





L/D = 78.40

Shape Factor (F) calculated according to ISO 22282-1:2012

F = 4.87

Equation for borehole permeability tests after BS EN ISO 22282-2:2012

$$k = \frac{S \ln\left({}^{h_0}/_{h(t)}\right)}{F(t - t_0)}$$

k = 8.05E-06 m/s

Calculated by:	CMcS
Checked by:	ER
Issue:	FINAL

Project:	Theatre Clwyd
Project No:	3455
Client:	Wynne Construction

Exploratory position reference:

WS103

Falling Head Permeability Test Results

GroundSolve Ltd
Consulting Geotechnical Engineers

Date:	21.04.2026
Test no:	1
Carried out by:	CMcS
Ground level: (m OD)	140.69
Test type:	Falling
Cavity type:	Cylindrical

Static water level (m)	1.57
Internal diameter *(D)* (m)	0.05
Length of standpipe below ground level (m)	3.92
Height of water above ground level (m)	0.00
Length of standpipe above ground level (m)	0.00
Water level at start of test (m)	0.00
Top of response zone (m)	1.00
Bottom of response zone (m)	3.92

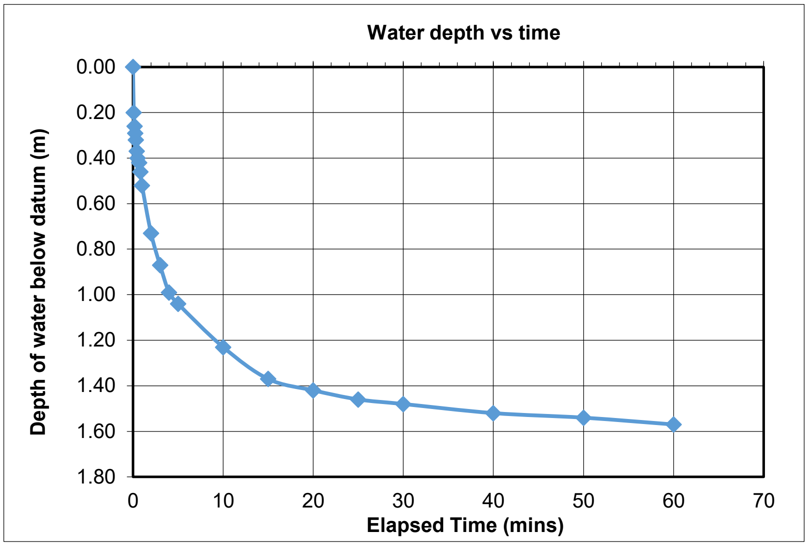
Time (t_0)	0	mins
Time (t)	60	mins

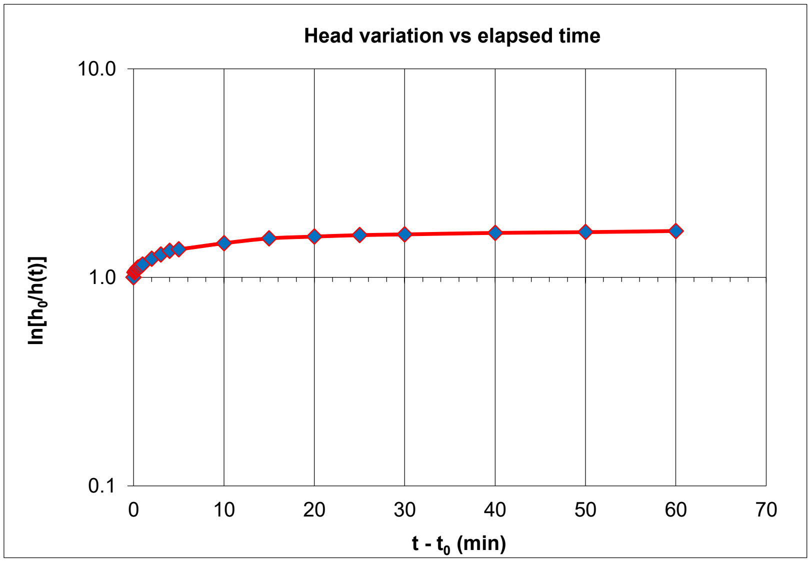
Head of water

Initial head (h_0) at (t_0)	3.92	m
Final head (h(t)) at (t)	2.35	m
Length of response zone *(L)*	2.92	m
Cross sectional area *(S)*	0.002	m^2

Strata description at test depth:	See log for full details

Elapsed time (mins)	Water below datum	Head of water
0	0.00	3.92
0.08	0.20	3.72
0.17	0.26	3.66
0.25	0.29	3.63
0.33	0.32	3.60
0.42	0.37	3.55
0.5	0.40	3.52
0.67	0.42	3.50
0.83	0.46	3.46
1	0.52	3.40
2	0.73	3.19
3	0.87	3.05
4	0.99	2.93
5	1.04	2.88
10	1.23	2.69
15	1.37	2.55
20	1.42	2.50
25	1.46	2.46
30	1.48	2.44
40	1.52	2.40
50	1.54	2.38
60	1.57	2.35





L/D = 58.40

Shape Factor (F) calculated according to ISO 22282-1:2012

F = 3.85

Equation for borehole permeability tests after BS EN ISO 22282-2:2012

$$k = \frac{S \ln\left({h_0}/{h(t)} \right)}{F(t - t_0)}$$

k = 7.24E-08 m/s

Calculated by:	CMcS	Project:	Theare Clwyd	Exploratory position reference:
Checked by:	ER	Project No:	3455	**WS104**
Issue:	FINAL	Client:	Wynne Construction	

APPENDIX H: CHEMICAL RESULTS

ANALYTICAL TEST REPORT

Report Number 26-01453, issue number 1

Contract name: Joint Archive Building-Theatre Clwyd

Client reference: 3455

Clients name: GroundSolve Ltd

Clients address:
GroundSolve Ltd
Unit 1
85 Station Road
Queensferry
Flintshire CH5 2TB

Samples received: 09/02/2026

Analysis started: 09/02/2026

Analysis completed: 16/02/2026

Report issued: 16/02/2026

Key

U	UKAS accredited test
M	MCERTS & UKAS accredited test
(B)	Analysis performed at Southampton Site
I/S	Insufficient sample to carry out test
U/S	Sample not suitable for testing
NAD	No Asbestos Detected

Full key available on Information page

ANeasham-Bourn

Approved by:
Abbie Neasham-Bourn
Senior Reporting Administrator

Unit 6 Parkhead, Greencroft Industrial Park, Stanley, County Durham, DH9 7YB

Telephone: (01207) 528578, Email supportsquad@chemtech-env.co.uk

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.
% Moisture reported as MCERTS drying at 30°C

Lab ref	Sample ID	Depth (m)	Sample description	Material removed	% Removed	% Moisture
88268	CP101	0.2	Brown Sandy Loamy Clay with Gravel and Vegetation.	-	-	13.3
88269	CP101	0.8	-	-	-	-
88270	WS101	0.5	Brown Sandy Loamy Clay with Gravel.	-	-	11.2
88271	WS101	1.5	Red Clayey Sand with Gravel.	-	-	8.4
88272	WS102	0.1	Brown Sandy Clayey Loam with Gravel.	-	-	9.6
88273	WS102	0.45	-	-	-	-
88274	WS103	0.5	Brown Sandy Clayey Loam with Gravel.	-	-	8.7
88275	WS104	0.9	Brown Sandy Clayey Loam with Gravel and Vegetation.	-	-	18.7
88276	WS104	0.1	-	-	-	-
88277	WS105	0.7	-	-	-	-
88278	WS105	0.15	Brown Sandy Clayey Loam with Gravel and Vegetation.	-	-	12.3

SOILS

Lab Number					88268	88270	88271	88272	88274
Client Reference					ES	ES	ES	ES	ES
Sample ID					CP101	WS101	WS101	WS102	WS103
Depth (m)					0.2	0.5	1.5	0.1	0.5
Sampling Date					09/02/2026	09/02/2026	09/02/2026	09/02/2026	09/02/2026
Test	**Method**	**Accred**	**LoD**	**Units**					
Asbestos									
Asbestos Identification	SUBCON	SU	0	-	NAD	NAD	NAD	NAD	NAD
Soil sample preparation parameters									
Stones Content	CE001	N	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Metals									
Water Soluble Sulphate	CE061	M	0.01	g/l	0.170	0.036	0.031	0.026	0.030
Acid Soluble Sulphate (SO4)	CE062	M	0.01	%	0.05	0.02	0.01	0.12	0.07
Arsenic	CE264	U	1.8	mg/kg	8.2	9.1	4.6	7.3	7.5
Cadmium	CE264	M	1.6	mg/kg	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6
Chromium	CE264	U	2	mg/kg	16.6	20.6	8.8	11.7	9.5
Copper	CE264	U	1.6	mg/kg	16.6	17.6	11.5	11.6	8.8
Lead	CE264	U	2.3	mg/kg	36.3	31.2	10.5	104	51.3
Mercury	CE264	U	0.7	mg/kg	< 0.7	< 0.7	< 0.7	< 0.7	1.3
Nickel	CE264	M	2.1	mg/kg	20.5	25.9	8.8	7.1	7.2
Selenium	CE264	U	3	mg/kg	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Zinc	CE264	M	4	mg/kg	63.5	65.2	25.2	114	51.2
Colourimetric									
Total Monohydric Phenols	CE078	N	0.5	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Cyanide	CE077	N	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Combustion									
Moisture Content	CE001	N	0.1	%	13.3	11.2	8.4	9.6	8.7
Total Organic Carbon	CE197	M	0.1	%	1.02	0.73	0.72	1.67	1.84
Soil Organic Matter	CE192	N	0.1	%	1.76	1.26	1.24	2.88	3.17
Polyaromatic hydrocarbons									
Naphthalene	CE087	M	0.016	mg/kg	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Acenaphthylene	CE087	M	0.015	mg/kg	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Acenaphthene	CE087	M	0.013	mg/kg	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
Fluorene	CE087	U	0.013	mg/kg	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
Phenanthrene	CE087	M	0.014	mg/kg	< 0.014	< 0.014	< 0.014	0.024	0.022
Anthracene	CE087	U	0.017	mg/kg	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017
Fluoranthene	CE087	M	0.017	mg/kg	0.020	< 0.017	< 0.017	0.023	0.024

SOILS

Lab Number					88268	88270	88271	88272	88274
Client Reference					ES	ES	ES	ES	ES
Sample ID					CP101	WS101	WS101	WS102	WS103
Depth (m)					0.2	0.5	1.5	0.1	0.5
Sampling Date					09/02/2026	09/02/2026	09/02/2026	09/02/2026	09/02/2026
Test	**Method**	**Accred**	**LoD**	**Units**					
Pyrene	CE087	M	0.016	mg/kg	0.019	< 0.016	< 0.016	0.022	0.025
Benzo(a)anthracene	CE087	U	0.012	mg/kg	< 0.012	< 0.012	< 0.012	0.016	0.018
Chrysene	CE087	M	0.028	mg/kg	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
Benzo(b)fluoranthene	CE087	M	0.02	mg/kg	< 0.020	< 0.020	< 0.020	0.022	0.020
Benzo(k)fluoranthene	CE087	M	0.025	mg/kg	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
Benzo(a)pyrene	CE087	U	0.019	mg/kg	< 0.019	< 0.019	< 0.019	< 0.019	< 0.019
Indeno(1,2,3-cd)pyrene	CE087	M	0.019	mg/kg	< 0.019	< 0.019	< 0.019	< 0.019	< 0.019
Dibenzo(a,h)anthracene	CE087	M	0.017	mg/kg	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017
Benzo(g,h,i)perylene	CE087	M	0.019	mg/kg	< 0.019	< 0.019	< 0.019	< 0.019	0.021
Coronene	CE087	N	0.02	mg/kg	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Total PAH(17)	CE087	N	0.3	mg/kg	< 0.300	< 0.300	< 0.300	< 0.300	< 0.300
BTEX									
Benzene	CE267	U	0.001	mg/kg	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	CE267	U	0.001	mg/kg	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Ethylbenzene	CE267	U	0.001	mg/kg	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
MTBE	CE267	N	0.002	mg/kg	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Total BTEX	CE267	N	0.007	mg/kg	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
m,p-Xylene	CE267	U	0.002	mg/kg	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
oXylenes	CE267	U	0.002	mg/kg	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Total Petroleum Hydrocarbons									
>C5-C6 Aliphatic (HS_1D_AL)	CE267	N	0.1	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
>C6-C8 Aliphatic (HS_1D_AL)	CE267	N	0.1	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
>C8-C10 Aliphatic (HS_1D_AL)	CE267	N	0.1	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
>C10-C12 Aliphatic (EH_2D_AL)	CE250	N	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C12-C16 Aliphatic (EH_2D_AL)	CE250	N	0.5	mg/kg	0.5	0.6	< 0.5	0.6	< 0.5
>C16-C21 Aliphatic (EH_2D_AL)	CE250	N	0.7	mg/kg	0.8	1.8	< 0.7	1.0	0.7
>C21-C35 Aliphatic (EH_2D_AL)	CE250	N	4	mg/kg	4.7	8.0	< 4.0	6.0	< 4.0
>C35-C40 Aliphatic (EH_2D_AL)	CE250	N	0.5	mg/kg	< 0.5	< 0.5	< 0.5	0.7	< 0.5
>C5-C7 Aromatic (HS_1D_AR)	CE267	N	0.01	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
>C7-C8 Aromatic (HS_1D_AR)	CE267	N	0.01	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
>C8-C10 Aromatic (HS_1D_AR)	CE267	N	0.01	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010

SOILS

Lab Number					88268	88270	88271	88272	88274
Client Reference					ES	ES	ES	ES	ES
Sample ID					CP101	WS101	WS101	WS102	WS103
Depth (m)					0.2	0.5	1.5	0.1	0.5
Sampling Date					09/02/2026	09/02/2026	09/02/2026	09/02/2026	09/02/2026
Test	**Method**	**Accred**	**LoD**	**Units**					
>C10-C12 Aromatic (EH_2D_AR)	CE250	N	0.6	mg/kg	2.6	2.6	1.9	2.4	1.9
>C12-C16 Aromatic (EH_2D_AR)	CE250	N	1	mg/kg	6.7	7.1	5.0	6.7	5.0
>C16-C21 Aromatic (EH_2D_AR)	CE250	N	2	mg/kg	3.4	3.4	2.3	3.5	2.5
>C21-C35 Aromatic (EH_2D_AR)	CE250	N	4.5	mg/kg	21.6	22.2	12.6	20.6	13.2
>C35-C40 Aromatic (EH_2D_AR)	CE250	N	1.5	mg/kg	4.8	4.5	2.9	5.0	3.4
>C10-C40 Soil (EH_1D_Total)	CE033	M	19	mg/kg	22.0	19.8	< 19.0	71.3	41.6
Diesel Range Organics (>C10-C25) (EH_1D_Total)	CE033	M	12	mg/kg	< 12	< 12	< 12	< 12	< 12
Mineral Oil (>C10-C40 Total) (EH_CU_1D_Total)	CE162	N	19	mg/kg	22	26	< 19	68	37
Wet Chem									
pH	CE004	M	0.1	pH units	6.9	8.4	8.2	8.4	8.1

SOILS

Lab Number					88275	88278
Client Reference					ES	ES
Sample ID					WS104	WS105
Depth (m)					0.9	0.15
Sampling Date					09/02/2026	09/02/2026
Test	**Method**	**Accred**	**LoD**	**Units**		
Asbestos						
Asbestos Identification	SUBCON	SU	0	-	NAD	NAD
Soil sample preparation parameters						
Stones Content	CE001	N	0.1	%	< 0.1	< 0.1
Metals						
Water Soluble Sulphate	CE061	M	0.01	g/l	0.022	0.011
Acid Soluble Sulphate (SO4)	CE062	M	0.01	%	0.05	0.02
Arsenic	CE264	U	1.8	mg/kg	10.2	11.0
Cadmium	CE264	M	1.6	mg/kg	< 1.6	< 1.6
Chromium	CE264	U	2	mg/kg	16.7	18.0
Copper	CE264	U	1.6	mg/kg	16.7	17.2
Lead	CE264	U	2.3	mg/kg	159	85.7
Mercury	CE264	U	0.7	mg/kg	< 0.7	< 0.7
Nickel	CE264	M	2.1	mg/kg	12.3	15.2
Selenium	CE264	U	3	mg/kg	< 3.0	< 3.0
Zinc	CE264	M	4	mg/kg	114	92.9
Colourimetric						
Total Monohydric Phenols	CE078	N	0.5	mg/kg	1.19	< 0.50
Total Cyanide	CE077	N	1	mg/kg	< 1.0	< 1.0
Combustion						
Moisture Content	CE001	N	0.1	%	18.7	12.3
Total Organic Carbon	CE197	M	0.1	%	4.37	1.65
Soil Organic Matter	CE192	N	0.1	%	7.53	2.84
Polyaromatic hydrocarbons						
Naphthalene	CE087	M	0.016	mg/kg	< 0.016	< 0.016
Acenaphthylene	CE087	M	0.015	mg/kg	< 0.015	< 0.015
Acenaphthene	CE087	M	0.013	mg/kg	< 0.013	< 0.013
Fluorene	CE087	U	0.013	mg/kg	< 0.013	< 0.013
Phenanthrene	CE087	M	0.014	mg/kg	0.032	< 0.014
Anthracene	CE087	U	0.017	mg/kg	< 0.017	< 0.017
Fluoranthene	CE087	M	0.017	mg/kg	0.071	0.031

