LITHOS

Geoenvironmental Appraisal

Land at Providence Street, Earlsheaton

For Precious Holdings (Wakefield) Ltd

Report no: 4985/2

Date: July 2024

SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	4985	**Site area/ha**	1.8
Client:	Precious Holdings (Wakefield) Ltd	**NGR:**	SE 259 211
Site:	Providence Street, Earlsheaton	**Nearest postcode:**	WF12 8HZ

The site is located off Providence Street, approximately 1.3 km east of Dewsbury town centre and currently comprises a storage container yard (northwest), overgrown clearing (centre) and overgrown woodland (southeast). Historically the site has been the location of a sandstone quarry an area of 'Tenters' (used in the woollen industry) and housing.

Lithos were commissioned by Precious Holdings to provide a geoenvironmental appraisal of the site, which it is understood is to be redeveloped with housing.

Lithos' investigation included an inspection of historical and geological maps and information provided by the British Geological Survey, the Landmark Information Group, the Coal Authority, and QGIS. In addition, a site inspection has been carried out.

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

Issue	Remarks
Made ground	Made ground topsoil was encountered across the area of cleared vegetation, with deeper made ground encountered underlying the container storage yard in the northwest and within the footprint of former buildings along Providence Street. The made ground comprised sandy Gravel & sandy Clay, with fragments of glass, metal, plastic, wood, coal & whole bricks and floor slabs.
Natural ground	Comprises a veneer of topsoil over Cohesive (sandy, gravelly Clay) and Granular (silty Sands and Gravels) Residual Soils, with solid Thornhill Rock (sandstone bedrock) encountered from 1.1m to 2.8m depth.
Contamination	High concentrations of arsenic and lead were identified in samples from across the site. The placement of a clean cover system (likely 600mm based on existing information) will be required. No asbestos fibres have been identified in any of the material screened to date.
Mining & quarrying	The site is located within a Coal Mining Development Low Risk Area (within the CA defined coal fields, but no known defined risks have been recorded by the CA; there may still be unrecorded issues). A former sandstone quarry is located within the site boundary, but beyond the net developable area. An additional former sandstone quarry is located immediately south of the site, this area is now under development with residential dwellings.
Hazardous gas	The site lies in an area where 3% to 5% of homes are estimated to be above the radon action level; therefore, basic radon protection measures are required. Monitoring wells have been installed within 6 window sample boreholes, monitoring is currently ongoing and a Gas Risk Assessment will be issued upon completion of the monitoring.
Preparatory works	Tree survey and surveying of tree stumps (including diameters). Demolition of existing buildings, with chasing out of any foundations & buried obstructions, grubbing of hardstand. Clearance of surface materials (fly-tipping), storage containers and vegetation.
Foundations	At this stage, it is anticipated that traditional strip/trench fill footings (deepened due to made ground & tree influence) will be the most suitable foundation solution for two & three storey domestic dwellings constructed at this site, founded in medium to high strength clays (cohesive residual soil) and dense sands and gravels (granular residual soil). Bedrock (Thornhill Rock sandstone) is anticipated at shallow depth, if encountered, foundations should be placed entirely on rock. Piles may be required where significant thicknesses of made ground or areas of significant tree influence in deeper cohesive residual soil are encountered.
Groundwater & excavations	Groundwater was not encountered during the intrusive investigation. Excavations within natural residual soils remained stable during excavation. If left open for long periods of time, especially in wet weather, some shoring may be required. Excavations within made ground was poor and shoring will be required, even in the short term.
Flooding & drainage	The entire site lies within Flood Zone 1. Based on the testing conducted, soakaways are anticipated to provide a suitable drainage solution for surface water run-off at this site, however, the topography of the site and surrounding area will need to be taken into account to prevent spring lines developing down slope.

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Issue	Remarks
Highways	Natural ground is anticipated to provide a CBR value of at least 3%, testing should be conducted to confirm this. Made ground along the route of proposed highways should be excavated, screened & re-engineered to provide a CBR value of at least 3%.

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

- Demolition of existing buildings/foundations and grubbing up of hardstand.
- Ground improvement – turnover of the full thickness of made ground, in order to remove buried obstructions and remove uncertainties about further contamination.

Some further work is required, most notably:

- Simple post demolition/ site clearance pitting investigation across previously inaccessible areas.
- Hazardous gas monitoring (underway) and issue of a Hazardous Gas Risk Assessment.
- Production of a Remediation Strategy.
- Topsoil/surface sampling across the area of woodland (beyond the net developable area) if it remains publicly accessible.

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02	Ground investigation fieldwork
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Appendix B - Drawings

Drawing	Revision	Title
4985/1	-	Site Location Plan
4985/2	-	Proposed Site Layout
4985/3	-	Site Features
4985/3A	-	Historic Site Features
4985/4	-	Site Photographs
4985/5	-	Preliminary Conceptual Site Model
4985/6	-	Exploratory Hole Locations
4985/7	-	Revised Conceptual Site Model
4985/8	-	Simple Foundation Zoning Plan

Appendix C - Commission

Appendix D - Historical OS plans#

Appendix E - Search responses#

From	Date	Content
Landmark	7th March 2024	Envirocheck report
Coal Authority	7th March 2024	Consultant's Coal Mining Report
British Geological Survey	7th June 2024	BGS Radon Report
British Geological Survey	September 1996	Scan of BGS Technical Report WA/96/17 – Bank Top Colliery Shaft

Appendix F & G - Exploratory records

Appendix F	SA01 to SA04 & TP01 to TP04
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Appendix H - Chemical results

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

Appendix J - Geotechnical test results

Appendix K - Soakaway test results

Appendix L - Gas monitoring results

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

FOREWORD (GEOENVIRONMENTAL APPRAISAL REPORT)

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

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

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

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

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

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

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

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

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

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

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

GEOENVIRONMENTAL APPRAISAL
of land at
PROVIDENCE STREET, EARLSHEATON

1 INTRODUCTION

1.1 The commission and brief

1.1.1 Lithos Consulting Limited were commissioned by Precious Holdings (Wakefield) Ltd to carry out a geoenvironmental appraisal of land at Providence Street, Earlsheaton.

1.1.2 Lithos have previously issued a Preliminary Investigation Report (Ref 4985/1, dated June 2024). The information contained in Report 4985/1 has been incorporated within this Report..

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

- A site walkover and inspection
- An assessment of the land use history
- Determination of the site's environmental setting
- A mining risk assessment in accordance with Coal Authority guidance.
- An intrusive ground investigation comprising 10 trial pits and 6 window sample boreholes
- Assessment of the geotechnical properties of the near surface deposits to enable provision of foundation and highway recommendations
- A qualitative assessment of contamination risks
- Recommendations for the necessary site preparatory and remediation works

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

1.2 The proposed development

1.2.1 It is understood that the site is to be redeveloped with c. 30 residential dwellings, associated gardens, POS and adoptable roads and sewers. A site layout (sketch masterplan) has been provided by JRP Associates (Drawing reference; 24 5721 SK04, dated July 2024) which is reproduced as Drawing 4985/2 in Appendix B to this report.

1.2.2 The net developable area comprises c. 0.86 ha in the north/centre due to biodiversity requirements.

1.3 Report format and limitations

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

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

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

2 SITE DESCRIPTION

2.1 General

2.1.1 The site's location is shown on Drawing 4985/1 presented in Appendix B to this report. Site details are summarised in the table below.