SOILS

Lab Number					88275	88278
Client Reference					ES	ES
Sample ID					WS104	WS105
Depth (m)					0.9	0.15
Sampling Date					09/02/2026	09/02/2026
Test	**Method**	**Accred**	**LoD**	**Units**		
Pyrene	CE087	M	0.016	mg/kg	0.080	0.031
Benzo(a)anthracene	CE087	U	0.012	mg/kg	0.053	0.032
Chrysene	CE087	M	0.028	mg/kg	0.047	< 0.028
Benzo(b)fluoranthene	CE087	M	0.02	mg/kg	0.070	0.036
Benzo(k)fluoranthene	CE087	M	0.025	mg/kg	< 0.025	< 0.025
Benzo(a)pyrene	CE087	U	0.019	mg/kg	0.061	0.034
Indeno(1,2,3-cd)pyrene	CE087	M	0.019	mg/kg	0.052	0.032
Dibenzo(a,h)anthracene	CE087	M	0.017	mg/kg	< 0.017	< 0.017
Benzo(g,h,i)perylene	CE087	M	0.019	mg/kg	0.045	0.028
Coronene	CE087	N	0.02	mg/kg	< 0.020	< 0.020
Total PAH(17)	CE087	N	0.3	mg/kg	0.512	< 0.300
BTEX						
Benzene	CE267	U	0.001	mg/kg	< 0.001	< 0.001
Toluene	CE267	U	0.001	mg/kg	< 0.001	< 0.001
Ethylbenzene	CE267	U	0.001	mg/kg	< 0.001	< 0.001
MTBE	CE267	N	0.002	mg/kg	< 0.002	< 0.002
Total BTEX	CE267	N	0.007	mg/kg	< 0.007	< 0.007
m,p-Xylene	CE267	U	0.002	mg/kg	< 0.002	< 0.002
oXylenes	CE267	U	0.002	mg/kg	< 0.002	< 0.002
Total Petroleum Hydrocarbons						
>C5-C6 Aliphatic (HS_1D_AL)	CE267	N	0.1	mg/kg	< 0.10	< 0.10
>C6-C8 Aliphatic (HS_1D_AL)	CE267	N	0.1	mg/kg	< 0.10	< 0.10
>C8-C10 Aliphatic (HS_1D_AL)	CE267	N	0.1	mg/kg	< 0.10	< 0.10
>C10-C12 Aliphatic (EH_2D_AL)	CE250	N	1	mg/kg	< 1.0	< 1.0
>C12-C16 Aliphatic (EH_2D_AL)	CE250	N	0.5	mg/kg	0.5	< 0.5
>C16-C21 Aliphatic (EH_2D_AL)	CE250	N	0.7	mg/kg	< 0.7	0.8
>C21-C35 Aliphatic (EH_2D_AL)	CE250	N	4	mg/kg	< 4.0	< 4.0
>C35-C40 Aliphatic (EH_2D_AL)	CE250	N	0.5	mg/kg	< 0.5	< 0.5
>C5-C7 Aromatic (HS_1D_AR)	CE267	N	0.01	mg/kg	< 0.010	< 0.010
>C7-C8 Aromatic (HS_1D_AR)	CE267	N	0.01	mg/kg	< 0.010	< 0.010
>C8-C10 Aromatic (HS_1D_AR)	CE267	N	0.01	mg/kg	< 0.010	< 0.010

SOILS

Lab Number					88275	88278
Client Reference					ES	ES
Sample ID					WS104	WS105
Depth (m)					0.9	0.15
Sampling Date					09/02/2026	09/02/2026
Test	**Method**	**Accred**	**LoD**	**Units**		
>C10-C12 Aromatic (EH_2D_AR)	CE250	N	0.6	mg/kg	2.1	1.9
>C12-C16 Aromatic (EH_2D_AR)	CE250	N	1	mg/kg	5.6	4.9
>C16-C21 Aromatic (EH_2D_AR)	CE250	N	2	mg/kg	2.8	2.8
>C21-C35 Aromatic (EH_2D_AR)	CE250	N	4.5	mg/kg	14.2	12.5
>C35-C40 Aromatic (EH_2D_AR)	CE250	N	1.5	mg/kg	3.6	3.3
>C10-C40 Soil (EH_1D_Total)	CE033	M	19	mg/kg	28.4	97.7
Diesel Range Organics (>C10-C25) (EH_1D_Total)	CE033	M	12	mg/kg	< 12	15
Mineral Oil (>C10-C40 Total) (EH_CU_1D_Total)	CE162	N	19	mg/kg	47	53
Wet Chem						
pH	CE004	M	0.1	pH units	7.2	8.2

METHOD DETAILS

METHOD	TESTNAME	METHOD SUMMARY	ANALYSIS BASIS
CE267	VPH in Soil	HS-GCFID	As submitted sample
CE250	GCXGC in Soil	DCM Extraction and GCxGC-FID	As submitted sample
SUBCON	Asbestos Soil	HSG248	Air Dried Sample
CE061	W. Sol Metals	ICPOES	Air dried sample
CE033	EPH in Soil	Acetone:Hexane Extraction and GCFID	As submitted sample
CE062	Acid Soluble Sulphate in Soils	HCl Extract and ICPOES	Air dried sample
CE264	Metals by ICP in Soil	ICPOES	Air dried sample
CE267	BTEX in Soils	Analysis by HSGCFID	As submitted sample
CE087	PAH in Soil	DCM Extraction and GCMS	As submitted sample
CE078	Phenols in Soil	Continuous Flow Analyser	As submitted sample
CE077	Cyanides in Soils	Continuous Flow Analyser	As submitted sample
CE197	TOC In Soil	PRIMACS Combustion Analyser	Air dried sample
CE162	Mineral Oil in Soil	Acetone:Hexane extract, Floriil clean up and GCFID	As submitted sample

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

a	Sampling date not provided
b	Sampling time not provided (waters only)
c	Sample not received in appropriate containers
d	Storage Temperature
e	Headspace present in sample container
f	Sample exceeded sampling to receipt
g	Sample exceeded holding time(s)

Lab ref	Sample ID	Depth (m)	Deviating	Tests (Reason for deviation)
88268	CP101	0.2	N	
88270	WS101	0.5	N	
88271	WS101	1.5	N	
88272	WS102	0.1	N	
88274	WS103	0.5	N	
88275	WS104	0.9	N	
88278	WS105	0.15	N	

REPORT INFORMATION

Report No.:26-01453, issue number 1

Key

U	ISO17025 Accredited Result
M	ISO17025 and MCERTS Accredited Result
N	Do not currently hold accreditation
^	MCERTS accreditation not applicable for sample matrix
*	ISO17025 accreditation not applicable for sample matrix
S	Subcontracted
I/S	Insufficient Sample
U/S	Unsuitable sample
N/T	Not tested
<	Means "less than"
>	Means "greater than"

LOD refers to limit of detection, except in the case of pH soils and pH waters where it means limit of discrimination.

This report shall not be reproduced except in full, without prior written approval.

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

The results relate only to the sample received.

Unless otherwise stated, sample information has been provided by the client. This may affect the validity of the results.

Moisture Content Calculated on a Wet Weight basis (at 30°C)

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

Where sampling was undertaken by Chemtech Environmental Limited it is outside the UKAS accreditation scope.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

BTEX compounds are identified by retention time only and may include interference from co-eluting compounds.

For soils and solids, all results are reported on a dry basis (30°C). Samples dried at no more than 30°C in a drying cabinet.

For soils and solids, analytical results are inclusive of stones and 'inert' material, where applicable.

'Client Reference', 'Sample ID', 'Sample Location', 'Sample Type', 'Depth', 'Sample Date' and 'Sample Time' information is provided by the customer

Sample Retention and Disposal

All soil samples will be retained for a period of 4 weeks from the point of receipt
All water samples will be retained for a period of 2 weeks from the point of Reporting
Charges may apply to extended sample storage

TPH Classification - HWOL Acronym System

HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
2D	GC-GC - Double coil gas chromatography
#1	EH_Total but with humics mathematically subtracted
#2	EH_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry

Unless specifically identified (noted as "(B)" in analyte name) all internal analysis performed at Durham site

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APPENDIX I: GEOTECHNICAL RESULTS

LABORATORY REPORT

Contract Number: PSL26/1673

Report Date:	26 March 2026
Client's Reference:	
Client Name:	Groundsolve Ltd Unit 1 Well House Barns Chester Road Bretton Flintshire CH4 0DH
For the attention of:	**James Thorburn**
Contract Title:	Theatre Clwyd, Mold
Date Received:	26/02/2026
Date Commenced:	26/02/2026
Date Completed:	26/03/2026
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)	S Eyre (Senior Technician)	D Nicholson (Senior Technician)

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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
CP101		B	2.00		Brown silty gravelly SAND.
CP101		UT	9.00		Firm brown very clayey very gravelly SAND.
CP101		UT	12.00		Brown sandy slightly gravelly CLAY.
CP102		B	1.20		Brown slightly sandy slightly gravelly CLAY.
CP102		B	7.50		Brown silty very gravelly SAND.
CP102		UT	12.00		Stiff brown sandy slightly gravelly CLAY.
CP103		UT	4.00		Stiff brown sandy slightly gravelly CLAY.
CP103		UT	6.00		Firm brown sandy gravelly CLAY.
CP103		B	9.00		Brown clayey very sandy GRAVEL.
WS101		B	3.00		Brown sandy CLAY.
WS102		B	0.80		Brown very clayey very sandy GRAVEL.
WS105		B	1.40		Brown slightly sandy gravelly CLAY.

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Theatre Clwyd, Mold

Contract No:
PSL26/1673
Client Ref:

SUMMARY OF SOIL CLASSIFICATION TESTS

BS 1377 - Part 2 : 2022 in accordance with BS EN ISO 17892 (as below)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Water Content %	Linear Shrinkage	Particle Density Mg/m^3	Liquid Limit %	Plastic Limit %	Plasticity Index %	Passing 0.425mm %	Remarks
CP101		UT	9.00		8.7			18	12	6	48	Low Plasticity CIL
CP101		UT	12.00		12.9			19	13	6	82	Low Plasticity CIL
CP102		UT	12.00		20.2				NP			
CP103		UT	4.00		11.4			21	13	8	93	Low Plasticity CIL

Water Content - BS 1377 - Part 2 : 2022 : Clause 4 in accordance with BS EN ISO 17892 - 1 : 2014 + A1 : 2022
Linear Shrinkage - BS 1377 - Part 2 : 2022 : Clause 7
Particle Density (Gas Jar method) - BS 1377 - Part 2 : 2022 : Clause 9
Liquid, Plastic Limit & Plasticity Index - BS 1377 - Part 2 : 2022 : Clause 5 & 6 in accordance with BS EN ISO 17892 - 12 : 2018 + A2 : 2022

SYMBOLS : NP = Non Plastic

UKAS TESTING 4043

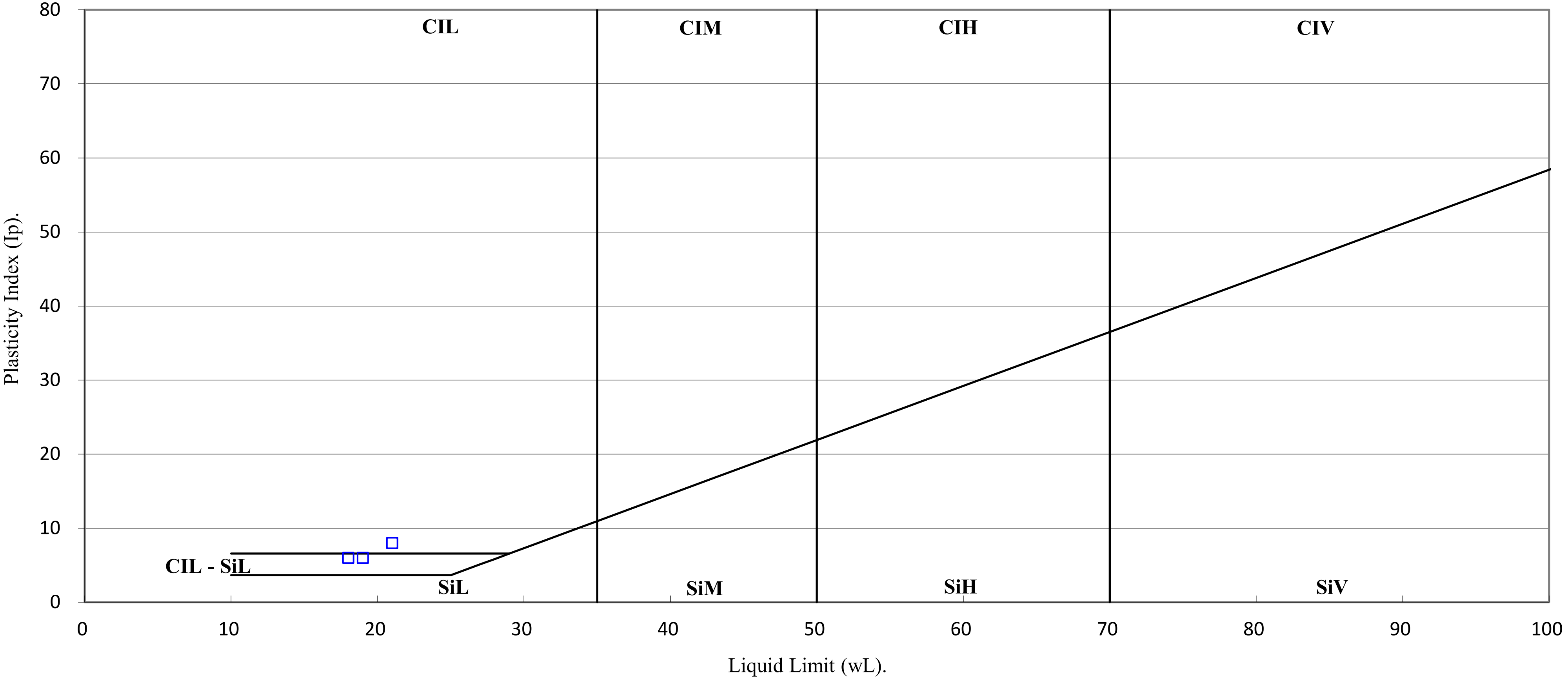
PSL PROFESSIONAL SOILS LABORATORY
A PHENNA GROUP COMPANY

Theatre Clwyd, Mold

Contract No:
PSL26/1673
Client Ref:

PLASTICITY CHART

BS EN ISO 14688-2:2017 Clause 4.4



UKAS TESTING 4043 PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY	**Theatre Clwyd, Mold**	**Contract No:** **PSL26/1673** **Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

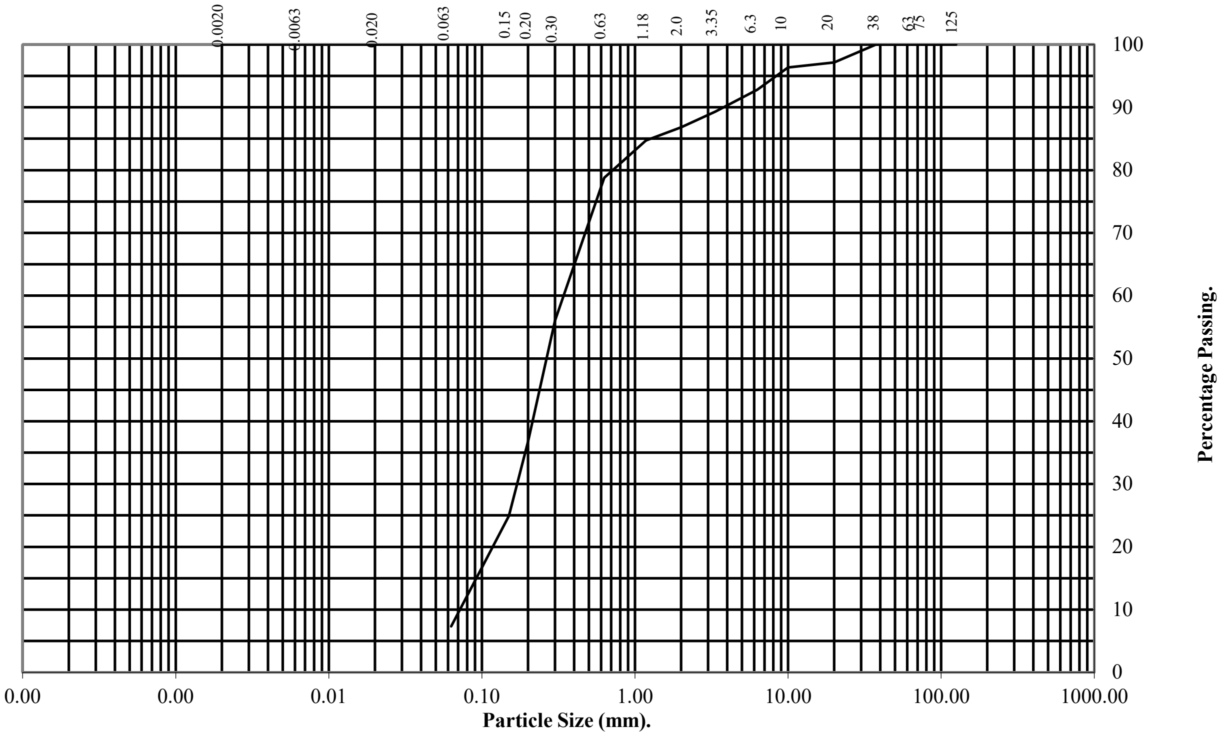
BS 1377 - Part 2 : 2022 : Clause 10 in accordance with BS EN ISO 17892 - 4 : 2016

Sieve Method, Clause 5.2

Hole Number: CP101 **Top Depth (m):** 2.00

Sample Number: **Base Depth (m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	96
6.3	93
3.35	89
2	87
1.18	85
0.63	79
0.3	56
0.2	37
0.15	25
0.063	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	13
Sand	80
Silt/Clay	7

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY
A PHENNA GROUP COMPANY

Theatre Clwyd, Mold

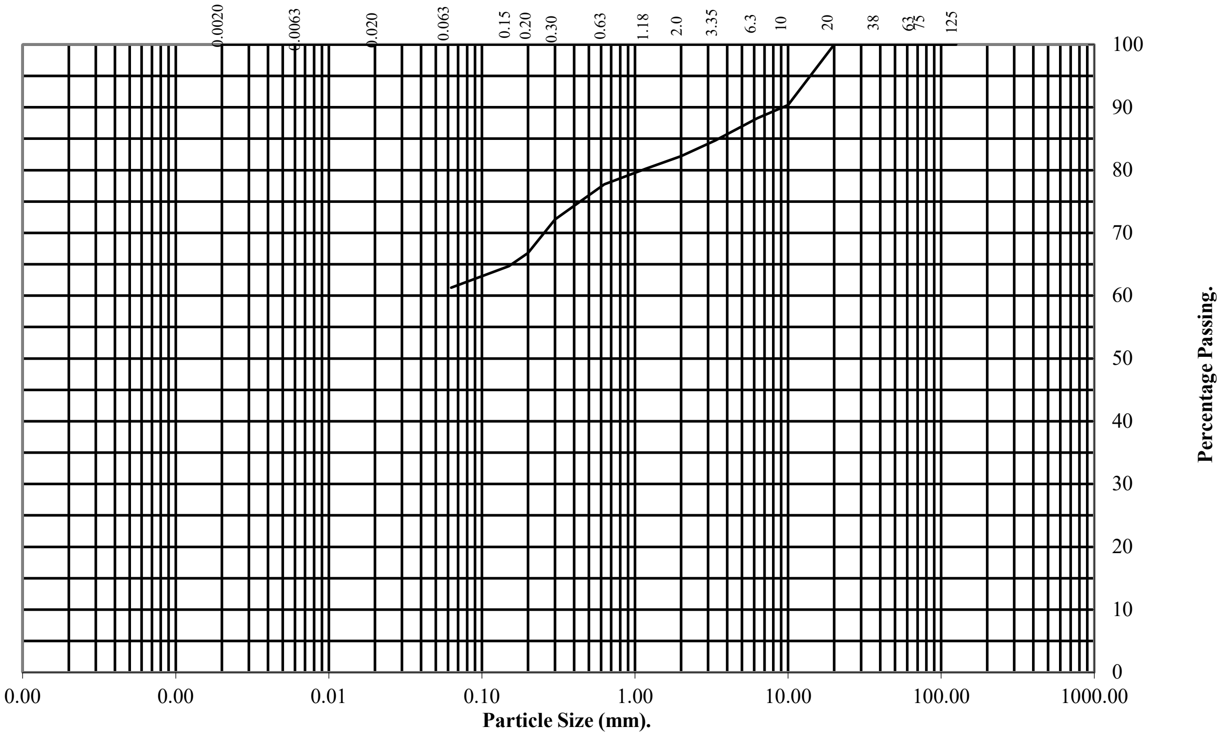
Contract No:
PSL26/1673
Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 - Part 2 : 2022 : Clause 10 in accordance with BS EN ISO 17892 - 4 : 2016

Sieve Method, Clause 5.2

Hole Number:	**CP102**	**Top Depth (m):**	**1.20**
Sample Number:		**Base Depth (m):**	
Sample Type:	**B**		



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	90
6.3	88
3.35	85
2	82
1.18	80
0.63	78
0.3	72
0.2	67
0.15	65
0.063	61

Soil Fraction	Total Percentage
Cobbles	0
Gravel	18
Sand	21
Silt/Clay	61

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Theatre Clwyd, Mold

Contract No:
PSL26/1673
Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

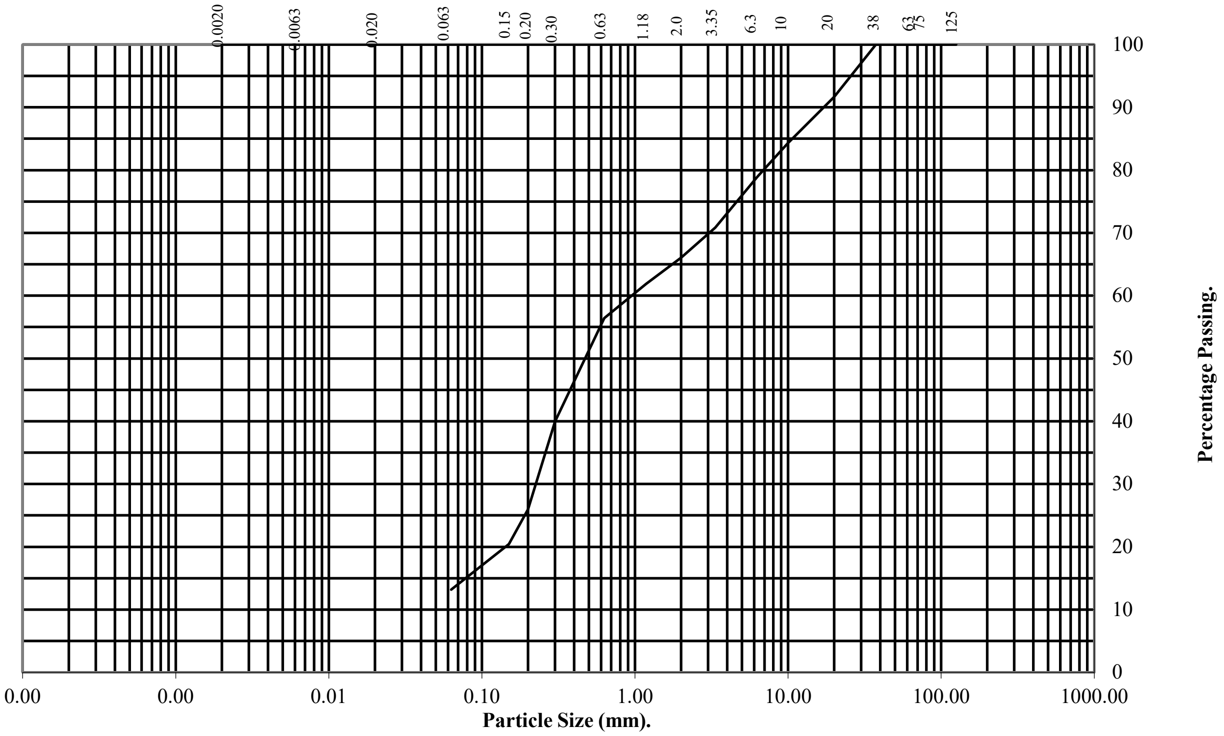
BS 1377 - Part 2 : 2022 : Clause 10 in accordance with BS EN ISO 17892 - 4 : 2016

Sieve Method, Clause 5.2

Hole Number: CP102 **Top Depth (m):** 7.50

Sample Number: **Base Depth (m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	92
10	84
6.3	79
3.35	71
2	66
1.18	62
0.63	56
0.3	40
0.2	26
0.15	20
0.063	13

Soil Fraction	Total Percentage
Cobbles	0
Gravel	34
Sand	53
Silt/Clay	13

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Theatre Clwyd, Mold

Contract No: **PSL26/1673**

Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

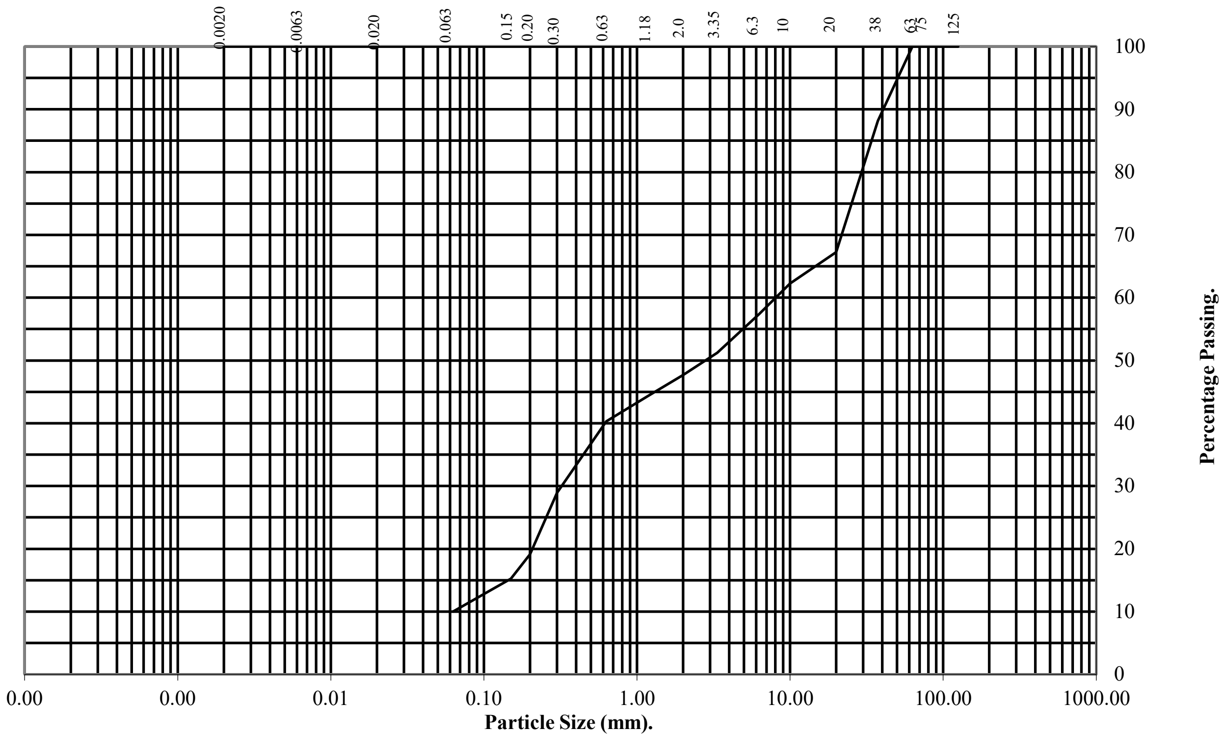
BS 1377 - Part 2 : 2022 : Clause 10 in accordance with BS EN ISO 17892 - 4 : 2016

Sieve Method, Clause 5.2

Hole Number: CP103 **Top Depth (m):** 9.00

Sample Number: **Base Depth (m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	88
20	67
10	62
6.3	57
3.35	51
2	48
1.18	44
0.63	40
0.3	29
0.2	19
0.15	15
0.063	10

Soil Fraction	Total Percentage
Cobbles	0
Gravel	52
Sand	38
Silt/Clay	10

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY
A PHENNA GROUP COMPANY

Theatre Clwyd, Mold

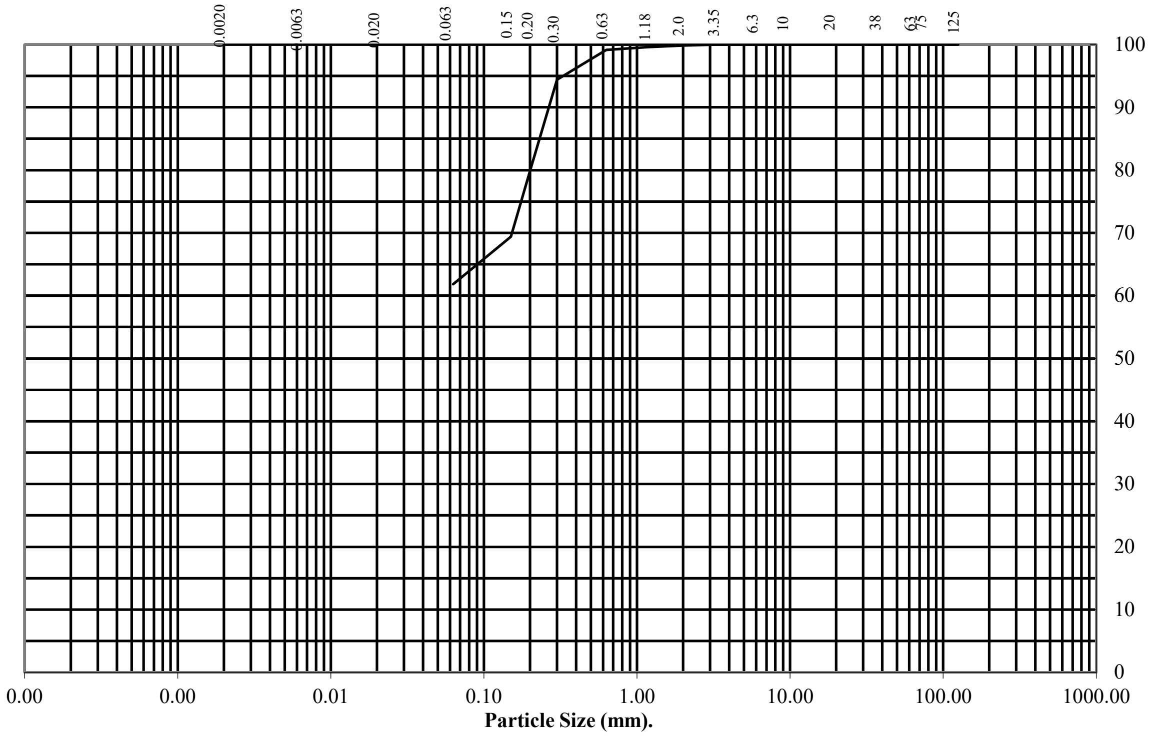
Contract No:
PSL26/1673
Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 - Part 2 : 2022 : Clause 10 in accordance with BS EN ISO 17892 - 4 : 2016

Sieve Method, Clause 5.2

Hole Number:	**WS101**	**Top Depth (m):**	**3.00**
Sample Number:		**Base Depth (m):**	
Sample Type:	**B**		



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	100
0.63	99
0.3	94
0.2	80
0.15	69
0.063	62

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	38
Silt/Clay	62

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Theatre Clwyd, Mold

Contract No:	**PSL26/1673**
Client Ref:	

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 - Part 2 : 2022 : Clause 10 in accordance with BS EN ISO 17892 - 4 : 2016

Sieve Method, Clause 5.2

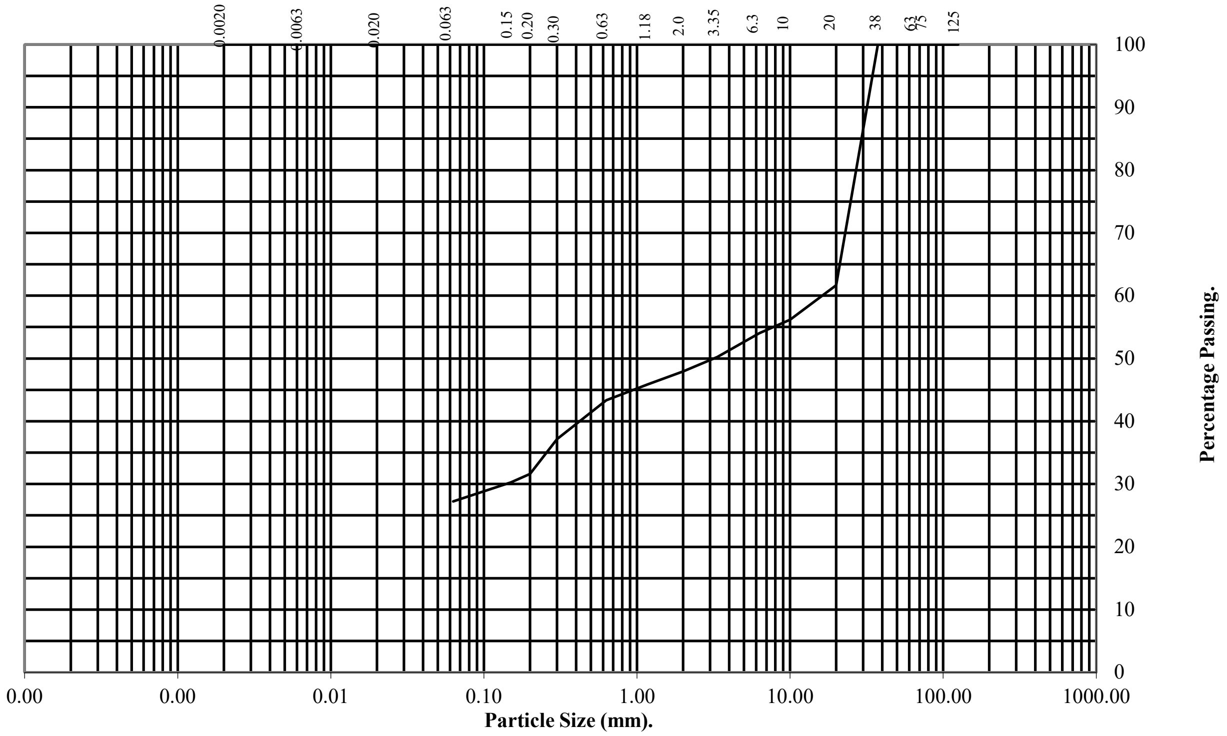
Hole Number: WS102

Top Depth (m): 0.80

Sample Number:

Base Depth (m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	62
10	56
6.3	54
3.35	50
2	48
1.18	46
0.63	43
0.3	37
0.2	32
0.15	30
0.063	27

Soil Fraction	Total Percentage
Cobbles	0
Gravel	52
Sand	21
Silt/Clay	27

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Theatre Clwyd, Mold

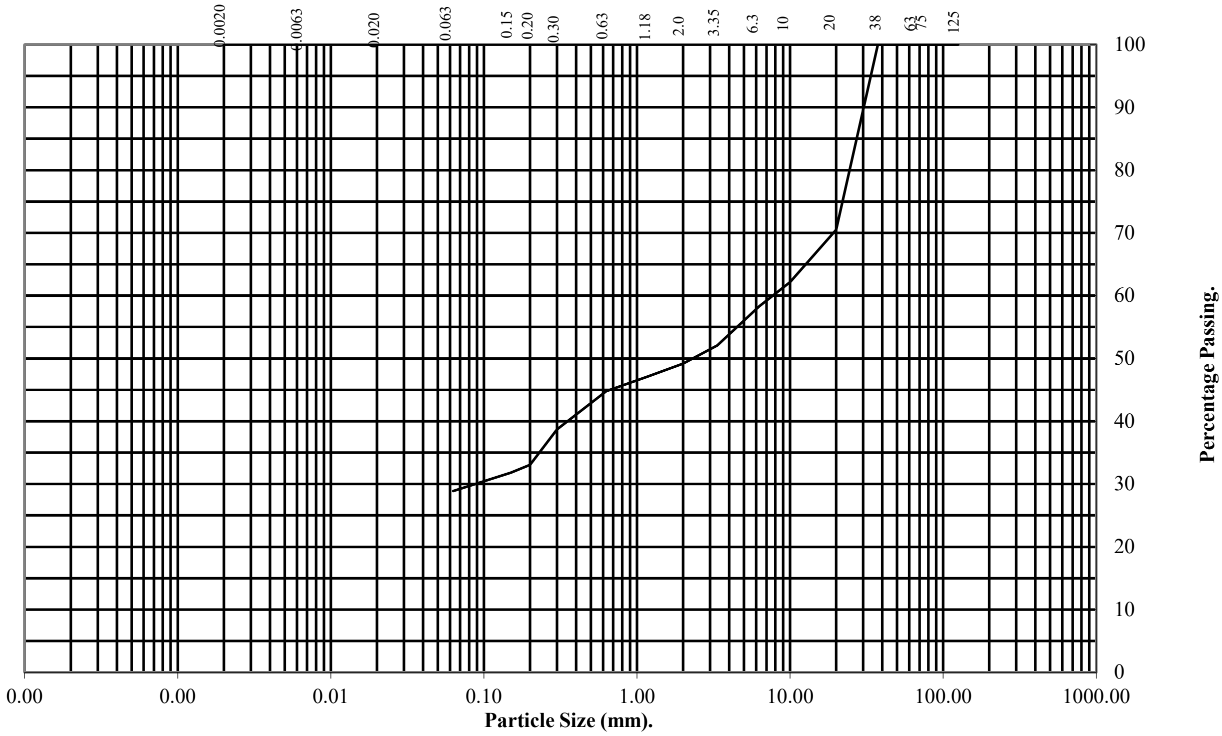
Contract No:
PSL26/1673
Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 - Part 2 : 2022 : Clause 10 in accordance with BS EN ISO 17892 - 4 : 2016