Detail	Remarks
Location	1.3 km east of Dewsbury town centre.
NGR	SE 259 211
Approximate area	1.8 ha (4.4 acres)
Known services	Overhead telecom along Providence Street and wooden utility mast in the south.

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on 12th March 2024.

2.2.2 Existing salient features, at the time of the walkover are presented on Drawing 4985/3 in Appendix B to this report and summarised in the table below.

Feature	Remarks
Current access	Off Providence Street to the northeast, with access to the container storage yard from Town Street to the northwest.
Topography	Land generally falls from the northwest to the southeast at c. 1:8 (v:h). The southeast of the site is undulating, including a large hollow (former quarry) and steep mounds. Retaining walls and large changes in ground level were noted along various boundaries and within the site, detailed below.
Approximate areas	10,100m² Overgrown woodland 6,300m² Cleared woodland 800m² Buildings/storage containers 550m² Gravel surfacing 300m² Cobbled street
Nature of boundaries	North – No physical boundary, open to Providence Street. Small section of stonework retaining wall in the northeast. East – Sandstone retaining wall with metal mesh and wooden fencing. South – Garden fences and walls, appear to be retaining walls in places. Open in the centre south with a c. 10m near vertical drop to a new residential development below. West – Garden fences and walls, gated access to Town Street in the northwest.
Surrounding land uses	North – Providence Street, with residential dwellings beyond (The Laurels & Syke Ing Villas). East – Residential dwellings (Jilling Ing Park & Gardens). South – Residential dwellings and a residential development site (Ossett Lane & Greenwood Drive). West – Overgrown grassland, residential dwellings and Town Street. Former Providence Mill buildings (now offices/commercial units) north of Town Street.

2.2.3 A selection of site photographs is included on Drawing 4985/4 in Appendix B to this report.

2.2.4 A compound for Homestead Mill (Container & Unit letting company) occupies the northwest of the site (accessed off Town Street along a cobbled road leading to a gravel yard), with shipping containers along the north/east and a one-storey office building along the south. An area of car parking/ storge lies in the southeast.

2.2.5 The centre of the site comprises a cleared area, with piles of wood chip and tree stumps (typically 100mm to 300mm in diameter). Some fly-tipping (tyres, clothing, garden/general waste, possible ACMs & building materials) of the area has occurred.

2.2.6 Two areas of overgrown vegetation are present on site, one in the northwest (c. 1,150m^2) and the other in the centre/east (c. 8,950m^2). Both comprise mature trees, brambles, and smaller shrubs with further fly-tipping (including refrigerators, car seats, and mattresses).

2.2.7 The overgrown area in the centre/east contains remnants of historic buildings (brick walls and hardstand) and varies significantly in topography, with large hollows and undulating ground. The largest hollow is likely associated with the former sandstone quarry shown on historical OS maps.

2.2.8 A single wooden utility mast (possibly electric) with no overhead cables attached was noted in the southwestern corner of the site, no other masts or overhead cables were identified within the site boundary. Utility plans show low voltage and 11kV cables on timber poles in the south, likely now decommissioned.

2.2.9 Multiple retaining walls were identified during the walkover and are summarised in the table below. It should be noted that other retaining walls hidden by dense vegetation may be present within or around the site.

Location	Approximate Length	Approximate Retained Height
North-eastern boundary	15m	1.0m
Eastern boundary	140m	0.5m in the north to >2.0m in the south
Southern boundary	15m	1.0m
Southwest boundary	30m	0.5m

2.2.10 In addition to the retaining walls, a large c. 10m near vertical drop is present along the southern boundary. The land below is currently undergoing development (residential dwellings), but no shoring or retaining walls have yet been constructed. The exposed rock face appeared to show sandstone from shallow depth.

3 SITE HISTORY

3.1 Site centred extracts from Ordnance Survey (OS) plans dating back to 1855 have been examined. Some of these plans are presented in Appendix D to this report.

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

Date	Site	Surrounding land
1855	Primarily comprises open arable land. A **sandstone quarry** is located in the southeast. Well located within the quarry footprint. **Tenters** located in the north of the site.	Open arable land immediately north and east. Residential/ Commercial buildings immediately northwest, along Sike Lane (now Town Street), running southwest to northeast. Buildings from c. 10m northwest, c. 10m south (north of Ossett Lane) and from c. 50m west. **Tenters** and **sandstone quarry** shown immediately south. Well located immediately east. Ossett Lane, running east to west c. 20m south.

Date	Site	Surrounding land
	Buildings shown in the northwestern corner. A small building is shown in the south, possible Wet house.	Building (Vicarage) located c. 50m north. Watercourse shown from c. 50m south, flowing southwest. Tenters shown from c. 80m west. Chickenley Mills (Woollen/Mungo) from c. 90m east. **Sandstone quarry** c. 130m south. **Coal pit** located c. 200m north.
1893	**Tenters** now occupy much of the centre/north of the site. Sandstone quarry now labelled Old quarry. Buildings and gardens now line the northern boundary of the site (off Providence Street). Building in the south no longer shown.	Providence Street now lies immediately north, running east to west towards Towns Street (Formerly Sike Street). Buildings shown along Providence Street from c. 10m north. **Mill Pond** from c. 20m east. Jilling Ing Mills (Woollen) from c. 40m southeast. Providence Mill (Woollen) from c. 50m northwest. Watercourse (Chickenley Beck) c. 60m east and c. 60m south, possibly culverted in between. **Mill Ponds** and buildings (Syke Ing Mills (Woollen)) from c. 80m northeast. Station Road from c. 90m south. Hoyle Head Mills (Woollen) from c. 110m west. Ossett & Dewsbury Branch (Railway line), running east to west c. 230m south. Bank Top Colliery from c. 250m north.
1907	No significant changes.	Providence Mill from c. 50m northwest increased in size. **Smithy** labelled c. 90m southwest. Allotment gardens shown c. 100m north. Tanks shown c. 100m northeast. Further mill building shown c. 140m north.
1922	Small building shown in the centre.	Sandstone quarry immediately south of Ossett Lane now labelled as 'old'.
1931	No significant changes.	Jilling Ing Mills increased in size, now from c. 20m east of the site. Bank Top Colliery now labelled old shaft c. 250m north.
1938	Tenters no longer shown.	Residential dwellings and Greenwood Ave shown immediately southwest. In addition to south of Ossett Lane. **Reservoir** shown from c. 20m east, associated with Jilling Ing Mills. Residential dwellings north of Providence Mill from c. 100m northwest.
1955	Buildings in the northwest labelled warehouse.	Tennis Courts and raised/ levelled ground shown from c. 40m south.
1972	Buildings along the northern boundary no longer shown. Building in the northeast remains.	Buildings north of Providence Street no longer shown.
1982	Building in the northeast no longer shown.	Residential development north of Providence Street from c. 10m north, The Laurels. Area of possible mineral extraction c. 30m south.
2009	No significant changes.	Jilling Ing Mills no longer shown.
2013		Residential development north of Ossett Lane immediately southeast (Jilling Ing Park).
2023	Comprises primarily of overgrown woodland, with buildings and containers in the northwest.	No significant changes.

3.3 Significant historical features are shown on Drawing 4985/3A in Appendix B.

3.4 The woollen industry has been prominent in the areas around Dewsbury since the late 1500s, with Earlsheaton known for blanket making. The site lies within close proximity to several woollen mills and from at least 1855 is shown to contain 'tenters' (or tenter frames) used for the drying of fabric (sheets).

3.5 Tenter frames typically comprised metal, wooden or even stone supports with two horizontal wooden beams lined with tenterhooks (small, hooked metal nails used to attach and hold the fabric in place). Typically, one of the wooden beams was adjustable which allowed for easier attachment/removal and allowed varying widths of fabric to be tentered on the same frames. Tenters varied in length and height, but those used in the manufacturing of blankets were typically the largest and could reach up to 3.6m in height.

3.6 Tenter frames were typically sited outdoors in seams of parallel rows (tenter fields), ideally on sloping ground as to avoid blocking air flow and casting shadows on adjacent tenter frames. It was commonplace for a "wet house" to be within or near tenter fields, these buildings were used to store fabrics prior to Tentering or in times of poor weather.

3.7 The process of tentering involves stretching and drying fabric (woollen cloth) to increase the dimensions (length and breadth) and allow inspection of any imperfections in the weave or pattern. The saying "on tenterhooks" originates from this process, comparing the tenseness of the stretched fabric to the tension of nervously waiting.

3.8 The fabric would have been mounted in the tenter frame whilst it was still wet from scouring and fulling processes, or to dry/set dyed fabrics.

3.9 Scouring is a chemical process which involves the cleaning of fabric by passing it between various cleaning soaps, detergents, urine, and other solutions to remove natural dirt and manufacturing oils.

3.10 Fulling is a physical process which consolidates the fabric by subjecting it to moisture, heat, friction, and pressure.

3.11 Outdoor tenter frames remained common place in the blanket industry until the 1950s when heated tenter sheds and tentering machines (stenters) became widely adopted. Indoor tentering and stenters were employed as early as the 1850s in other fabric/textile manufacturing.

3.12 The 1922 historical OS map is the last time that tenter frames appear within the site boundary, it is likely that by this point the mills around the area had adopted indoor tentering methods.

4 ENVIRONMENTAL SETTING

4.1 General

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

Issue	Data reviewed	Summary
Geology	1:10,000 BGS map (Sheet SE22SE) BGS Technical Report (WA/96/17) - Bank Top Colliery Shaft	Made ground – None mapped. Likely underlying footprints of historic buildings, infrastructure (tenter frames/wet houses) and possibly within the footprint of the former sandstone quarry. Drift soils – None mapped. Solid (bedrock) – Thornhill Rock (Sandstone) – Pennine Middle coal measures beyond the eastern boundary. Shallowest coal seam – Joan Coal recorded at 50.90m bgl within Bank Top Colliery Shaft (c. 250m north), with topography the Joan Coal is anticipated at c. 30 to 40m depth beneath the site. Strata Dip – None shown, anticipated to be east/southeast. Faults – None within 250m. Cavities / Mineral Veins / Fissures – None mapped.
Mining	Coal Authority BGS maps	This site is located within a Coal Mining Development Low Risk Area. Past and present workings – Shallowest recorded workings (Black Bed Coal) from 300m below the site. Further details in Section 4.2 below. Opencast – None within 250m. Mine entries – None within 250m.
Quarrying	Historical OS plans	Former sandstone quarries within and adjacent to the site.
Radon	UK Health Security Agency	The site lies in an area where between 3% to 5% of homes are estimated to be above the radon action level; basic radon protection measures are required.
Hydrogeology	Environment Agency electronic open data via QGIS Defra Catchment data explorer Envirocheck Report	Source Protection Zone – None within 1km. Aquifer - None (Drift); Secondary A (Solid). Groundwater abstractions – None within 500m. Soil leaching potential – Medium. Pollution incidents – None within 500m.
Hydrology		Nearest watercourse – Chickenley Beck (possibly culverted) c. 60m south, flowing southwest to the River Calder c. 800m southwest. Water quality – Ecology; Moderate. Chemical; Failed, for mercury, PFOS & PBDE. Pollution incidents – Minor incidents c. 50m east and c. 130m northeast for rubbish pollution in July/August 1996 and c. 140m northwest for an unknown pollutant in September 1989. Significant incident c. 140m north for unknown sewage pollution in February 1989. Abstractions – None within 500m. Discharge consents – All relating to Yorkshire Water owned sewers and storm tanks/CSOs. Multiple c. 100m east from 1963. Two c. 200m northeast from 2004. Multiple c. 330m northeast from 1963.
Flood risk		The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. In accordance with Chapter 14 of the National Planning Policy Framework, a site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency).

4.2 Coal & mining

4.2.1 In July 2011 the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology relating to coal mining development areas. This Section provides the necessary mining risk assessment required by the proposed planning application.

4.2.2 Geological maps (SE22SE) suggests that 2 coal seams underlie the site. These are the:

- **Joan Coal** (c. 0.4m – 1.8m thick), outcropping c. 450m west. Anticipated to lie c. 30m to 40m bgl.
- **Flockton Thick Coal** (c. 0.2m – 2.7m thick), from c. 50m to 60m bgl (c. 20m below the Joan Coal).

4.2.3 The BGS Technical Report WA/96/17 contains information from a shaft at Bank Top Colliery (NGR 425830 421510 at 94.5m AOD). This shaft lies approximately 250m north of the site and was sunk to a depth of 84.43m, a summary is provided below:

- Joan Coal at 50.90m bgl (0.61m thick)
- Flockton Thick Coal (Cannel) at 65.63m bgl (0.25m thick)
- Flockton Thin Coal at 82.04m bgl (0.66m thick)

4.2.4 The majority of the site lies within a Low Risk Area - within the defined coalfield, but no known defined risks have been recorded by the CA; there may still be unrecorded issues.

4.2.5 A CA mining report states that there are:

- Known past underground mine workings from c. 320m depth (*the Black Bed Coal*)
- No probable unrecorded shallow workings
- No spine roadways recorded at shallow depth
- No recorded mine entries within 100m
- No recorded outcrops
- No geological faults, fissures or breaklines
- No opencast mines within 500m
- No CA managed tips within 500m
- No coal mining related subsidence within 50m
- No Mine gas emissions recorded within 500m

4.2.6 The mining report suggests there are no known shallow workings (i.e. at less than 30m depth). However, it should be noted that it did not become a statutory requirement to maintain and preserve plans of abandoned mines until the Mine (Coal) Regulations Act of 1872 and consequently there may be mineworkings beneath the site for which the Coal Authority have no records.

4.3 Mineral safeguarded areas

4.3.1 The site is underlain by **Thornhill Rock** (sand & gravel near surface, sandstone at depth) and could be considered by the Local Authority to lie within a Mineral Safeguarding Area (MSA).

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

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

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

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

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

4.3.6 Surface extraction of sand & gravel/sandstone at this site is considered **unlikely** to be viable based on the size of the site and its proximity to adjacent residential properties. Prior extraction of minerals would have the potential to cause unacceptable impacts on neighbouring properties and infrastructure, including: noise, air quality, traffic impacts and land stability. However, it would be prudent to seek further advice from a Minerals Surveyor.

4.4 Landfills

4.4.1 Known areas of landfill in the vicinity of the proposed development site are summarised below:

Location	NGR (proximity to site)	Remarks	Source of data
Syke Ing Close, Earlsheaton, Dewsbury	SE 261 212 (from c. 110m northeast)	Name: Former dams at Syke Ing Mills (Ref: 4700/0083) License Holder: L B Constructions Wakefield Ltd License Issued: August 1977 License Surrendered: November 1977 Waste: Inert and Commercial (Construction/Demolition) Current Land Use: Recently constructed residential development (Jilling Ing Park)	EA electronic open data via QGIS Envirocheck

4.4.2 The approximate area of the landfill detailed above is shown on Drawing 4985/3A in Appendix B.

5 PRELIMINARY CONCEPTUAL SITE MODEL

5.1.1 An assessment of potential contaminants associated with the former uses has been undertaken with reference to CLR8 and the following DETR Industry Profiles:

- Textile works and dye works.