Sieve Method, Clause 5.2

Hole Number:	**WS105**	**Top Depth (m):**	**1.40**
Sample Number:		**Base Depth (m):**	
Sample Type:	**B**		



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	70
10	62
6.3	58
3.35	52
2	49
1.18	47
0.63	45
0.3	39
0.2	33
0.15	32
0.063	29

Soil Fraction	Total Percentage
Cobbles	0
Gravel	51
Sand	20
Silt/Clay	29

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

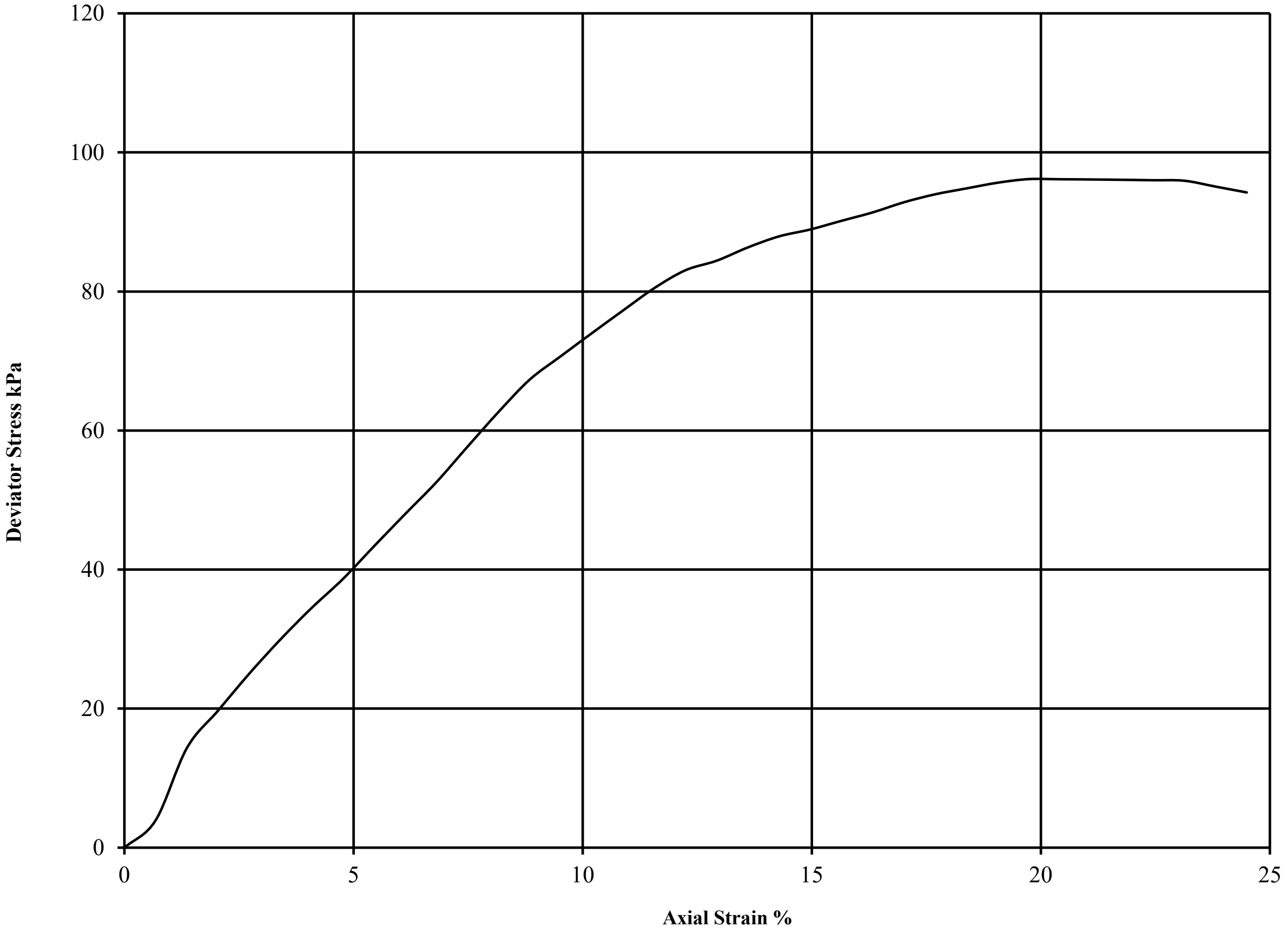
Theatre Clwyd, Mold

Contract No:
PSL26/1673
Client Ref:

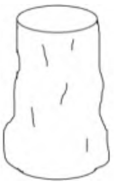
UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 - Part 2 : 2022 : Clause 28 in accordance with BS EN ISO 17892 - 8 : 2018

Hole Number:	**CP101**	**Top Depth (m):**	**9.00**
Sample Number		**Base Depth (m):**	
Sample Type	**UT**		



Diameter (mm):	102	Height (mm):		150	Test:	UU Single Stage		Remarks:
Specimen	Water Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Undisturbed Sample Sample taken from top of tube Rate of strain = 1.3 %/min See summary of soil descriptions
1	8.7	2.39	2.19	130	96	48	19.1	Plastic

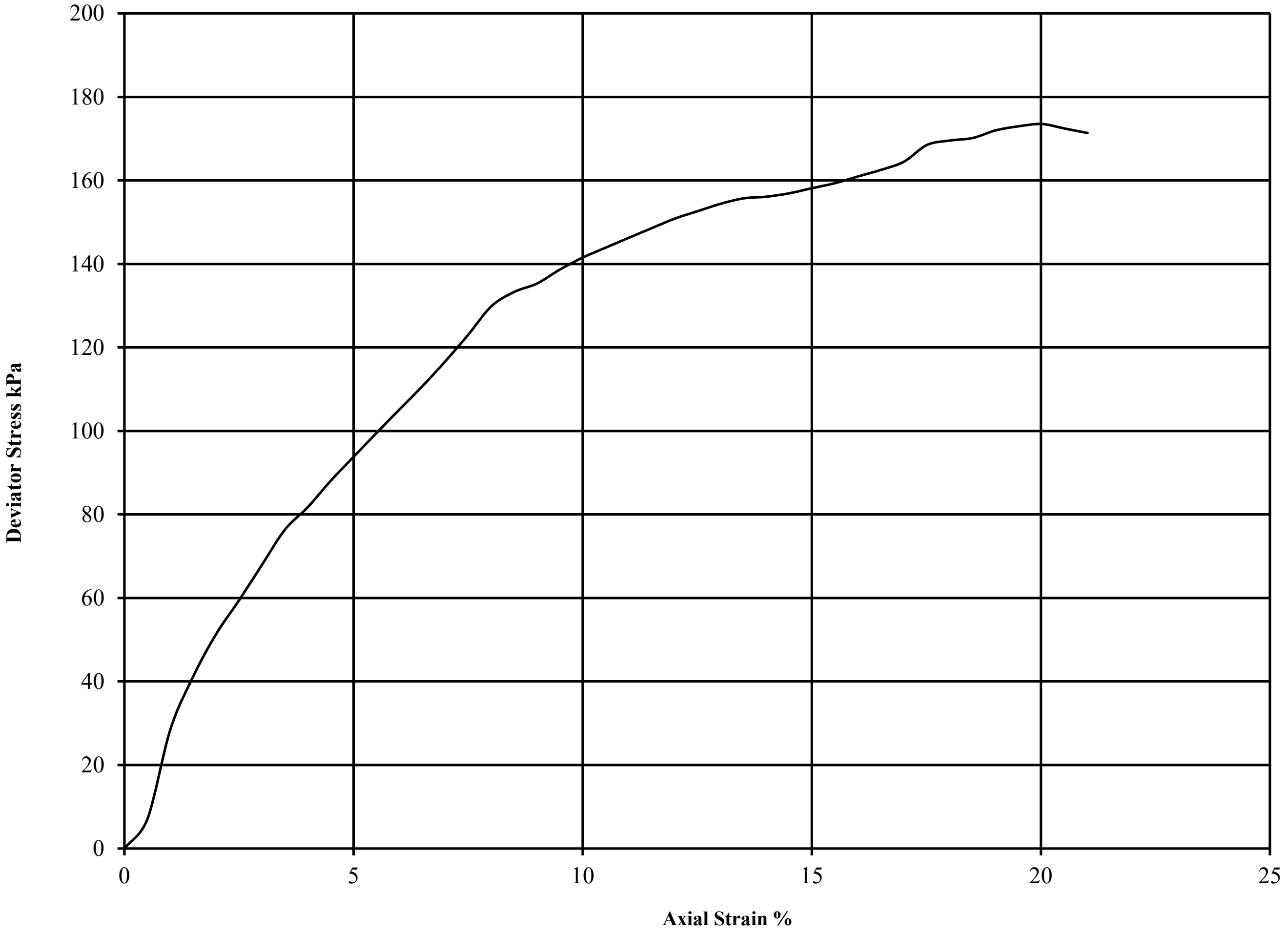


UKAS TESTING 4043 PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY	**Theatre Clwyd, Mold**	**Contract No:** **PSL26/1673** **Client Ref:**

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 - Part 2 : 2022 : Clause 28 in accordance with BS EN ISO 17892 - 8 : 2018

Hole Number:	**CP102**	**Top Depth (m):**	**12.00**
Sample Number		**Base Depth (m):**	
Sample Type	**UT**		



Diameter (mm):		102	Height (mm):		204	Test:	UU Single Stage		Remarks:
Specimen	Water Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)		Undisturbed Sample Sample taken from top of tube Rate of strain = 0.9 %/min See summary of soil descriptions
1	18.2	2.15	1.82	175	174	87	19.5	Plastic	

PROFESSIONAL SOILS LABORATORY
A PHENNA GROUP COMPANY

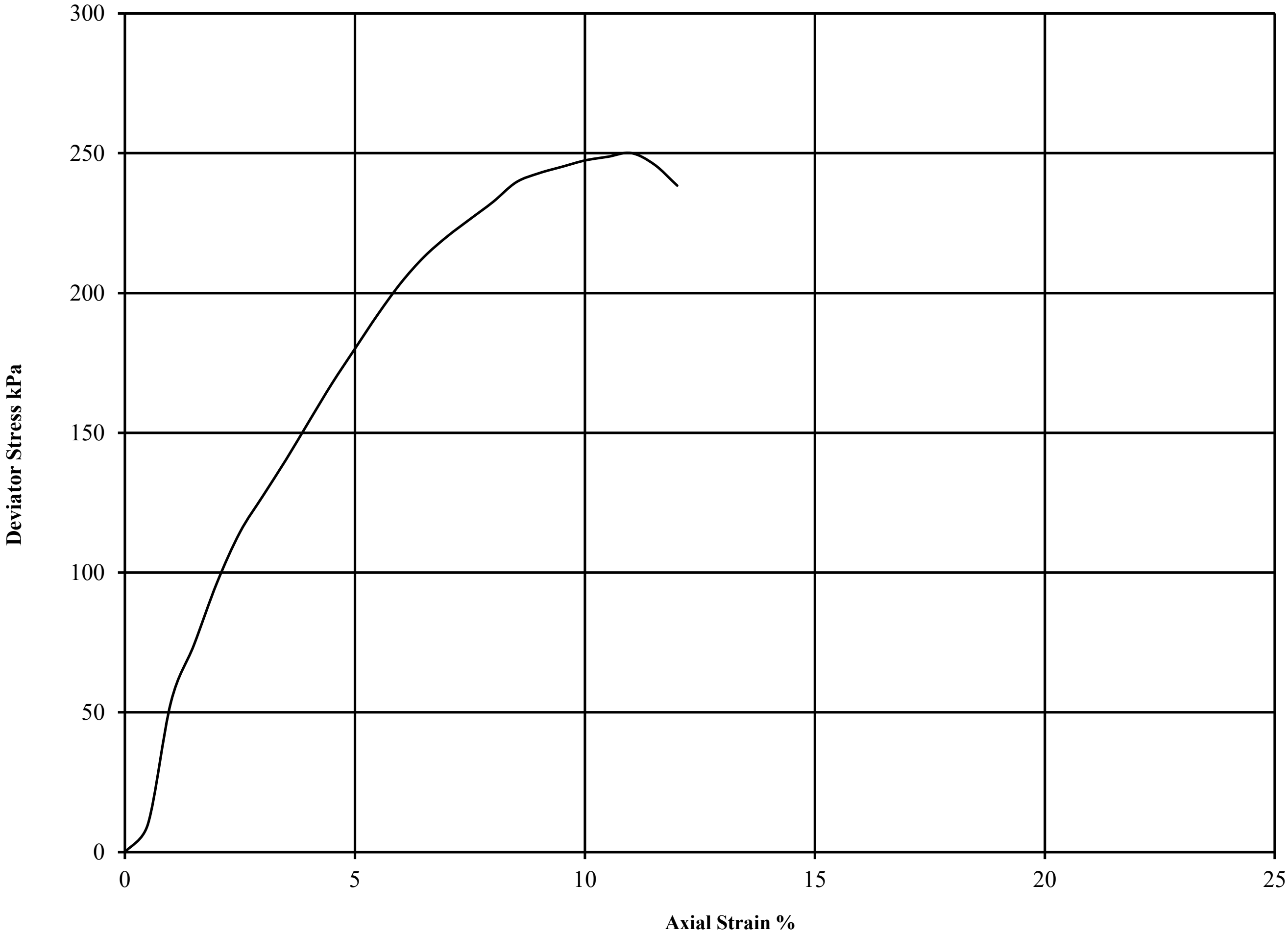
Theatre Clwyd, Mold

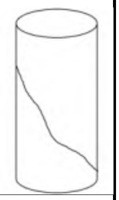
Contract No:
PSL26/1673
Client Ref:

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 - Part 2 : 2022 : Clause 28 in accordance with BS EN ISO 17892 - 8 : 2018

Hole Number:	**CP103**	**Top Depth (m):**	**4.00**
Sample Number		**Base Depth (m):**	
Sample Type	**UT**		



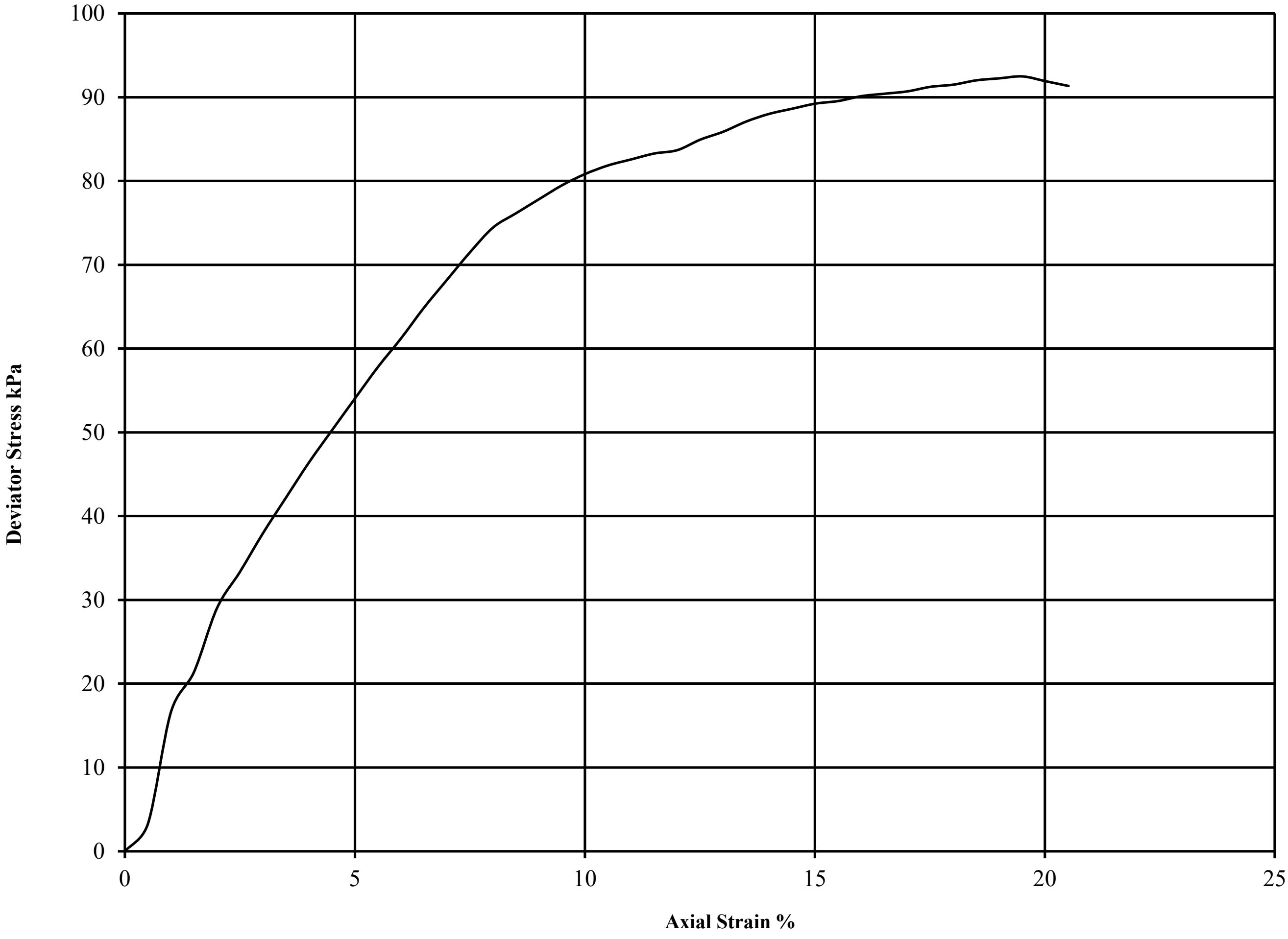
Diameter (mm):		102	Height (mm):		204	Test:	UU Single Stage		Remarks:
Specimen	Water Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)		Undisturbed Sample Sample taken from top of tube Rate of strain = 0.9 %/min See summary of soil descriptions
1	11.3	2.24	2.01	60	250	125	10.5	Brittle	

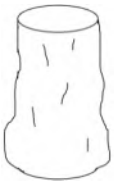
UKAS TESTING 4043 PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY	**Theatre Clwyd, Mold**	**Contract No:** **PSL26/1673** **Client Ref:**

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 - Part 2 : 2022 : Clause 28 in accordance with BS EN ISO 17892 - 8 : 2018

Hole Number:	**CP103**	**Top Depth (m):**	**6.00**
Sample Number		**Base Depth (m):**	
Sample Type	**UT**		



Diameter (mm):		102	Height (mm):		204	Test:	UU Single Stage		Remarks:
Specimen	Water Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)		Undisturbed Sample Sample taken from top of tube Rate of strain = 0.9 %/min See summary of soil descriptions
1	10.7	2.27	2.05	90	92	46	19.0	Plastic	

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Theatre Clwyd, Mold

Contract No:	**PSL26/1673**
Client Ref:	

Analytical Test Report	**E26/02826/PSL/26-08927 - Amendment A**
Clients Project Reference	PSL26/1673 Theatre Clwyd, Mold
Clients Order Number	PSL26/1673
Sample(s) Analysed	2
Sample(s) received / instructed	03/03/2026 / 03/03/2026
Sample(s) Tested	03/03/2026 to 09/03/2026
Report issued	11/03/2026
Report issue number	2

Tested on Behalf of
Professional Soils Laboratory
5/7 Hexthorpe Road
Hexthorpe
Doncaster

DN4 0AR

Signed

James Gane
Analytical Services Manager

Notes:

Amendment A 11/03/2026. Report updated to include Total Sulphur.