5.1.2 As a consequence of this assessment, anticipated potential contaminants, within soil and/or groundwater include:

- Inorganics (metals) associated with made ground associated with the former residential buildings, woollen manufacturing practices (tentering), and tipped material.
- Asbestos &/or ACMs within the made ground associated with from the former buildings and tipped material.
- Organics (TPH, PAH, VOC, SVOC) associated with woollen manufacturing practices (dyes, solvents, soaps, and detergents); and vehicle/material storage (fuels and oils).

5.1.3 A preliminary conceptual site model, presented as Drawing 4985/5 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 4 inclusive of this report.

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

5.1.5 The conceptual model will likely be subject to modification in light of data arising from the proposed intrusive ground investigation; see Section 8.8.

6 GROUND INVESTIGATION DESIGN

6.1 Anticipated ground conditions & potential issues

6.1.1 Based on the data reviewed in Section 4 (Environmental Setting), anticipated ground conditions are expected to comprise:

Anticipated condition	Remarks
Made ground	Anticipated to underlie the storage yard in the north; footprints/cellars of historic buildings, woollen industry infrastructure (Tenter frames/wet houses); and possibly within the footprint of the former sandstone quarry.
Natural soils	A veneer of low quality topsoil over completely weathered Thornhill Rock (Sand & Gravel).
Bedrock	Thornhill Rock (Sandstone) at relatively shallow depth.
Mineworkings	None anticipated at shallow depth, Joan Coal anticipated at c. 30m to 40m depth.
Groundwater	Likely at depth within bedrock.

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

Type of issue	Specific issue	Remarks
Potential on-site contamination sources	1. Former & current buildings 2. Made ground 3. Fly tipped materials 4. Vehicle storage 5. Historic woollen mills	1. ACMs, inorganics (metals) 2. Inorganics (metals) 3. ACMs, inorganics 4. Leakage/spillage (fuels/oils) 5. Fabric drying processes – chemicals, bleach and metals
Potential off-site contamination sources	1. Landfills, backfilled ponds, quarries	1. Hazardous gas
Potential geotechnical hazards	1. Relict buried obstructions 2. Deep made ground 3. Topography including sheer drop along the southern boundary.	1. Former building foundations 2. Former cellars, backfilled quarry 3. Retaining walls (on and off site).
Other potential constraints	1. None	1. -

6.2 Ground investigation design & strategy

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

Exploratory holes	Purpose
About 10 Trial Pits	To determine the nature, distribution and thickness of shallow natural soils, including suitability of the ground for founding structures and highways. To determine the general nature of localised made ground, including the:

Exploratory holes	Purpose
	• Nature, distribution and thickness. • Nature, degree and extent of any contamination. • Proportion of undesirable elements e.g. biodegradable matter, foundations etc.
Within 4 Trial Pits	To determine whether soakaways could be utilised for storm water drainage
About 6 Dynamic sampling (mini boreholes)	To allow for investigation in areas of restricted access (container storage yard in the northwest). To confirm the strength (density) of natural in-situ granular soils via SPTs. To install monitoring wells across the site in order to monitor for hazardous gas and determine groundwater levels.

6.2.2 Proposed exploratory hole locations were selected to provide a representative view of the strata beneath the site and to target potential areas of interest identified in Sections 3 (Site History) and 5 (Preliminary Conceptual Site Model) above. A nominal 25m to 30m grid spacing was proposed. Additional exploratory locations might be scheduled by the site engineer in light of the ground conditions actually encountered.

6.2.3 The number of representative samples taken will be reflective of the geological complexity actually encountered. However, in general about 3 samples will be taken from most exploratory holes.

7 FIELDWORK

7.1 Objectives

7.1.1 The original investigation strategy is outlined in Section 6.2 above.

7.2 Exploratory hole location constraints

7.2.1 No access was available to overgrown areas across the centre and east of the site. No exploratory holes (window sample boreholes) were advanced in the north of the storage container yard due to the presence of underground cables.

7.3 Scope of works

7.3.1 Fieldwork was supervised by Lithos on the 19th and 20th June 2024 and comprised the exploratory holes listed below.

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs 01 to 06	1.8m to 3.1m	Vane tests in cohesive soils
Soakaway tests	Within SAs 01 to 04	2.2m to 2.5m	Soakaway tests undertaken
Window sample boreholes	WSs 01 to 06	2.0m to 2.7m	SPTs undertaken at 1m intervals Monitoring wells installed in each borehole

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

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

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

- The monitoring wells installed

7.3.4 Exploratory hole locations are shown on Drawing 4985/6 presented in Appendix B; hole positions are based on data from a hand-held GPS (typically +/- 3m accuracy) and have not been surveyed in.

8 GROUND CONDITIONS

8.1 General

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

8.1.2 Typical ground conditions encountered at the site are described below in Sections 8.2 (made ground) and 8.4 (natural ground), with a summary provided in the table on page 13.

8.2 Made ground

8.2.1 The made ground on site is a heterogeneous mixture of materials and it is unlikely, even with a huge amount of sampling, that it could be accurately characterised. Nonetheless, the bulk of the made ground can be categorised as one of 4 broad types:

- **Made Ground Topsoil:** Encountered in 8 exploratory holes to 0.2m - 0.3m depth (average 0.25m) depth, comprising dark greyish brown sandy Clay with gravel of mixed lithologies, glass, metal, plastic and concrete.
- **Granular Made Ground:** Encountered in 5 exploratory holes to 0.05m - 2.0m (average 1.0m) depth, comprising dark greyish brown gravelly, clayey Sand or silty Sand and Gravel. Gravel was typically of mixed lithologies including brick, glass, coal, plastic, metal and wood.
- **Cohesive Made Ground:** Encountered in WS01 only to a depth of 0.5m, comprising orangish brown and black sandy Clay with gravel of mixed lithologies, asphalt, ceramic, brick and plastic.
- **Reworked Natural Ground:** Encountered in WS01 only to a depth of 1.3m, comprising orangish brown sandy Clay with gravel of mixed lithologies and brick.

8.2.2 Review of the trial pit logs suggest made ground (excluding made ground topsoil) thicknesses beneath the site vary between 0.5m and 2.0m (average 1.3m). The thickest made ground (TP02) was encountered along Providence Street, in the footprint of former buildings. Made ground in excess of 1.0m deep was only encountered in 4 of the 16 exploratory holes, located along Providence Street and within the container storage yard in the northwest.

8.2.3 Made ground topsoil was encountered across the cleared area (centre and north of the site).

8.2.4 Worn tarmac hardstand and cobbled surfacing are present in the container storage yard in the northwest, further made ground is anticipated underlying this hardstand.

8.2.5 Whilst not encountered during this investigation, the possibility of 'burial pits', and/or asbestos sheeting (used as shuttering), and/or fragments of asbestos sheeting within the hardcore beneath concrete slabs.

8.2.6 It is considered likely that further made ground is present in the east and north to a greater extent than was encountered during the investigation.

8.3 Obstructions

8.3.1 It is apparent from a review of historical OS Plans (see Section 3) that buildings have been present on about 10% (2,000m^2) of the total site area. Furthermore, tarmac hardstand and cobbled surfacing cover approximately 800m^2. Drawing 4985/3A shows the footprints of the former structures, and areas of hardstand.

8.3.2 Trial Pits (TPs 01 to 03) and window sample boreholes (WS01 and 02) have been advanced in locations where relict foundations were anticipated, based on superimposition of historical OS plans on the current features; see Drawing 4985/3A and 4985/6.

8.3.3 Occasional c. 600mm diameter (broken when recovered to surface) sandstone floor slabs and frequent whole bricks were encountered within the made ground along Providence Street (TPs 01 to 03), likely associated with demolition of former buildings. Some floor slabs appeared to be loose within made ground and others in situ as a basement floor (TP01) and as a patio/path (TP03).

8.3.4 Buried red brick and sandstone block work walls were encountered in two exploratory holes (TP01 & 02), likely associated with cellars of former buildings. Further buried walls/obstructions are anticipated across the site where former buildings are located on historical plans.

8.3.5 Given the site is to be redeveloped, removal of obstructions and oversized material will be required.

8.4 Natural ground

8.4.1 Natural ground was encountered in the majority of the exploratory holes, and typically comprised the following:

- **Topsoil:** Slightly gravelly sandy Clay/Silt was identified across the centre and south of site to a typical depth of 300mm.
- **Cohesive Residual Soil (Clay):** Encountered in 13 exploratory holes to 1.1m to >2.3m (average 1.7m) depth, comprising Stiff to very stiff sandy, gravelly Clay with a high cobble content.
- **Granular Residual Soil (Sands and Gravels):** Encountered in 5 exploratory holes to 1.7m to >2.7m (average 2.4m) depth, comprising dense to very dense silty Sands and Gravels of sandstone or sandy, silty Gravel of sandstone.
- **Thornhill Rock (Sandstone):** Encountered in 10 exploratory holes underlying Residual Soils from 1.5m to 2.8m (average 1.9m) depth, comprising medium strong, light orangish brown, medium grained Sandstone.

8.4.2 The in-situ relative density of granular deposits on site was established by carrying out Standard Penetration Tests (SPTs) during the drilling of the boreholes; see Section 13.6.

Summary of ground conditions

Hole ID	Final Depth	Depth to Base of Made Ground	Depth to Base (mbgl)								Remarks
			Made Ground Topsoil	Topsoil	Granular Made Ground	Cohesive Made Ground	Reworked Natural Ground	Cohesive Residual Soil	Granular Residual Soil	Thornhill Rock	
SA01	2.4	0.3	0.3	-	-	-	-	1.5	-	>2.4	From 1.5m, advanced with breaker to 2.4m depth.
SA02	2.2	0.2	0.2	-	-	-	-	1.6	-	>2.2	From 1.8m, advanced with breaker to 2.2m depth.
SA03	2.3	-	-	0.2	-	-	-	1.1	1.7	>2.3	From 1.8m, advanced with breaker to 2.3m depth.
SA04	2.5	-	-	0.3	-	-	-	2.3	>2.5	-	-
TP01	1.8	1.5	-	-	1.5	-	-	>1.8	-	-	From 0.2m, continual side wall spalling and overbreak. Sandstone and red brick walls encountered from near surface in southern and eastern walls of the pit.
TP02	2.3	2.0	-	-	2.0	-	-	>2.3	-	-	From 0.5m, overbreak. At 2.0m, complete collapse of side wall. Red brick wall encountered from near surface in eastern end of the pit.
TP03	3.1	0.5	-	-	0.5	-	-	1.6	2.8	>3.1	-
TP04	2.6	-	-	0.2	-	-	-	1.3	>2.6	-	-
TP05	2.3	0.2	0.2	-	-	-	-	1.9	-	>2.3	-
TP06	2.3	-	-	0.3	-	-	-	1.8	-	>2.3	-
WS01	2.0	1.3	-	-	0.05	0.5	1.3	-	-	>2.0	-
WS02	2.0	1.1	-	-	1.1	-	-	-	-	>2.0	-
WS03	2.0	0.2	0.2	-	-	-	-	1.6	-	>2.0	-
WS04	2.0	-	-	0.2	-	-	-	1.5	>2.0	-	-
WS05	2.0	-	-	0.4	-	-	-	1.8	-	>2.0	-
WS06	2.7	0.3	0.3	-	-	-	-	1.4	>2.7	-	-

8.5 Visual & olfactory evidence of organic contamination

8.5.1 No visual/olfactory evidence of hydrocarbon contamination was noted within any exploratory hole.

8.6 Groundwater

8.6.1 No significant inflows of groundwater were encountered during the investigation.

8.7 Stability

8.7.1 Stability of excavations within natural ground (bedrock and residual soils) was generally good and pits remained stable during excavation.

8.7.2 The stability within made ground was poor, especially where thicknesses were greater than 1m and significant oversize material (floor slabs and bricks) where encountered.

8.8 Revised conceptual ground model (ground conditions)

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

- The nature and distribution of made ground, including the presence of significant buried obstructions
- The strength, nature and depth of underlying natural strata
- The nature and distribution of contamination (based on visual/olfactory evidence only)

8.8.2 Further refinement of the Conceptual Site Model is presented in Sections 11.3 and 11.4, where the results of laboratory testing for contaminants have been considered.

9 SOAKAWAY TEST RESULTS

9.1 UK guidance

9.1.1 General notes about soakaways, including their location, design, and Lithos' test methodology are presented in Appendix A.

9.1.2 UK guidance does not explicitly state that soakaways cannot be constructed in made ground, but such construction is not generally considered good practice. There may be a risk of settlement caused by wash out of fine soil particles if soakaway waters are allowed to infiltrate into made ground. Furthermore, UK guidance does state that the soakaways should not be built where the presence of contamination could result in pollution of groundwater.

9.1.3 Given topography in the east and south of the site it is considered possible that springs will appear down-gradient, meaning careful positioning of any soakaways will be required. However, it is understood that this area will not undergo development, and such are unlikely to pose an issue.

9.1.4 CIRIA C753[1] recommends that soakaways should not be constructed 'in ground where the water table reaches a level within 1m below the base of the soakaway at any time of the year'.

[1] *CIRIA C753. The SuDS Manual (2015).*

9.1.5 BRE DG365[2] "Soakaway Design" advises that each soakaway pit should be filled and allowed to drain three times to near empty on the same or consecutive days.

9.2 Field tests

9.2.1 Soakaway testing was carried out in 4 pits, in general accordance with BRE DG365 "Soakaway Design". The locations of the soakaways are shown on Drawing 4985/6 presented in Appendix B to this report.

9.2.2 Infiltration rates for each soakaway test have been calculated in accordance with BRE DG365. This design takes into account time for the water level to fall from 75% to 25% of its effective depth. The effective depth is the difference between the starting water level and the soakaway pit base depth.

9.2.3 Two filling cycles were undertaken in SAs 01 to 03, with only one filling cycle in SA 04.

9.2.4 Calculated infiltration rates for each successful test are summarised in the table below, and copies of the associated calculations are presented in Appendix K to this report.

Soakaway	Stratum	Test	Infiltration rate (m/s)
SA01	Cohesive Residual Soil (0.3 to 1.5m), and Thornhill Rock Sandstone (1.5 to 2.4m)	1	1.49 x10^{-4} m/s
		2	1.56 x10^{-4} m/s
SA02	Cohesive Residual Soil (0.3 to 1.6m), and Thornhill Rock Sandstone (1.6 to 2.2m)	1	5.53 x10^{-5} m/s
		2	3.73 x10^{-5} m/s
SA03	Cohesive Residual Soil (0.2 to 1.1m), Granular Residual Soil (1.1 to 1.7m), and Thornhill Rock Sandstone (1.7 to 2.3m)	1	5.45 x10^{-4} m/s
		2	5.39 x10^{-4} m/s
SA04	Cohesive Residual Soil (0.3 to 2.3m), and Granular Residual Soil (2.3 to 2.5m),	1	6.87 x10^{-5} m/s

9.3 Discussion & conclusions

9.3.1 Drainage Engineers could use the infiltration rates reported above to determine the feasibility of soakaways as a solution for the discharge of surface water run-off.