General

This report shall not be reproduce except in full

Please refer to Methodologies page for details pertaining to the analytical methods undertaken.

Samples were supplied by customer, results apply to the samples as received.

Samples will be retained for 14 days after issue of this report unless otherwise requested.

Where specification limits are included these are for guidance only. Where a measured value has been highlighted this is not implying acceptance or failure and certainty of measurement values have not been taken into account.

Uncertainty of measurement values are available on request.

Moisture Content was determined in accordance with CTS method statement MS - CL - Sample Prep, oven dried at <30˚C.

Moisture Content is reported as a percentage of the dry mass of soil, this calculation is in accordance with BS1377, Part 2, 1990, Clause 3.2

Stone Content was determined in accordance with CTS method statement MS - CL - Sample Prep and refers to the percentage of stones retained on a 10mm BS test sieve.

MCERTS Accreditation only covers the SAND, CLAY and LOAM matrices

Deviating Samples

On receipt samples are compared against our sample holding and handling protocols, where any deviations have been noted these are reported on our deviating sample page (if present)

Accreditation Key

U = UKAS Accreditation, M = MCERTS Accreditation, N = Unaccredited, SC = Subcontracted

E26/02826/PSL/26-08927 - Amendment A

PSL26/1673 Theatre Clwyd, Mold

Analytical Test Results - ENV Analysis Solids

Lab Reference					**720596**	**720597**
Client Sample ID					-	-
Client Sample Location					CP101	CP103
Client Sample Type					B	B
Client Sample Number					-	-
Depth - Top (m)					2	2
Depth - Bottom (m)					2	2
Date of Sampling					-	-
Time of Sampling					-	-
Sample Matrix					Sand	Clay
Determinant	**Code**	**Units**	**LOD**	**Accreditation**		
Water Soluble Sulphate (as SO4)	ANIONSS	mg/L	10	N	< 10	29
Acid Soluble Sulphate	ASSO4S	%	0.01	N	< 0.01	0.01
Total Sulphur Content (as S)	1377TS-ELT	%	0.01	U	0.05	0.02
pH	PHS	pH units	1	M	6.7	8.4
Chloride	ANIONSS	mg/L	0.1	N	6.8	2.7
Nitrate as NO3	ANIONSS	mg/L	1	N	< 1.0	< 1.0
Magnesium	1377MGICP	mg/L	1.5	N	< 15.00	3.2
Ammonium (NH4)	ANIONSS	mg/L	1	N	1.3	1.3

E26/02826/PSL/26-08927 - Amendment A

PSL26/1673 Theatre Clwyd, Mold

Sample Descriptions

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Description	Moisture Content (%)	Stone Content (%)	Passing 2mm test sieve (%)
720596	-	CP101	SOIL	-	Dark brown gravelly silty sand	-	-	70
720597	-	CP103	SOIL	-	Light brown gravelly silty clay	-	-	80

E26/02826/PSL/26-08927 - Amendment A

PSL26/1673 Theatre Clwyd, Mold

Analysis Methodologies - Please refer to sample comments page (if present) for any changes to methods Methods

Test Code	Test Name / Reference	Sample condition for analysis	Sample Preperation	Test Details
1377MGICP	BS1377 WS Magnesium (ICP)	Oven dried	Passing 2mm test sieve	Water Soluble Magnesium testing of Soil in accordance with BS 1377 : Part 3 : 2018 + A1 : 2021 Clause 10.
1377TS-ELT	BS1377 Total Sulphur Content by HTC	Oven dried	BS1377 : Part 1 : 2016	Total Sulphur Content testing of Soil in accordance with BS 1377 : Part 3 : 2018 + A1 : 2021 Clause 7.10 (using Eltra CS-800 Analyser)
ANIONSS	MS - CL - Anions by Aquakem (2:1Extract)	Oven dried	Passing 2mm test sieve	Determination of Anions (inc Sulphate, chloride etc.) in soils by Aquakem. Analysis is based on a 2:1 water to soil extraction ratio
ASSO4S	MS - CL - Acid Soluble Sulphate	Oven Dried	Passing 2mm test sieve	Determination of total sulphate in soils by acid extraction followed by ICP analysis
PHS	MS - CL - pH in Soils	As received	Passing 10mm test sieve	Determination of pH in soils using a pH probe (using a 1:3 soil to water extraction)
SAMPLEPREP	MS - CL - Sample Preparation	-	-	Preparation of samples (including determination of moisture content) to allow for subsequent analysis

E26/02826/PSL/26-08927 - Amendment A

PSL26/1673 Theatre Clwyd, Mold

Sample Deviations

Deviations are listed below against each sample and associated test method, where deviation(s) are noted it means data may not be representative of the sample at the time of sampling and it is possible that results provided may be compromised.

Observations on receipt

A - No date of sampling provided
W - No time of sampling provided
C - Received in inappropriate container
H - Contains headspace
T - Temperature on receipt exceeds storage temperature
R - Sample(s) received with less than 2 hours for testing to commence/complete, any result formally classed as deviating will be marked with an X against the applicable test (i.e. RX)

Observations whilst in laboratory

X - Exceeds sampling to extraction or analysis timescales

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Test	Deviations
720596		CP101				A
720597		CP103				A

4161

E26/02826/PSL/26-08927 - Amendment A

PSL26/1673 Theatre Clwyd, Mold

Additional Method Notes

Method	Notes
TRL 447 Suite	1. Sample preparation was in accordance with TRL 447 Appendix C. 2. Testing was carried out in accordance with methods 1, 2 and 4 of TRL 447 2001 (Updated 2005). 3. Oxidisable sulphides and total potential sulphate have been calculated in accordance with TRL 447, Appendix C Test 4. Values are reported against a dry mass of sample passing a 2mm test sieve after oven drying, where required material retained on the 2mm test sieve was recombined with the test portion prior to analysis.
BS1377 Acid Soluble Chloride	1. Sample preparation was in accordance with BS 1377 : Part 1 : 2016 2. Testing was in accordance with BS 1377 : Part 3 : 2018 + A1: 2021, acid soluble method. 3. Some information required by BS 1377 has not been reported. This information is available on request.
BS1377 Loss on Ignition	Testing was in accordance with BS 1377: Part 3: 2018 + A1: 2021 Clause 6. Determination of the mass loss on ignition. Some information required by BS1377: 2016: Part 1 has not been reported. This information is available on request.
BS1377 Organic Matter Content	1. Sample preparation was in accordance with BS 1377 : Part 1 : 2016 2. Testing was in accordance with BS 1377: Part 3: 2018 + A1: 2021 Clause 4. 3. The reported % organic content is the average organic matter content present in the soil fraction passing the 2mm test sieve to the nearest 0.1% of the original oven dry mass of soil. 4. Some information required by BS 1377 has not been reported. This information is available on request.
BS1377 pH Value	pH testing was in accordance with BS 1377 : Part 3 : 2018 + A1: 2021 Clause 12
BS1377 Sulphate (acid soluble)	1. Sample preparation was in accordance with BS 1377 : Part 1 : 2016. 2. Sulphate testing of Soil in accordance with BS 1377 : Part 3 : 2018 + A1 : 2021 Clause 7.9 & 7.5. 3. Some information required by BS 1377 has not been reported. This information is available on request.
BS1377 Total Dissolved Solids	Determination of TDS in accordance with BS 1377: Part 3
BS1377 Total Sulphur	1. Sample preparation was in accordance with BS 1377 : Part 1 : 2016.
BS1377 Water Soluble Chloride	1. Sample preparation was in accordance with BS 1377 : Part 1 : 2016 2. Testing was in accordance with BS 1377 : Part 3 : 2018 + A1: 2021, Clause 7.2, water soluble method. 3. Some information required by BS 1377 has not been reported. This information is available on request.
BS1377 Sulphate (water soluble) (ICP-OES)	1. Sample preparation was in accordance with BS 1377 : Part 1 : 2016. 2. Sulphate testing of Soil in accordance with BS 1377 : Part 3 : 2018 + A1 : 2021 Clause 7.3 & 7.5. 3. pH of the water extract was not recorded. 4. Some information required by BS 1377 has not been reported. This information is available on request.
EN1744 Acid Soluble Sulphate	Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 12. Analysis subcontracted to a UKAS accredited laboratory
EN1744 Total Sulphur by HTC (Cl. 11.2)	Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 11.2 Analysis subcontracted to a UKAS accredited laboratory
EN1744 Total Sulphur (Cl. 11.1)	Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 11. Analysis subcontracted to a UKAS accredited laboratory
EN1744 Water Soluble Chloride	Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 7 (Reference Method). Analysis subcontracted to a UKAS accredited laboratory
EN1744 Water Soluble Sulphate	Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 10. Analysis subcontracted to a UKAS accredited laboratory

Additional Method Notes

Method	Notes
Oxidisable Sulphides Calculation (HTC)	Calculated in accordance with TRL 447 using results determined in accordance with EN1744
Oxidisable Sulphides Calculation (Grav)	Calculated in accordance with TRL 447 using results determined in accordance with EN1744
Total Potential Sulphate (Calc from 1744 Total S)	Derived from the Total sulphur concentration determined in accordance with EN1744.
BS1881 Alkali (Na2O + K2O)	1. Testing was in accordance with BS 1881: Part 124: 2015 Clause 12.3. 2. A concrete density of 2300kg/m3 was used in the calculation of equivalent sodium oxide content per m3 of concrete. 3. Samples received were smaller than required by Clause 4.1 of BS 1881 : Part 124 :2015. 4. Quality control samples are tested with each batch of samples.
BS1881 Calcium Oxide Content (EDTA Titration)	1. Testing was in accordance with BS 1881: Part 124: 2015 Clause 6.4. 2. Cement content (%m/m) has been calculated assuming the presence in the concrete of Ordinary Portland Cement, containing 64.5% by mass of Calcium Oxide. 3. Samples of the original constituents of the mix were not submitted. 4. Samples received were smaller than required by Clause 4.1 of BS 1881 : Part 124 :2015. 5. Quality control samples are tested with each batch of samples. 6. Samples were identified as being part of a batch and therefore the results are from a single analysis only.
BS1881 Cement Content (ICP method)	1. Testing was in accordance with BS 1881: Part 124: 2015 Clause 6.5 by ICP. 2. Cement content has been calculated assuming the presence in the concrete of Ordinary Portland Cement, containing 20.2% and 64.5% by mass of soluble silica and calcium oxide respectively. 3. Samples of the original constituents of the mix were not submitted. 4. Samples received were smaller than required by Clause 4.1 of BS 1881 : Part 124 :2015. 5. Quality control samples are tested with each batch of samples. 6. Samples were identified as being part of a batch
Chloride in Concrete by Aquakem (Acid Soluble)	1. Testing was in accordance with in house method statement MS - CL - Chloride in Hardened concrete by Aquakem. 2. Samples were not passed over the 125micron BS Test Sieve before testing. 3 Quality control samples are tested with each batch of samples.
Moisture Content of Grout Mortar & Concrete	1. Testing was in accordance with in house method statement MS Moisture Content of Grout, Mortar and Concrete
MS - Sulphate in Hardened Concrete by ICP	1. Testing undertaken in accordance with in house method statement MS - Sulphate in hardened concrete by ICP. 2. Samples received were smaller than required by Clause 4.1 of BS 1881 : Part 124 :2015. 3. Quality control samples are tested with each batch of samples.
BS1881 Water Cement Ratio	1 Testing was in accordance with BS 1881: Part 124: 2015+A1:2021. 2. Cement content was determined in accordance with BS 1881: Part 124: 2015+A1:2021 Clause 6.5 by ICP. 3. Samples of the original constituents of the mix was/was not submitted. 4. Original water/cement ratio has been calculated in accordance with BS 1881: Part 124: 2015+A1:2021 Clause 9.6. 5. Samples received were smaller than required by Clause 4.1 of BS 1881 : Part 124 :2015+A1:2021.
BS4551 Mix Proportion	1.Sample preparation was in accordance with BS4551 2005 + A2:2013 Clause 7. 4.5. 2. Testing was in accordance with BS 4551: Part 2: 2005 + A2:2013 Clause 7.5.3 and 7.5.3.4. 3. Cement content has been calculated assuming the presence in the mix of Ordinary Portland Cement containing 20.2% and 64.5% by mass of soluble silica and calcium oxide respectively.
BS6463-102 Neutralizing Value	Testing was undertaken in accordance with an in house method statement based on

Additional Method Notes

Method	Notes
BS3882:2015 Specification for topsoil	Testing was undertaken in accordance with the methodologies within BS3882:2015
BS8601:2013 Specification for subsoil	Testing was undertaken in accordance with the methodologies within BS8601:2013
Depth of Carbonation (BS EN 14630:2006)	1. Testing was carried out in accordance with BS EN 14630:2006 Depth of Carbonation. 2. Testing was carried out in the laboratory. 3. Indicator Solution Used– 1g of Phenolphthalein powder dissolved in a solution of 50ml of Methylated Spirits and 100ml of deionised water
HAC	1. Testing was in accordance with BRE Information Sheet IS 15/74. 2. Contaminated samples may give a false result. 3. Samples taken from extensively carbonated concrete containing Portland Cement may give a false positive result. 4. If conclusive identification of the presence of High Alumina Cement is required this result should be confirmed by a more definitive test.
pH Value of Concrete	1. Testing was in accordance with in house method statement MS – pH Value of Hardened Concrete, Grout and Water from voids
Sub - EN1744 Sulphide	Analysis was in accordance with BS EN 1744-1 : 2009 + A1 : 2012, clause 13 and subcontracted to a UKAS accredited laboratory for this test

APPENDIX J: SUMMARY CHEMICAL TEST RESULTS

Job No: 3455

Site Name: Theatre Clwyd

Commercial (6% SOM)

	CP101	WS101	WS101	WS102	WS103	WS104	WS105								
Metals & Non-Metals	0.2	0.5	1.5	0.1	0.5	0.9	0.15	Min (mg/kg)	Max (mg/kg)	Average (Unround	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Arsenic	8.2	9.1	4.6	7.3	7.5	10.2	11	4.6	11	8.27	8.27	7	640	C4SL	0
Cadmium	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	0	0	1.60	1.6	7	410	C4SL	0
Chromium	16.6	20.6	8.8	11.7	9.5	16.7	18	8.8	20.6	14.56	14.56	7	8600	S4UL	0
Copper	16.6	17.6	11.5	11.6	8.8	16.7	17.2	8.8	17.6	14.29	14.29	7	68000	S4UL	0
Lead	36.3	31.2	10.5	104	51.3	159	85.7	10.5	159	68.29	68.29	7	2300	C4SL	0
Mercury	<0.7	<0.7	<0.7	<0.7	1.3	<0.7	<0.7	1.3	1.3	0.79	0.79	7	58	S4UL	0
Nickel	20.5	25.9	8.8	7.1	7.2	12.3	15.2	7.1	25.9	13.86	13.86	7	980	S4UL	0
Total Monohydric Phenols	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	1.19	< 0.50	1.19	1.19	0.60	0.6	7	1300	S4UL	0
Selenium	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	0	0	3.00	3	7	12000	S4UL	0
Zinc	63.5	65.2	25.2	114	51.2	114	92.9	25.2	114	75.14	75.14	7	730000	S4UL	0