9.3.2 It should be noted that soakaway percolation in bedrock is predominately via joints within the rock mass. The relatively small-scale soakaway test pits may not intercept such joints, and this can result in variable test results. It is possible that the larger surface area associated with soakaway construction during development will intercept such joints; although this cannot be guaranteed.

9.3.3 In order to obtain approvals from the LLFA, Highways etc, the drainage designer is likely to require further testing: (a) within 25m of proposed chamber locations; and (b) to include 3 fills.

9.3.4 Given that the soakaway tests have yielded satisfactory results, consideration should be given to the installation of groundwater wells to depths of around 4-5m in 3 boreholes, and subsequent groundwater level monitoring over about 12 months. Given the anticipated depth to bedrock, these boreholes will need to be advanced by rotary probing.

[2] *BRE DG365. Soakaway Design (2016).*

10 CONTAMINATION (ANALYSIS)

10.1 General

10.1.1 The site has been formerly utilised by the woollen industry as a tenter field (see Section 3) and occupied by residential buildings along Providence Street (northeastern boundary).

10.1.2 Raw materials formerly stored and used on site are likely to include dyes, solvents, soaps and detergents.

10.1.3 The site's former and current usage (fly tipping and storage container yard) is likely to have given rise to some ground contamination. Furthermore, significant thicknesses of made ground were encountered in 10 of the 16 exploratory locations during the ground investigation.

10.1.4 An assessment of potential contaminants associated with the former uses has been undertaken; see Section 5.

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

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

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

10.2 Testing scheduled

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

Type of sample	No. of samples	Determinands
Topsoil	6	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID Speciated Polycyclic Aromatic Hydrocarbons (PAH) Clay/sand/silt content and visible contaminants, sharps (glass etc) to check compliance with BS3882:2015
Made ground topsoil	8	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID Speciated Polycyclic Aromatic Hydrocarbons (PAH) Banded Total Petroleum Hydrocarbons (TPH)
Made ground	8	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID Water soluble sulphate, chloride, nitrate and magnesium TOC, Speciated Polycyclic Aromatic Hydrocarbons (PAH), Banded Total Petroleum Hydrocarbons (TPH)
Reworked Natural ground	1	

10.2.2 Account was taken of previous uses in specific areas, with analysis concentrated on samples recovered from the vicinity of former buildings.

10.3 Soil contamination results

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

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

Summary of degree of soils contamination (inorganics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Trigger Level Concentrations are shown in BLUE and assume a **residential with gardens** end-use.											
			pH	As ∞	B~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg*	Ni	Se	Vn	Zn$	Asbestos
				37	5	26	4000	100	200	199	109	434	584	200	
SA03	0.1	Topsoil	4.7	**43**	0.6	0.1	28	49	**250**	0.33	21	< 0.5	43	73	N.D.
SA04	0.1	Topsoil	5.4	25	0.5	0.3	24	44	**350**	0.33	20	< 0.5	37	140	N.D.
TP04	0.1	Topsoil	6.1	**39**	0.6	0.3	20	72	**520**	0.26	26	0.8	39	150	N.D.
TP06	0.1	Topsoil	5.6	32	0.5	0.3	18	63	**270**	0.42	27	< 0.5	40	110	N.D.
WS04	0.1	Topsoil	4.8	**44**	0.8	< 0.1	18	55	**360**	0.33	17	< 0.5	31	66	N.D.
WS05	0.1	Topsoil	5.6	21	0.4	0.4	15	38	140	0.2	19	< 0.5	27	100	N.D.
SA01	0.1	Made Ground Topsoil	5.9	**42**	0.6	0.5	20	77	**330**	0.31	25	< 0.5	38	**260**	N.D.
SA02	0.1	Made Ground Topsoil	5.8	**48**	0.7	0.2	27	63	170	0.27	23	< 0.5	33	120	N.D.
TP01	0.1	Made Ground Topsoil	9	5.6	1.8	< 0.1	4.1	9.5	32	< 0.05	3.5	< 0.5	15	24	N.D.
TP02	0.1	Made Ground Topsoil	7.5	23	0.5	0.3	16	35	90	0.14	18	< 0.5	27	84	N.D.
TP03	0.1	Made Ground Topsoil	8.6	14	1	0.4	35	39	180	0.07	15	< 0.5	25	85	N.D.
TP05	0.1	Made Ground Topsoil	6.3	30	0.3	0.3	18	62	180	0.31	21	< 0.5	30	110	N.D.
WS03	0.1	Made Ground Topsoil	6.7	24	1	0.6	39	61	**990**	0.28	17	< 0.5	26	**230**	N.D.
WS06	0.1	Made Ground Topsoil	6.8	30	0.6	0.3	14	52	190	0.42	17	< 0.5	25	130	N.D.
WS01	0.6	Reworked Natural Ground	6.9	7.6	0.3	0.2	15	22	100	< 0.05	17	< 0.5	15	87	N.D.
TP01	0.4	Granular Made Ground	8.1	14	0.7	0.2	11	36	100	0.17	10	< 0.5	20	66	N.D.
TP01	1.2	Granular Made Ground	7.9	8	0.7	0.2	8	16	180	0.1	6.5	< 0.5	12	46	N.D.
TP02	0.6	Granular Made Ground	9.3	8.9	0.5	< 0.1	8.4	16	35	< 0.05	8.5	< 0.5	13	36	N.D.
TP03	0.3	Granular Made Ground	9.2	8.3	0.5	0.2	55	17	44	0.05	16	< 0.5	18	50	N.D.
WS02	0.2	Granular Made Ground	9.4	4.1	1	0.3	53	89	25	< 0.05	18	< 0.5	39	140	N.D.
WS02	0.7	Granular Made Ground	8.6	7.7	0.8	0.2	19	28	60	< 0.05	20	< 0.5	24	71	N.D.
WS01	0.1	Cohesive Made Ground	7.9	12	0.5	0.4	17	34	150	0.09	22	< 0.5	20	140	N.D.
WS01	0.4	Cohesive Made Ground	6.6	**56**	0.5	0.3	27	92	**490**	0.48	26	0.7	43	120	N.D.

Key	
36	Parameter tested for and found to be in excess of Tier 1 concentration
179	Parameter tested for and found to be > 5 x Tier 1 concentration
12	Parameter tested for but not found to be in excess of Tier 1 concentration
-	Parameter not tested for
♣	Tier 1 Value is pH dependent
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI screen would be 21mg/kg
*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.

Source of Guidance Trigger Level	
With the exception of those annotated with one of the symbols below (∞, $, ~), all Soil Screening Values in brackets above have been derived using CLEA v1.06. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE\Defra)
$	Ministry of Agriculture, Fisheries & Food. Code of Practice for Agricultural Practice for the Protection of Soil. 1998
~	Engineering judgement (Lithos). Boron is a phytotoxic, although most phytotoxic compounds can pose a risk to human health if sufficient concentrations are present. However, plants represent the most sensitive receptor, and a Tier 1 value which is protective of flora is therefore also protective of human health.
N.D.	Not detected, applicable to asbestos I.D. screen only

Summary of degree of soils contamination (organics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Soil Screening Concentrations are shown in BLUE and assume a **residential with gardens and 600mm** cover end use					
			% TOC	PAH		TPH - C6 to C40		
				B(a)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				25	6	23	218	5000
SA03	0.1	Topsoil	6.0	< 0.03	< 0.03	-	-	-
SA04	0.1	Topsoil	6.5	0.47	0.03	-	-	-
TP04	0.1	Topsoil	9.5	< 0.03	< 0.03	-	-	-
TP06	0.1	Topsoil	5.1	< 0.03	< 0.03	-	-	-
WS04	0.1	Topsoil	8.6	< 0.03	< 0.03	-	-	-
WS05	0.1	Topsoil	4.1	< 0.03	< 0.03	-	-	-
SA01	0.1	Made Ground Topsoil	11.0	0.25	0.05	< 0.1	<66	230
SA02	0.1	Made Ground Topsoil	12.0	< 0.03	< 0.03	< 0.1	<30	<24
TP01	0.1	Made Ground Topsoil	6.1	1.1	0.05	< 0.1	**<600**	<1300
TP02	0.1	Made Ground Topsoil	5.9	0.09	< 0.03	< 0.1	<33	140
TP03	0.1	Made Ground Topsoil	9.0	0.05	< 0.03	< 0.1	<31	230

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Soil Screening Concentrations are shown in BLUE and assume a **residential with gardens and 600mm** cover end use					
			% TOC	PAH		TPH - C6 to C40		
				B(a)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				25	6	23	218	5000
TP05	0.1	Made Ground Topsoil	6.5	0.06	< 0.03	< 0.1	<30	<35
WS03	0.1	Made Ground Topsoil	12.0	0.82	< 0.03	< 0.1	<85	300
WS06	0.1	Made Ground Topsoil	7.5	0.06	< 0.03	< 0.1	<38	<66
WS01	0.6	Reworked Natural Ground	2.1	< 0.03	< 0.03	< 0.1	<30	<20
TP01	0.4	Granular Made Ground	4.1	0.75	0.08	< 0.1	<41	264
TP01	1.2	Granular Made Ground	4.6	0.38	0.04	< 0.1	**<600**	<1040
TP02	0.6	Granular Made Ground	4.3	0.04	< 0.03	< 0.1	<35	<77
TP03	0.3	Granular Made Ground	2.2	< 0.03	< 0.03	< 0.1	<30	<36
WS02	0.2	Granular Made Ground	2.2	0.24	< 0.03	< 0.1	<31	179
WS02	0.7	Granular Made Ground	2.7	0.34	< 0.03	< 0.1	<30	120
WS01	0.1	Cohesive Made Ground	1.9	0.09	< 0.03	< 0.1	<30	46
WS01	0.4	Cohesive Made Ground	8.9	0.64	< 0.03	< 0.1	<105	316

Key		Source of guidance trigger level	
60	Parameter tested for and in excess of Tier 1 concentration.	All Soil Screening Values in brackets above have been derived using CLEA v1.071. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM). Assumes isolation beneath a minimum 600mm thickness of soil cover, see Generic Notes 04 in Appendix A.	
0.3	Parameter tested for but not in excess of Tier 1 concentration.	~	Assumes all GRO is aromatic fraction C7 to C8.
-	Contaminant not tested for.	◊	Assumes all DRO is aliphatic fraction C10 to C12.
		∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).

Inorganic determinands

10.3.3 The table below shows the breakdown of the 23 samples that were analysed for inorganic parameters and how many can be classified as uncontaminated and contaminated.

Type of sample	No. of samples analysed	No. of samples classified as:	
		Contaminated	Uncontaminated
Topsoil	6	5	1
Made ground topsoil	8	2	6
Reworked Natural ground	1	0	1
Made ground	8	1	7

10.3.4 Elevated concentrations of **lead**, **arsenic**, and **zinc** were recorded in one or more samples taken from across the site.

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

10.3.6 Most substances are harmful to human health at lower concentrations than would be detrimental to plant growth. However, there are three notable exceptions – boron, copper, and **zinc**. Plants are the more sensitive receptor to these elements i.e. detrimental effects are seen in plants at concentration which do not present a risk to human health. Consequently, for the zinc and copper, consideration and protection of flora would also be protective of human health.

10.3.7 Allowable concentrations of heavy metals in arable soils are set out in Defra's Code of Good Agricultural Practice 2009[3]. The value for zinc is 200mg/kg, and is based on a continued annual application of heavy metal rich fertiliser (sludge); as such it is not representative of activity in a standard UK garden.

10.3.8 Lithos have also derived a value for **zinc** in relation to risks to human health, using the CLEA model, assuming a residential end use with consumption of home grown produce in a sandy loam soil with 6% SOM. The reported value is 2,170mg/kg, ten times greater than the potential phytotoxic concentration.

10.3.9 On balance, given the context of a residential development and the relatively low concentrations recorded, **zinc** is not considered significant and no special remedial measures are considered necessary.

10.3.10 The exceedances of **lead** and **arsenic** (8 and 6 respectively, with 5 other samples of lead close to the Trigger Level), are likely associated with the tenter frames and tentering processes (dyes) previously located on the site, will need further consideration.

10.3.11 Current UK guidance regarding the statistical analysis of soil contamination data obtained during a site investigation is provided by CL:AIRE[4], and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

[3] *Defra – Protecting our Water, Soil & Air – A Code of Good Agricultural Practice for farmers, growers and land managers. 2009*
[4] *CL:AIRE, 2020.Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.*

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

10.3.13 Lithos can confirm that statistical assessment of the made ground material analysed here is **not appropriate** because:

- Made Ground is considered too heterogenous
- There are insufficient samples from the various material types to allow representative statistical assessment to be undertaken

Asbestos

10.3.14 No asbestos fibres were identified in any of the 23 samples screened.

10.3.15 Possible asbestos-containing materials (ACMs), such as broken fragments of asbestos-cement sheeting were noted during the site walkover (none within the net developable area), none of these possible ACMs were tested for asbestos.

10.3.16 No ACMs were identified during the excavations of trial pits. However, testing of possible ACMs will be required if fragments are noted to be present during site clearance and once hardstand has been grubbed up etc.

Organic determinands

10.3.17 This site is brownfield and underlain by topsoil and made ground which has yielded elevated concentrations of a number of inorganic determinands. Consequently, for organic compounds, the Tier 1 Soil Screening Values used in this report have been derived with reference to a CSM that assumes a minimum 600mm of clean soil cover will be placed in gardens/landscaped areas (Lithos Scenario B).

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

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

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

Soil type	Typical TOC (%)	Comparison of soil results with revised screening value necessary?
Topsoil	6.6	No
Made ground topsoil	8.8	
Reworked Natural ground	2.1	Yes, but no significant organic contamination was recorded in this soil type. All determinands well below "6%" screening value; most below limit of detection.
Made ground	3.9	

10.3.21 It should be noted that none of the samples tested for organic determinands exceeded the individual screening values.

Hydrocarbons (TPH)

10.3.22 Given the absence of both visual/olfactory evidence of any hydrocarbon contamination and the presence of fuel tanks, a simple banded TPH (cf full speciation) was scheduled on 17 samples.