	CP101	WS101	WS101	WS102	WS103	WS104	WS105								
Petroleum Hydrocarbons	0.2	0.5	1.5	0.1	0.5	0.9	0.15	Min (mg/kg)	Max (mg/kg)	Average (Unround	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Benzene	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.00	0.001	7	98	C4SL	0
Toluene	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.00	0.001	7	180000	S4UL	0
Ethylbenzene	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.00	0.001	7	27000	S4UL	0
m,p-Xylene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.00	0.002	7	30000	S4UL	0
>C5-C6 Aliphatic	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.10	0.1	7	12000	S4UL	0
>C6-C8 Aliphatic	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.10	0.1	7	40000	S4UL	0
>C8-C10 Aliphatic	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.10	0.1	7	11000	S4UL	0
>C10-C12 Aliphatic	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.00	1	7	47000	S4UL	0
>C12-C16 Aliphatic	0.5	0.6	< 0.5	0.6	< 0.5	0.5	< 0.5	0.5	0.6	0.53	0.53	7	90000	S4UL	0
>C16-C35 Aliphatic	5.5	9.8	< 4.0	7	0.7	< 4.0	0.8	0.7	9.8	4.54	4.54	7	1800000	S4UL	0
>C35-C40 Aliphatic	< 0.5	< 0.5	< 0.5	0.7	< 0.5	< 0.5	< 0.5	0.7	0.7	0.53	0.53	7	1800000	S4UL	0
>C6-C7 Aromatic	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.01	0.01	7	86000	S4UL	0
>C7-C8 Aromatic	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.01	0.01	7	180000	S4UL	0
>C8-C10 Aromatic	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.01	0.01	7	17000	S4UL	0
>C10-C12 Aromatic	2.6	2.6	1.9	2.4	1.9	2.1	1.9	1.9	2.6	2.20	2.2	7	34000	S4UL	0
>C12-C16 Aromatic	6.7	7.1	5	6.7	5	5.6	4.9	4.9	7.1	5.86	5.86	7	38000	S4UL	0
>C16-C21 Aromatic	3.4	3.4	2.3	3.5	2.5	2.8	2.8	2.3	3.5	2.96	2.96	7	28000	S4UL	0
>C21-C35 Aromatic	21.6	22.2	12.6	20.6	13.2	14.2	12.5	12.5	22.2	16.70	16.7	7	28000	S4UL	0
>C35-C40 Aromatic	4.8	4.5	2.9	5	3.4	3.6	3.3	2.9	5	3.93	3.93	7	28000	S4UL	0

	CP101	WS101	WS101	WS102	WS103	WS104	WS105								
Polyaromatic Hydrocarbons (PAH)	0.2	0.5	1.5	0.1	0.5	0.9	0.15	Min (mg/kg)	Max (mg/kg)	Average (Unround	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Acenaphthene	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	0.01	0.01	7	100000	S4UL	0
Acenaphthylene	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	0.02	0.02	7	100000	S4UL	0
Anthracene	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	0.02	0.02	7	540000	S4UL	0
Benzo(a)anthracene	< 0.012	< 0.012	< 0.012	0.016	0.018	0.053	0.032	0.016	0.053	0.02	0.02	7	180	S4UL	0
Benzo(a)pyrene	< 0.019	< 0.019	< 0.019	< 0.019	< 0.019	0.061	0.034	0.034	0.061	0.03	0.03	7	77	C4SL	0
Benzo(b)fluoranthene	< 0.020	< 0.020	< 0.020	0.022	0.02	0.07	0.036	0.02	0.07	0.03	0.03	7	45	S4UL	0
Benzo(g,h,i)perylene	< 0.019	< 0.019	< 0.019	< 0.019	0.021	0.045	0.028	0.021	0.045	0.02	0.02	7	4000	S4UL	0
Benzo(k)fluoranthene	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.03	0.03	7	1200	S4UL	0
Chrysene	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	0.047	< 0.028	0.047	0.047	0.03	0.03	7	350	S4UL	0
Dibenzo(a,h)anthracene	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	0.02	0.02	7	3.6	S4UL	0
Fluoranthene	0.02	< 0.017	< 0.017	0.023	0.024	0.071	0.031	0.02	0.071	0.03	0.03	7	23000	S4UL	0
Fluorene	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	0.01	0.01	7	71000	S4UL	0
Indeno(1,2,3-cd)pyrene	< 0.019	< 0.019	< 0.019	< 0.019	< 0.019	0.052	0.032	0.032	0.052	0.03	0.03	7	510	S4UL	0
Naphthalene	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	0.02	0.02	7	1100	S4UL	0
Phenanthrene	< 0.014	< 0.014	< 0.014	0.024	0.022	0.032	< 0.014	0.022	0.032	0.02	0.02	7	23000	S4UL	0
Pyrene	0.019	< 0.016	< 0.016	0.022	0.025	0.08	0.031	0.019	0.08	0.03	0.03	7	54000	S4UL	0

	CP101	WS101	WS101	WS102	WS103	WS104	WS105								
Other Contaminants / Testing	0.2	0.5	1.5	0.1	0.5	0.9	0.15	Min (mg/kg)	Max (mg/kg)	Average (Unround	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Total Organic Carbon	1.02	0.73	0.72	1.67	1.84	4.37	1.65	0.72	4.37	1.71	1.71	7	-	-	-
pH	6.9	8.4	8.2	8.4	8.1	7.2	8.2	6.9	8.4	7.91	7.91	7	-	-	-
Total Cyanide	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.00	1	7	-	-	-

APPENDIX K: CURRENT GUIDANCE FOR GROUND GAS RISK ASSESSMENT

Current Guidance for Ground Gas Risk Assessment

Origin of Ground and Landfill Gases

When carrying out a ground gas risk assessment for permanent ground gases (e.g., methane and carbon dioxide), the origin or source of the gases is important as potential risks will vary depending on the source. This Appendix relates to the risk of the two main ground gases of concern: methane and carbon dioxide and does not apply to other ground gases (e.g., radon or vapours from hydrocarbon spills). Methane and carbon dioxide are major constituents of landfill gas but can also occur from a variety of anthropogenic and natural sources, as summarised in Table G1 below:

Table G1. Potential Sources of Ground Gases

Gas	Source	Comments
Landfill Gas	Anaerobic decomposition of degradable waste within landfill sites. Typically, 60% methane and 40% carbon dioxide during methanogenic phase.	Composition varies over time, particularly in early stages. Contains a range of minor constituents (particularly carbon monoxide and hydrogen sulphide).
Landfill Associated Gases	- Anaerobic degradation of leachate external to the site; - Degassing of dissolved gases in groundwater; - Evolution of gases following interaction between leachate and groundwater	Can result in secondary (external) production of methane or carbon dioxide.
Made Ground	Anaerobic degradation of organic components	Very variable depending on source
Sewer Gas, Cess Pits	Anaerobic degradation of organic components of sewage producing methane and carbon dioxide.	Often characterised by hydrogen sulphide odour.
Mains Gas	Leakage from underground pipework or storage tanks. Mainly methane but often contains higher alkanes.	An odouriser is added to permit detection of leaks. Typically, 90% CH_4, but 1 to 27% C_2-C_4 alkanes, May also contain other trace gases e.g., CO, helium and CO_2 (from degradation of CH_4 in the ground).
Other Anthropogenic Sources	- Degradation of leaked or spilled hydrocarbons or other industrial chemicals; - Anaerobic degradation of organic contaminants in groundwaters (e.g., silage liquor); - Reactions between monitoring well construction components and environment; - Burial grounds/cemeteries.	Hydrocarbon spillages often have an 'oily' odour. Fuel spillages common – Petrol or Diesel and can contain a wide range of VOC's. Can degrade to produce methane / carbon dioxide.
Alluvium / Marsh / Peat Gas	Anaerobic microbial degradation of organic material (usually waterlogged vegetation / peat). Often associated with the presence of alluvial deposits or dredgings.	
Geogenic Gas	Natural seepages of carbon dioxide and hydrocarbon gases derived from geologic sources such as coal seams and deep oil / gas source formations. Can be present in solution in groundwaters.	Methane most common but can contain carbon dioxide and higher alkanes.
Mine Gases	Various types. Most common is "fire damp" with high methane, produced by the desorption of gas trapped in coal. "Black damp" (Stythe gas) with high carbon dioxide and denser than air. "White damp" is high in carbon monoxide.	Methane most common. Can contain higher alkanes, carbon dioxide and carbon monoxide. Often low in oxygen.
Natural Shallow Ground Gas	Various types - high carbon dioxide formed by subsurface aerobic activity leading to depleted oxygen and elevated carbon dioxide; - chemical degradation of rocks (e.g., carbonates) producing carbon dioxide; - carbon dioxide production in root zone of soils by plants.	Gases can be emitted from ground under falling barometric pressure conditions.

This Appendix concentrates on the assessment of risk from methane and carbon dioxide. This Appendix does not provide guidance for the assessment of risk when other gases are present due to 'Other Sources' from the above table (particularly organic compounds such as BTEX and VOC's or for the risk from radon or hydrogen sulphide).

To determine the origin of the gas a range of factors must be considered together, including;

1. Proximity of likely sources;
2. Ground conditions (geology, hydrogeology, anthropogenic pathways etc);
3. Properties of gases present including:
    a. Chemical composition;
    b. Physical properties;
    c. Ratios of components e.g., methane : carbon dioxide.
4. Timeframe of activities such as infilling periods, capping works, installation of gas control systems etc.

Identification of the originating source may be problematic given that there may be more than one source present and trace gas analysis may be required. Identification of the sources of the gases encountered during monitoring is usually carried out through a process of eliminating the most unlikely potential sources (given the site setting) and selecting those which are the more likely candidates.

Hazards Associated with Presence of Ground Gases

Methane gas is combustible and potentially explosive. When the concentration of methane in air is between the limits of 5.0%v/v and 15.0%v/v an explosive mixture is formed. The Lower Explosive Limit (LEL) of methane is 5.0%v/v, which is equivalent to 100% LEL. The 15.0%v/v limit is known as the Upper Explosive Limit (UEL), but concentrations above this level cannot be assumed to represent safe concentrations. Further, the LEL and UEL will vary (up and down) depending upon the proportion of other gases (including oxygen). However, the fact that methane is a colourless, odourless gas means that there is no simple indicator of the presence of the gas until such a time as explosive limits are reached, and an incident occurs. Methane is lighter than air and has a low toxicity. However, at high concentrations it can result in asphyxiation due to oxygen displacement.

Carbon dioxide is a colourless, odourless gas, which, although non-flammable, is both toxic and an asphyxiant. As carbon dioxide is denser than air, it will collect in low points and depressions. The UK Health & Safety Executive (HSE) has published information relating to concentrations of carbon dioxide that humans may be exposed to, which uses concentrations contained in the Control of Substances Hazardous to Health Regulations 2002 (as amended). These are the Long-Term Occupational Exposure Limit (LTOEL, 8-hour period) and the Short-Term Occupational Exposure Limit (STOEL, 15-minute period), which are 0.5% and 1.5% carbon dioxide, respectively.

Parameters Influencing the Rate of Ground Gas Production

Figure G2 is taken from EA guidance document LFTGN 03 illustrates typical ground gas generation curves from biodegradable materials:

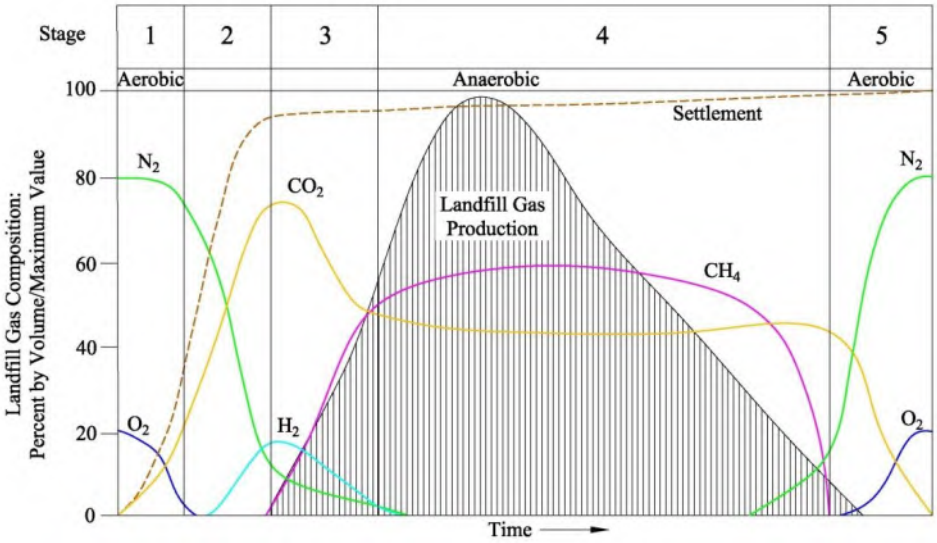


Figure G2. Idealised Representation of Landfill Gas Generation.

The production of methane and carbon dioxide at a landfill site may be expected to be considerable and ongoing. Concentrations of methane will eventually decrease, followed by concentrations of carbon dioxide, but the duration and rate of gas production can vary markedly between sites. Five distinct phases of gas production occur during the process which are, in order of event (as marked on Figure G2), as follows:

1. An aerobic phase involving oxygen depletion and temperature increase through aerobic respiration;
2. The establishment of anaerobic conditions and the evolution of carbon dioxide and hydrogen through acidogenic activity;
3. Commencement of methanogenic activity; the establishment of populations of methanogenic bacteria;
4. A phase of stable methanogenic activity, which may go on for many tens of years;
5. A phase of decreasing methanogenic activity, representing depletion of the organic material and a return to aerobic conditions.

The time scale for the return to the normal ground gas concentrations will be highly variable, depending upon the types and quantities of materials present. In addition, the optimum parameters influencing the rate of decomposition and ground gas production within the ground at a site are as follows:

- High water content with adequate rainfall and water infiltration to provide moisture content between approximately 20 to 26%;

- Conditions that either are or are very close to anaerobic;
- High proportion of biodegradable materials;
- A pH between 6.5 and 8.5, ideally verging slightly on the acidic between pH 6 to 7;
- Temperature between 25°C and 55°C;
- The ratio of the biochemical and chemical oxygen demands (BOD:COD);
- High permeability;
- Small particle size, as finer subsurface materials possess a greater surface area to provide a growing 'face' for the micro-organisms but high fines levels reduces permeability and reduces decomposition rate.

For this reason, it is vital that sources of methane and carbon dioxide are identified prior to the commencement of any work on a construction site, and that the ground gas regime is characterised at the worst temporal conditions a site may experience. From this, a risk assessment is carried out to identify the risk at the site from ground gases so that suitable protection measures can be designed and incorporated into a development to prevent a dangerous build-up of gas occurring.

Factors Influencing the Migration and Behaviour of Ground Gases

There are many factors that influence the migration of ground gases which can affect the risk from a gassing source:

- driving force – pressure differential along a pathway, diffusion and dissolved in solution;
- meteorological conditions – short term and seasonal conditions including atmospheric pressure changes (e.g., rapidly falling pressure causes gas to expand increasing emission rates), rainfall, frozen ground and thawing, temperature;
- geological and groundwater conditions – these can have the over-riding influence on the direction/pathways and quantity of migrating gas;
- anthropogenic influences – man-made pathways include mine shafts, service runs/drains, foundation piles, underground voids/pits/basements, foundation/building design/construction

Guidance Documents

Currently in the UK, there are no statutory threshold limits for hazardous gases in the ground as site specific variables mean that standard threshold values cannot be applied. The published guidance relating to development of sites where methane and carbon dioxide are present has been produced in response to building projects on or close to landfill sites, as both gases are principal constituents of landfill gas. Much of the historic guidance that has been produced on gas risk assessment focused on landfill sites and as a result there has previously been a lack of clarity when relating the process to gas conditions on non-landfill sites.

Statutory guidance regarding methane in the ground has previously taken a limiting concentration of 1.0 % by volume methane (equal to 20% of the lower explosive limit of methane in air) above which necessary actions will be appropriate. For carbon dioxide the limiting recommended trigger was 1.5 % by volume (the Long-Term Exposure Limit for carbon dioxide). Above these concentrations the Building Regulations Approved Document C (1992) stated that consideration should be given to whether actions may be appropriate, whilst more specific solutions would be likely to be necessary at concentrations greater than 5% by volume of carbon dioxide (Building Regulations Approved Document C, 1992). However, the latest fully revised version of Approved Document C (DoE, 2004) no longer endorses this approach and instead requires the use of a risk-based approach in interpreting the findings of a gas monitoring survey. Further, the latest EA documentation on landfill gas (LFTGN 03, 2004) continues to sanction the use of a risk-based approach through a structured approach to the assessment of ground gases and links with the risk assessment process outlined within CLR 11 for soil contaminants.

With the above in mind, recent guidance has been produced in 2006 and 2007 with the aim of providing up to date advice in relation to residential and commercial development. The guidance does not address issues associated with gas derived from landfills, for this refer to *"Guidance on the Management of Landfill Gas"* (Environment Agency 2004) for an overview.

Recent guidance relevant to gas assessments for residential and commercial development includes;

- **Wilson *et al.* (CIRIA C665, December 2007) *"Assessing Risks Posed by Hazardous Ground Gases for Buildings."***

  This document provides up to date advice on all aspects of ground gas risk assessment such as investigation, monitoring programmes, data collection and interpretation. The guidance presents separate methodologies for the characterisation of:

  - **All development types except low rise housing with gardens and for Low Rise Buildings without a 150mm void** (Situation A) (Table 8.5 CIRIA C665)

  and;

  - **Low rise housing with gardens with a 150mm ventilated sub-floor void** (Situation B) (Table 8.7 CIRIA C665)
    (See below for further explanation of the methods of characterisation)

- **Boyle and Witherington (NHBC / RSK Group, Report 10627-R01(04) January 2007) *"Guidance on the Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present."***

  This document presents the "Traffic Lights System" detailed below and is relevant only for low rise properties (e.g., bungalows and town houses) that have a ventilated sub-floor void (i.e., Situation B as described in CIRIA C665).

- **Wilson and Card (CIEH, expected 2011) *"Ground Gas Handbook for Designers and Regulators"***

  This document is expected to provide practical guidance on ground gas assessments and the design and evaluation of protection measures.

- **British Standard (BS 8485+A1, January 2019)** ***"Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings"***

  This document provides an overview of gas characterisation and assessment. The Standard is intended to be used by designers of gas protection measures and regulators involved in the assessment of design solutions. The Standard provides a framework in line with CLR11 allowing designers to judge the adequacy of ground gas and related site investigation data. The document provides an approach to determine appropriate ground gas parameters that can be used to identify a range of possible construction solutions mitigating against the presence of ground gas on a development site.

Each of these documents continues to highlight the importance of, and give further guidance towards, carrying out a tiered risk-based decision-making process in accord with government policy on dealing with contamination from historic or natural sources and highlight the importance of the Conceptual Model in site characterisation. These documents also stress the importance that the assessor should be confident that the ground gas monitoring results are representative of the likely worse case ground gas regime on a site and that the data collected from the site is sufficient. With this in mind, CIRIA C665 sets out ideal monitoring periods as below.

Idealised Frequency and Period of Monitoring (after Table 5.5a and 5.5b, CIRIA C665)						
		Generation Potential of Source				
		Very Low	Low	Moderate	High	Very High
Sensitivity of Development	Low (Commercial)	4/1	6/2	6/3	12/6	12/12
	Moderate (Flats)	6/2	6/3	9/6	12/12	24/24
	High (Residential with Gardens)	6/3	9/6	12/6	24/12	24/24

Notes

1. First number is the number of readings and the second is the minimum period in months (e.g., 6/2 – six sets of readings over two months).

2. At least two sets of readings must be at low (preferably under 1,000 mb) and falling pressure.

3. High sensitivity end use on high or very high hazard site will not normally be acceptable unless the source is treated to reduce gassing potential.

Before the latest guidance, good practice for site characterisation had been based upon the method proposed by Wilson and Card (1999). CIRIA C665 (2007) effectively supersedes Wilson and Card (1999) and includes a modified version of the Wilson and Card method (Tables 8.5, 8.6 and Box 8.1). Gas concentrations and flow rates for either methane and/or carbon dioxide measured at a site to 'Characteristic Situations.' Appropriate protection measures are selected from Table 8.6 (if using modified Wilson & Card method) and from Box 8.4 from CIRIA C665 (if using the NHBC traffic lights method). Throughout the risk assessment process, strong regard must be given to the nature of the gassing source, the flow rates and the estimated surface emissions. Note that certain protection measures are stated in CIRIA Report 149 that are now considered wholly inappropriate to certain developments and consequently should not be used without modification. Throughout the process, it is important to remember that these tables are not intended to be used as a definitive design tool and have been prepared to show the typical scope of measures for gas control.

Both the NHBC (2007) and CIRIA (2007) guidance documents and BS 8485+A1 (2019) propose that both ground gas concentrations and flow rates are used to calculate the limiting gas well gas volume flow rates for methane and carbon dioxide, based on the ground gas conditions monitored for during the worse-case temporal conditions. This limiting gas well volume flow rate is termed the Gas Screening Value (GSV, note that this was termed borehole gas volume flow), and is calculated as follows:

$$\mathbf{GSV}\ (\text{l/hr}) \mathbf{=} \frac{[\text{gas well gas concentration (\%v/v)}]\ \mathbf{x}\ [\text{gas well flow rate (l/hr)}]}{100}$$

These GSVs are then compared to generic ‘Traffic Lights’ contained within the NHBC guidance, which present typical maximum gas concentrations and limiting GSV’s, for ‘Situation B Development’ (Low rise housing with gardens).

Table 8.7 NHBC Traffic light system for 150 mm void

Traffic Light	Methane [1]		Carbon Dioxide [2]	
	Typical max concentration [3] (% by volume)	Gas Screening Value [2,4] (litres/hour)	Typical max concentration [3] (% by volume)	Gas Screening Value [2,4] (litres/hour)
Green				
	1	0.13	5	0.78
Amber 1				
	5	0.63	10	1.6
Amber 2				
	20	1.60	30	3.10
Red				

Notes:

1. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst-case temporal conditions that the site may be expected to encounter will be the decider as to what Traffic Light is allocated;
2. Borehole Gas Volume Flow Rate, in litres per hour as defined in Wilson and Card (1999), is the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered;
3. The Typical Maximum Concentrations can be exceeded in certain circumstances should the Conceptual Site Model indicate it is safe to do so;
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.

Box 8.4 of CIRIA C665 Gas protection measures for low-rise housing development based upon allocated NHBC Traffic light (Boyle and Witherington, 2007)

Traffic Light Classification	Protection Measures Required
Green	Negligible gas regime identified, and gas protection measures are not considered necessary.
Amber 1	Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Intermediate to high gas regime identified, which requires high-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Membranes should always be fitted by a specialist Contractor. As with Amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further Gas Risk Assessment and/or possible remedial mitigation measures to reduce and/or remove the source of gas.

For a 'Situation A Development' (All development except low rise housing with gardens), the GSV value is used to derive the appropriate Characteristic Situation from Table 8.5 of CIRIA C665 (below):

Table 8.5 from CIRIA C665 Modified Wilson and Card Classification

Characteristic Situation (CIRIA R149)	Comparable Partners in Technology gas Regime (see Box 8.2)	Risk Classification	Gas Screening Value (CH_4 or CO_2) (l/hr)[1]	Additional Factors	Typical Source of Generation
1	A	Very low risk	<0.07	Typically, methane ≤ 1% and/or carbon dioxide ≤ 5%. Otherwise consider increase to Situation 2	Natural soils with low organic content "Typical" made ground
2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to characteristic Situation 3	Natural soil, high peat/organic content. "Typical" made ground
3	C	Moderate risk	<3.5		Old landfill, inert waste, mine working flooded
4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.	Mine working susceptible to flooding, completed landfill (WMP 26B criteria)
5	E	High risk	<70		Mine working unflooded inactive with shallow workings near surface
6	F	Very high risk	>70		Recent landfill site

It was intended in CIRIA C665 that the characteristic situation allocated to the development from the table above would then be used in Table 8.6 of CIRIA C665 in order to determine the level of gas protection the development requires. However, BS8485:2015 superseded this document and a different set of mitigation standards were put forward.

The recommended minimum gas protection score (points) be selected based on the building type (Table 3 which defines four building types) and the ground gas Characteristic Situation as detailed in Table 4 of BS8485:2015+A1:2019 (see below).

The first step in the decision-making process is to obtain the level of gas protection necessary in the range 0 to 7.5 from Table 4. Then a combination of structural barriers (Table 5) ventilation protection measures (Table 6) and/or gas resistant membranes (Table 8)should be chosen to meet that requirement. The level of gas protection necessary should take into account the characteristic gas situation and a number of other factors. The whole decision-making process should be made transparent, where all parties can see the approach being taken, can understand the various steps and decisions made and be confident that a risk-assessed solution has been designed and installed commensurate with the construction and site constraints.

Where the gas Characteristic Situation is 4 or more (and for NHBC Red situations according to CIRIA C665), the site requires a comprehensive risk assessment to confirm the scope of protection measures. These are higher risk sites and reliance on Table 4 alone is not sufficient.

BS8485:2015+A1:2019 Table 3 Building Types

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ public, possible multiple	Commercial / public	Commercial / industrial
Control (change of use, structural alterations, ventilation	None	Some but not all	Full	Full
Room sizes	Small	Small / medium	Small to large	Large industrial / retail park style

BS8485:2015+A1:2019 Table 4 Gas Protection Score by CS and Type of Building				
	Required Gas Protection			
CS	High risk	Medium risk	Low risk	
	Type A	Type B	Type C	Type D
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5 (A)	5.5(A)	4.5	3.5
5	(B)	6A)	5.5	4.5
6	(B)	(B)	(B)	6

a) Residential building should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g., high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g., in institutional and/or fully serviced contractual situations.

b) The gas hazard is too high for this empirical method to be used to define the gas protection measures

NOTE 3 The NHBC has published guidance for use on residential developments, which utilise an alternative classification ("traffic light") system. This guidance typically applies to Type A buildings utilising beam and block floor constructions with clear void ventilation. The design choice variables are limited to decisions relating to the membrane specification and verification recommendations (see Table 7). Designers utilising this system would therefore need to refer to NHBC to assess compliance for specific recommendations [see 8485:2015 for further on this note]

NOTE4 The method of selecting the combination of these types of protection is given in section 7.2 of BS8485:2015. Once type of measures has been decided, the detailed design and specification of the measures should be undertaken (section 7.3)

Section 7.2 defines the order of selecting protective measures. The first choice is provided by structural barriers as defined in Table 5.

BS8485+A1:2019 Table 5 Gas protection scores for structural barriers		
PROTECTION ELEMENT/SYSTEM	**SCORE**	**COMMENTS**
Floor and substructure design		
Floor slabs Block and beam floor slab	0	*General – score conditional that breaches of slab are sealed*
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	0.5	
Cast in situ monolithic reinforced ground-bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations (with only nominal mesh reinforcement)	1 or 1.5	*To achieve 1.5, raft or suspended slab to be well reinforced to prevent cracking and minimal penetrations*
Basement floor and walls to BS 8102:2009, Grade 2 waterproofing – See notes in BS8485:2015+A1:2019	2	
Basement floor and walls to BS 8102:2009, Grade 3 waterproofing - See notes in BS8485:2015+A1:2019	2.5	*Conditional that waterproofing is not based on geosynthetic clay liner*

Ventilation methods are detailed in Table 6, and points can only be gained from using one of the five types:

BS8485:2015+A1:2019 Table 6 Gas Protection Scores for Ventilation Protection Measures

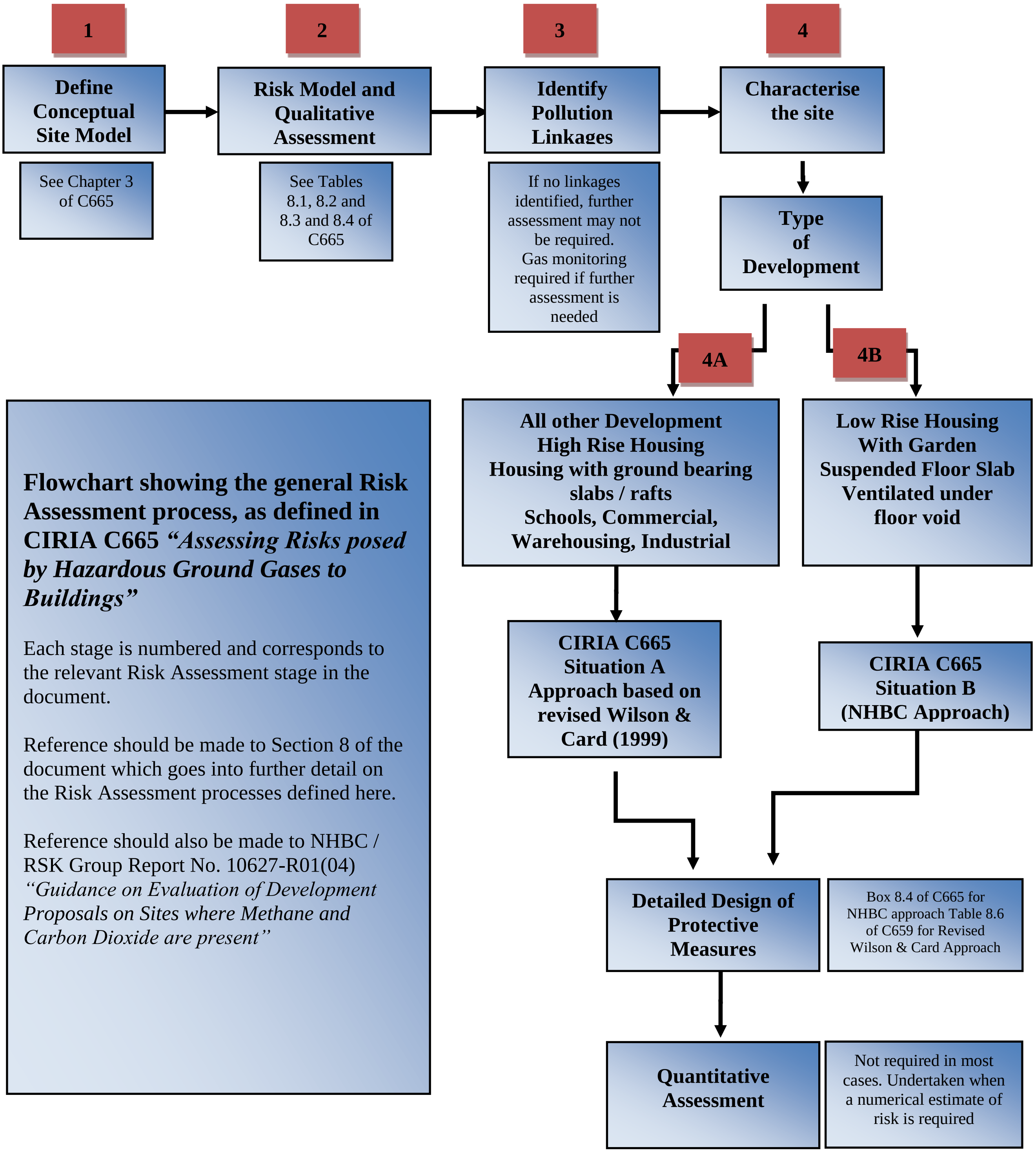
PROTECTION ELEMENT/SYSTEM	SCORE	COMMENTS
a) Pressure relief pathway (usually formed by low fines gravel or with a thin geocomposite blanket with strips terminating in a gravel trench external to the building	0.5	*Whenever possible, a pressure pathway relief pathway (as a minimum) should be installed in all gas protection measures systems.* *If a layer has a low permeability and/or is not terminating in a venting trench (or similar), then the score is zero.*
b) Passive sub floor dispersal layer		*Performance criteria shown in Fig B.6 and B.7 of BS 8484:2015.[See Annex B]*
Very good performance	2.5	
Good performance	1.5	
Media used to provide the dispersal layer are: • Clear void • Polystyrene void forming blanket • Geocomposite void former blanket • No-fines gravel layer with gas drains • No-fines gravel layer		
c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5 to 2.5	*This system relies on continued serviceability of the pumps; therefore, alarm and response systems should be in place. [See Annex B].*
d) Active positive pressurisation by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5 to 2.5	*This system relies on continued operation of the pumps; therefore, alarm and response systems should be in place. [See Annex B].*
e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or under croft)	4	*Assumes car park is vented , designed to Building Regulations 2000, Approved Document F.*

Membrane methods are detailed in Table 7.

BS8485:2015+A1:2019 Table 7 Gas protection score for gas resistant membrane		
PROTECTION ELEMENT/SYSTEM	**SCORE**	**COMMENTS**
Gas resistant membrane meeting all of the following criteria: • Sufficiently impervious to gases with a methane gas transmission rate <40.0 ml/day/m^2/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method) • Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • Sufficiently strong to withstand in-service stresses (e.g., settlement if placed below a floor slab); • Sufficiently strong to withstand the installation process and following trades until covered (e.g., penetration from steel fibres in fibre reinforced concrete, dropping tools etc); and to withstand in-service stresses (e.g., settlement if placed below a floor slab) • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • verified in accordance with CIRIA C735	2	*The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints.* *If a membrane is installed that does not meet the criteria, then the score is zero.*
See notes in BS8485:2015+A1:2019 regarding membrane requirements		

For a site which is impacted by migratory gases from an off source, the development may be protected by imposing pathway intervention methods, which if successfully validated, could also remove the need for further analysis. It is essential that the gas regime in these circumstances has been fully characterised and that the only source impacting the site is located off site and that the pathway is clearly defined and its interception equally proven before construction commences. Pathway intervention methods may include vertical membrane installations, venting trenches, rows of stone columns, activated trenches and various proprietary systems. These systems are particularly relevant to domestic housing where there is limited scope for foundation type solutions.

Following the choice of protection measures, detailed design should be entered into [Section 8 of BS 8485:2015+A1:2019].



Flowchart showing the general Risk Assessment process, as defined in CIRIA C665 *“Assessing Risks posed by Hazardous Ground Gases to Buildings”*

Each stage is numbered and corresponds to the relevant Risk Assessment stage in the document.

Reference should be made to Section 8 of the document which goes into further detail on the Risk Assessment processes defined here.

Reference should also be made to NHBC / RSK Group Report No. 10627-R01(04) *“Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are present”*

APPENDIX L: GUIDANCE FOR CLASSIFICATION OF SOIL FOR OFF SITE DISPOSAL AT A LANDFILL SITE

Guidance for Classification of Soil for Off Site Disposal at a Landfill Site

Many site developments create a portion of excess soils and Made Ground which if not re-usable, are required to be disposed off-site at a suitably licensed landfill site. The regulations and associated guidance published by the Environment Agency is relatively complex and lengthy. This guidance provides a summary of the following documents which should be referred to when assessing soil (and common constituents found within Made Ground on remediation sites) for off-site disposal:

- Guidance for Waste destined for disposal in landfills: Interpretation of the Waste Acceptance Requirements of the Landfill (England and Wales) Regulations 2002 (as amended) (EA, 2004);
- Guidance on Sampling and Testing of Wastes to Meet Landfill Waste Acceptance Procedures (EA, April 2005);
- WM3 - Hazardous Waste: Interpretation of the Definition and Classification of Hazardous Wastes (EA, May 2015);
- European Regulation No 1272/2008 on Classification, Labelling and Packaging of substances 2015 (CLP 2015);
- Guidance on Waste Destined for Disposal in Landfill (EA, June 2006);
- Treatment of Non-hazardous wastes for Landfill (EA, February 2007).

It is important to distinguish between the waste classification system and the designation of materials as “suitable for use” on site. A material may be retained on site for an appropriate end use if that end-use is clearly designated and that a site-specific risk assessment ensures that it does not pose a risk to human health or controlled waters. However, if this material is excavated and sent for disposal, the material is then subject to waste management regulations and the two systems cannot be directly correlated. It is therefore important to note that classifying a material as hazardous (should it be excavated and become a waste) does not necessarily indicate that it might not be suitable to be kept on site for re-use. Separate guidance in the form of a Code of Practice (CL:AIRE Version 2, 2011) has been developed jointly between the development industry and the Environment Agency to provide best practice when assessing whether materials are wastes or not, and for determining when waste can cease to be waste for a particular use.

In accordance with the current waste regulations (or Landfill Directive, as they are more commonly known), from 30th October 2007 all waste materials produced from construction sites have to be pre-treated prior to disposal. Pre-treatment includes waste minimisation, recovery (e.g., separation of demolition waste to be used as hardcore) and separation of materials into different waste categories (e.g., separate inert waste from hazardous waste etc). Mixing of different waste types shall be avoided and intentional mixing of inert materials with hazardous waste to ‘dilute it’ and hence change its waste classification, is illegal.

The current waste regulations (based on the EU landfill directive) introduced a two-tier classification system for waste materials, defining them as either being hazardous or non-hazardous. Landfills are licensed to take wastes based on a three-tier classification system with the non- hazardous waste divided into two sub-categories:

- Non-Hazardous - inert;
- Non-Hazardous - non-hazardous;
- Hazardous.

Waste materials are categorised with a six-figure numeric code in the European Waste Catalogue. Commonly found construction and demolition wastes including excavated soil from contaminated sites and Made Ground with their waste codes are summarised below (this is not a comprehensive list):

Waste Code	What is it?	Likely Waste Category–		
		Inert Waste	Non-Hazardous	Hazardous Waste
17 01 01 Concrete	Concrete, possibly with reinforcement (from Construction & Demolition)	✓		
17 01 02 Bricks		✓		
17 01 06* Mixtures of concrete, bricks, tiles & ceramics containing dangerous substances	These are not normally considered hazardous but if they are contaminated (e.g., by asbestos) then could be hazardous – see comment above			✓
17 01 07 Mixtures of concrete, bricks, tiles & ceramics other than those in 17 01 06	This is mixed inerts c.f. 17 09 04	✓		
17 05 03* soils and stones containing dangerous substances				✓
17 05 04 soils and stones other than those mentioned in 17 05 03	Soil and stones only (excluding top soil, peat, soil and stones from contaminated sites)	✓		
17 06 05* Construction materials containing asbestos	e.g., corrugated asbestos sheeting			✓
17 08 02 Gypsum-based construction materials other than those mentioned in 17 08 01	Plaster & plasterboard (although specific disposal requirements are required for high sulphate waste – see EA guidance 'Understanding the Landfill Directive' version 1.0 March 2010.		✓	
17 09 01* Construction & demolition wastes containing mercury				✓
17 09 02* Construction & demolition wastes containing PCBs	Waste with more than 50 mg/kg of PCB's are hazardous			✓

Waste Code	What is it?	Likely Waste Category–		
		Inert Waste	Non-Hazardous	Hazardous Waste
17 09 03* Other mixed construction & demolition wastes containing dangerous substances	Broad range of potentially (see notes below – if asterix the waste is hazardous) hazardous wastes			✓
17 09 04 Mixed construction & demolition wastes other than those mentioned in 17 09 01, 17 09 02 & 17 09 03	Mixed inerts with soil, tarmac, cables, vegetation, plaster, etc. (this waste can only be considered inert if it passes the waste acceptance criteria identified in the regulations).	✓	✓	

Note: all wastes with an asterix code are hazardous regardless of whether they are mirror or absolute entries in the EWC list the decision to with regard to composition must come before applying the code for mirror entries.

Some materials are classified as Inert Waste based in its origin (e.g., 17 01 01 Concrete, or glass) without any requirement for laboratory chemical analysis.

However, most soils will require laboratory testing to confirm whether they are classified as Hazardous Waste. The protocol for assessing these materials and the appropriate threshold values is complicated and are set out in the Environment Agency's "Technical Guidance *WM3* Hazardous Waste – Interpretation of the Definition and Classification of Hazardous Waste" (2015). If the test results for the waste indicates that it is not hazardous then further analysis of the waste is required to determine whether it is Inert Waste. If the waste does not meet the criteria for either Hazardous or Inert, then it is by default classified as Non-hazardous Waste.

As an alternative location to landfills for off-site disposal of inert and non-hazardous waste, there are a number of sites which have Waste Permit Exemptions that can accept certain categories of inert and non-hazardous wastes. Additionally, some quarries can accept certain types of wastes to be used for quarry restoration material. For both alternatives to disposal at landfill sites the material still requires chemical testing as these sites have site specific acceptance criteria for wastes. It should also be noted that these types of sites do not incur landfill tax which in the 2018/19 tax year is £2.80 for inactive waste (inert and some types of non-hazardous waste) and £88.95/Tonne for active waste (some types of non-hazardous waste and hazardous waste. Note that the Inland Revenue uses a different classification scheme for waste for tax purposes to the European Waste Classification scheme.

Waste Categorisation

The process of determining the category of wastes is a three-stage process:

- Stage 1 – is the waste either Hazardous or Inert by definition without the requirement for chemical analysis (if it is then Stages 2 and 3 are not required);
- Stage 2 - Waste characterisation;
- Stage 3 - WAC classification.

Waste characterisation determines if a waste is hazardous or not. Excavated soil is characterised using a system based on the contaminants present and their hazardous properties. The system uses total concentrations of the contaminants. Thresholds (as a percentage of the waste) have been set for the various hazardous properties.

Fourteen hazardous properties together with other scenarios where material could cause a hazard have been defined:

- Hazardous properties: explosive, oxidising, highly flammable/flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, toxic for reproduction, mutagenic and ecotoxic;
- Substances which can release toxic/very toxic gases in contact with water, acid or air;
- Substances which, after disposal, can yield another substance, e.g., a leachate, which possesses any of the above hazardous properties.

Some of the hazardous properties are sub-divided e.g., there are three categories of carcinogenic, mutagenic and toxic for reproduction substances. The hazardous properties were originally defined in the European Hazardous Waste Directive 91/689/EC. Should a waste contain a contaminant with one or more of the listed hazardous properties at a concentration equal to or above the threshold value for the particular property, then the waste is hazardous. The hazardous properties of a wide range of chemicals are sourced from CLP 2015.

There are many reasons why waste soil is classified as being hazardous, but the majority of reasons can be divided into the following four groups:

- Hydrocarbons – this is probably the most common reason for the hazardous classification of soils. For most soils hydrocarbon analysis will be required for both Polycyclic Aromatic Hydrocarbons (PAH) and speciated Petroleum Hydrocarbons (PHCs) but depending on the site's history other groups of organic contaminants may also be is included in any analysis suite for soil samples;
- Metals – Particularly sites from former metal processing or mining sites and also some types of ash have metal concentrations that are sufficiently high to characterise materials requiring disposal as hazardous waste.
- Asbestos;
- Anions – e.g., sulphate in plasterboard (there are special disposal requirements for high sulphate waste and specific WAC requirements); it is possible that sulphate salts of metals and semi-metals could make the waste hazardous – the sulphate concentration could possibly be significant under H12, H13 and H14.

The characterisation of wastes with significant metal concentrations involves some processing of the analysis data. The chemical analysis results for inorganic substances are generally reported as total concentrations e.g., total lead, total arsenic, total sulphate etc. However, CLP 2015 deals with the hazardous properties of actual compounds e.g., lead sulphate, arsenic pentoxide, nickel carbonate. Therefore, the total metal results have to be converted into assessed chemical analysis results for the compound most likely to be present in the soil samples. For example, if the sample contains high total lead concentrations and high sulphate concentrations, then the lead is likely to be present in the soil as lead sulphate. The most likely compounds can often be determined from a desk study or previous site uses. If the site has been derelict for a number of years, consideration should be given as to whether water soluble compounds should or should not be chosen, as rainfall could have removed them from the soil (this does not apply if the soil has been taken from below under a concrete slab etc). Chemical knowledge and common sense needs to be used in choosing a suitable compound.

If no data is available, then a worst-case scenario has to be assumed and the most hazardous compound likely to be present has to be chosen. For example, metal chromates (lead chromate, nickel chromate) are often the most hazardous compounds formed by many metals, but if the chromium concentrations in the soil are low, chromates are unlikely to be present. It should also be noted that for many of the hazard categories, the cumulative hazard from different compounds is added (e.g., add the concentrations of the copper, lead and zinc compounds together to assess the Hazard Category H14 Ecotoxicity).

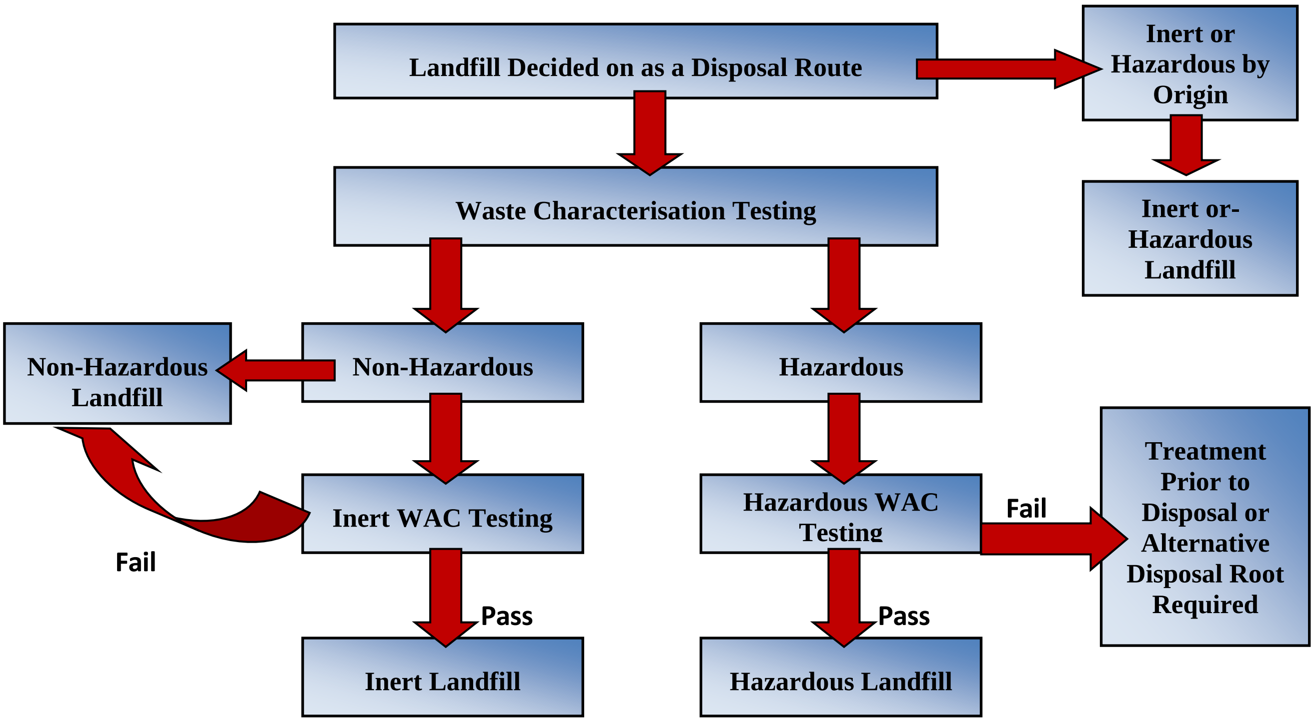
If the results of the above assessment determine that the waste is hazardous, it must then be analysed for the Waste Acceptance Criteria (WAC) analysis contained within appropriate Environmental Permitting Regulations (this comprises mainly leachate but also analysis for TOC and Loss on ignition). WAC limit values have been set for the listed determinands. If any of the determinands exceed their limit value, the waste must be pre-treated to reduce concentrations to below the limit values before the waste may be disposed of at a landfill site licensed to take hazardous waste.

For waste classified as not being hazardous, then there are two options available. Currently, waste correctly characterised as not being hazardous may be disposed of without WAC testing to a non-hazardous landfill. Alternatively, WAC testing for Inert Waste can be carried out (this is similar to the list for hazardous waste with the addition of PAH's, BTEX and Mineral Oil). If the results pass the Inert WAC criteria it can be disposed of at an Inert Waste Landfill. If any of the WAC test results exceed the Inert WAC criteria the waste has to be disposed at a non- hazardous landfill. There are WAC limits for non-hazardous waste set for pH and TOC. If these two criteria are not met then the waste must be pre-treated to so that it meets the criteria before it can be disposed.

If materials fail the WAC criteria it may be possible to pre-treat the waste on-site or be taken to a soil treatment centre for pre-treatment to reduce the soil's hazardous properties (e.g., by bioremediation of hydrocarbons).

It should be noted that in order to dispose of Hazardous Waste, the site must register as a producer of Hazardous Waste with the Environment Agency. When disposing of waste materials to landfill sites the appropriate Duty of Care Waste Transfer procedures must be followed.

Landfilled Waste Decision Tree



Landfill Tax

It should be noted that HM Revenue and Customs (HMRC) classify wastes for tax purposes using a different scheme to the threefold landfill EU Landfill Directive scheme (i.e., the hazardous, non-hazardous and inert). HMRC have a two-fold system for landfill tax. The Standard Landfill Tax is currently £88.95/T and applies to all wastes unless they qualify for the reduced rate of landfill tax of £2.80/T. The wastes that qualify for the reduced rate of Landfill Tax are set out in The Landfill Tax (Qualifying Material) Order 2011 with supplementary information on the interpretation of these regulations in HMRS “Notice LFT1 – A General Guide to Landfill Tax” (May 2012) and HMRC Briefing Notes 15/12 and 18/12.

APPENDIX M: UNFORESEEN GROUND CONTAMINATION

Unforeseen Ground Contamination

There is the potential for areas of previously unexpected contamination to be present, as is the case with any "brownfield" site. Any significant quantities of asbestos, significant ashy soils, unusual, brightly coloured or significantly oily or odorous material should be considered in this category. If unexpected contamination is found the following procedures should be adhered to:

1. All site works at the position of the suspected contamination will cease.
2. A suitably trained geo-environmental specialist should assess the visual and olfactory observations of the condition of the ground and the extent of contamination, and the Client and the Local Authority should be informed of the discovery. Should the contamination be likely to affect controlled waters the Environment Agency shall also be informed.
3. The suspected contaminated material will be investigated and tested appropriately in accordance with the assessed risks. The investigation works will be carried out in the presence of a suitably qualified geo-environmental engineer. The investigation works shall commence to recover samples for testing and, using visual and olfactory observations of the condition of the ground, delineate the area over which contaminated materials are present.
4. The unexpected, contaminated material will either be left in situ or be stockpiled whilst testing is carried out and suitable assessments completed to determine whether the material can be re-used on site or requires to be disposed as appropriate.
5. Where the material is left in situ awaiting results it will be reburied or covered with plastic sheeting.
6. Where the potentially contaminated material is to be temporarily stockpiled it will either be placed either on a prepared surface of clayey Alluvium, or on 2000-gauge Visqueen sheeting (or other impermeable surface) and covered to prevent dust and odour emissions.
7. Any areas where unexpected visual or olfactory ground contamination will be surveyed, a photographic record kept, and testing results incorporated into the Verification Report.
8. A photographic recorded will be made of relevant observations.
9. The testing suite will be determined by the independent geo-environmental specialist on the basis of visual and olfactory observations.
10. Test results will be compared against current assessment criteria suitable for the future use of the area of the site affected.
11. The results of the investigation and testing of any suspect unexpected contamination will be used to determine the relevant actions. After consultation with the Local Authority and if necessary the Environment Agency, materials should either be:

- re-used in areas where test results indicate that it meets compliance targets so it can be reused without treatment; or
- treatment of material on site to meet compliance targets so it can be reused; or

- removal from site to a treatment centre or to a suitably licensed landfill or permitted treatment facility.

12. Verification Report will be produced for the work.

Asbestos

Asbestos cement products and asbestos fibres have not been encountered in the soils at the site but based on the age of the Made Ground material containing asbestos could be expected to be encountered. If non-notifiable asbestos (e.g., chrysotile asbestos cement board) is encountered in excavations then it will be dealt with in accordance with the Control of Asbestos Regulations 2012 (CAR 2012) and the HSE's ACoP for asbestos (2013). Finding non-notifiable asbestos is a very common occurrence on brownfield sites and is a relatively low risk activity and can be dealt with as a matter of routine. Therefore, it is not proposed that the Council will be notified but an appropriate record will be kept of confirmatory testing and disposal. This will be included in remediation verification reports.

If suspect notifiable asbestos is encountered then the Council and the HSE will be notified. An appropriate action plan will be agreed with the Council and the HSE in accordance with CAR 2012. The action plan will include the preparation of the Risk Assessment and Plan of Work in accordance with CAR and other statutory requirements including:

- Site mobilisation;
- Excavation methodology;
- Handling, movement and storage on-site of excavation arisings;
- Any processing of excavation arisings containing ACMs;
- Movement and placement of arisings to final destination;
- Placing of cover system over soils with and ACMs remaining on-site;
- Off-site disposal of ACMs;
- Licences;
- PPE & RPE; and,
- Dust and fibre monitoring.

Potential mitigation measures that would be required include:

- Ensuring works are carried out by suitably trained and experienced personnel with working with asbestos;
- Site investigation and risk assessment;
- Removal or treatment of asbestos hotspots;
- Use of PPE and RPE by construction workers; and,

- Compliance monitoring.

Unexpected Tanks

No buried underground fuel storage tanks have been encountered during the site investigation works; however, there remains a low risk that tanks are present on-site. Should an underground tank be encountered, operations should cease in the area. Additionally, there may be pipework associated with these tanks which could have oily residues. The following procedures are to be adhered to if tanks and pipework are identified:

1. All site works at the position of the tanks/pipework should stop.
2. A description of the tank should be made by the geo-environmental engineer including; condition and surround, along with visual and olfactory observations should any contents in the tank be apparent. A photographic recorded will also be made of relevant observations.
3. The tank's position and depth should be determined and marked on a plan of the site.
4. The independent geo-environmental engineer will inform Client and the Local Authority.
5. During the presence of the independent geo-environmental engineer, investigation works should be undertaken to obtain samples of any liquid or sludge contents and to establish dimensions of the tank.
6. Testing will be determined on the basis of visual and olfactory observations by independent geo-environmental engineer.
7. Test results will be compared against current assessment criteria and proposals for disposal of any contents determined in agreement with the appropriate Regulatory Parties.
8. Emptying the tank and disposal of contents to a suitable licenced disposal facility.
9. Degassing and removal of the tank by a suitably qualified contractor will be required, and a Naked Flame Certificate should be provided.
10. Once the tank has been emptied in accordance with the above proposals, it is to be removed for disposal to a licensed waste management facility. Copies of the relevant waste consignment notes are to be kept and included in the Verification Report.
11. Excavation and remediation of any contaminated soils around the tank will be carried out.
12. Samples of the base and sides of the resultant hole will be sampled and supervised by the independent geo-environmental engineer to confirm whether risks to human health or controlled waters.