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

10.3.24 Two samples from TP01 (at 0.1m and 1.2m) have exceedances for DRO C_{10} to C_{21} (trigger level of 218mg/kg) compounds, with <600mg/kg. These samples have been processed with a 20x dilution during laboratory testing which has raised the LOD and caused the reported value to be higher than the Lithos Tier 1 Screening Concentrations,

10.3.25 Dilution is used to protect the laboratory instruments from **possible** contamination from high levels of other analytes, this is routine procedure for the laboratory if the sample extract that is to be tested is too dark in colour. It is therefore considered highly unlikely that these samples represent true exceedances of DRO C_{10} to C_{21} compounds.

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

Polycyclic Aromatic Hydrocarbons (PAH)

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

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

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

10.4 Topsoil

10.4.1 Topsoil and made ground topsoil (typically 200mm to 300mm thick) is present across most of the site. Testing suggests this material is **not** chemically suitable for re-use due to the presence of **lead** and **arsenic**.

BS3882 Topsoil testing

10.4.2 The presence of visible contaminants, sharps (glass etc) was assessed by the Engineer in the field (inspection of initial trial pit arisings and inspection of the cleared woodland); glass and/or sharp metal fragments were identified in all of the made ground topsoil encountered, no sharps were identified in the topsoil encountered. BS3882 considers visual contaminants to comprise 'undesirable potentially injurious foreign object(s) visible to the naked eye'.

10.4.3 The clay/sand/silt content of 3 topsoil samples have been determined to check compliance with BS3882[5] requirements.

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

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

10.4.5 The results are summarised below:

Parameter	BS3882 Specification	SA03 @ 0.2m	SA04 @ 0.2m	TP04 @ 0.2m
Retained on 2mm sieve	< 30%	21	23	20
Retained on 20mm sieve	< 10%	**12**	**13**	5
Retained on 50mm sieve	0%	0	0	0
Clay content	5 to 35%	22	21	21
Silt content	0 to 65%	39	40	40
Sand content	0 to 90%	39	39	39
Visible contaminants	< 0.5%	0	0	0
Texture	-	Clay Loam		

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

10.4.6 The results indicate that the topsoil complies with the requirements for multipurpose topsoil, with the following exceptions:

- The coarse gravel content of 2 of the 3 samples tested slightly exceeded the maximum permissible level (12% and 13% *cf* upper threshold of 10%). However, the average clay, silt and sand content from all 3 samples is within the specified range.
- 3 of the 6 samples (SA03 & 03 and WS04) recorded a pH value below the specified range (5.5 to 8.5).

11 CONTAMINATION (QUALITATIVE RISK ASSESSMENT & REMEDIATION)

11.1 Topsoil

11.1.1 Topsoil and made ground topsoil, typically 200mm to 300mm thick is present across the cleared area.

11.1.2 Testing suggests this material is **not** suitable for re-use. It is recommended that it is placed in garden areas and/or POS, immediately beneath the proposed 600mm cover, and that it is overlain by no more than 1m of soil.

11.2 Summary of significant contamination

11.2.1 A veneer of topsoil and made ground topsoil lies across the majority of the site, with deeper made ground beneath the footprint of former buildings along Providence Street and beneath the storage container yard in the northwest.

11.2.2 The contamination encountered appears primarily within the surface/near surface materials (topsoil and made ground topsoil), only one sample of made ground (WS01 at 0.4m) is considered to be contaminated. It should be noted that two other samples (TP01 at 1.2m & WS01 at 0.1m) came close to exceeding trigger level concentration for lead.

11.2.3 These contaminated materials (topsoil, made ground topsoil, and made ground) contain elevated concentrations of **arsenic** and **lead**, in addition to containing materials (e.g. metal, glass, whole bricks, and sandstone slabs), which would generally be considered undesirable as a near-surface material in garden areas.

11.3 Revised conceptual ground model (contamination)

11.3.1 The Preliminary Conceptual Site Model has been amended in light of data obtained during the ground investigation, most notably with respect to the distribution of underground obstructions (cellar walls) and contaminants.

11.3.2 A revised Conceptual Site Model is presented as Drawing 4985/7 in Appendix B. The model includes the contaminants described in Section 11.2 above, and potential contaminant linkages (summarised below in Section 11.5) to receptors.

11.4 Environmental setting & end use

11.4.1 As discussed in Section 11.2 above, contamination exists in the topsoil, made ground topsoil and made ground at this site. In order to assess the significance of this contamination, consideration must be given to the site's environmental setting and the proposed end use.

11.4.2 The underlying Thornhill Rock (sandstone bedrock) is classified as a Secondary A Aquifer. The nearest watercourse is the Chickenley Beck, which flows in a south westerly direction, approximately 60m beyond the site's southern boundary. Therefore, the site's environmental setting is considered to be **moderate sensitivity**.

11.4.3 With respect to human health, the proposed end use (residential) is considered sensitive.

11.4.4 Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures, see Section 15.7.

11.5 Contaminant linkages

11.5.1 In terms of a proposed redevelopment of this site, plausible contaminant linkages can be summarised as follows.

Contaminants

11.5.2 Contaminants have been summarised in Section 11.2 above.

Pathways

11.5.3 Potential contaminant pathways include:

- Ingestion
- Inhalation of contaminated particulates
- Surface water run-off, including existing drainage infrastructure
- Downward infiltration of leachable/mobile contaminants to groundwater
- Gas migration

Receptors

11.5.4 Potential contaminant receptors include:

- The environment - bedrock aquifer and/or Chickenley Beck
- End users of the site (residents)
- End users of the site (public) if the remaining woodland area remains publicly accessible.

11.5.5 It can be concluded that there are plausible pathways between the soil contaminants summarised in Section 11.2 above and potential receptors. Consequently, some remediation will be required; either treatment/removal of the contaminant, or "breakage" of the pathway.

11.6 Potential remediation options

General

11.6.1 Given the constraints discussed in Section 7.2 (storage container yard, utilities, and woodland), a simple post-demolition/clearance trial pit investigation will be required before definitive recommendations are provided. However, at this stage it is considered unlikely that anything more than placement of soil cover in garden areas will be required.

11.6.2 Approval of the recommendations given below should be sought from the appropriate regulatory authorities prior to commencement of site redevelopment.

Soil cover

11.6.3 As discussed in more detail below, the presence of **lead** and **arsenic** will necessitate placement of a **600mm** thick surface cover of "clean" soil in garden areas. Within landscaped areas (within the net developable area) associated the development this can be reduced to **450mm**.

11.6.4 In areas covered by hardstand, or floor slabs (buildings) contaminants will be satisfactorily isolated from end users.

11.6.5 New utilities should be laid in trenches reinstated with 'clean' backfill in order to prevent exposure to maintenance workers in the future.

11.6.6 If the woodland area (beyond the net developable area) is accessible to the public, further assessment (surface sampling and subsequent laboratory testing) would be considered prudent to determine the extent of contamination within this area. If the wooded area is not to be publicly accessible following development, no further action is required.

Inorganic contamination

11.6.7 The topsoil, made ground topsoil, and made ground has yielded elevated concentrations of inorganic materials; most notably **lead** and **arsenic**. Therefore, where residual made ground remains beneath garden areas (i.e. not beneath hardstanding) a **600mm** thick surface cover of "clean" soil comprising 500mm subsoil and 100mm topsoil is recommended. Within landscaped areas (within the net developable area) associated the development this can be reduced to **450mm**.

11.6.8 This cover will break potential contaminant linkages between the contaminated made ground and future end-users.

Organic contamination

11.6.9 No areas of gross organic contamination were encountered during the site works. However, localised areas of more onerous contamination than that identified to date may be present on site.

11.6.10 However, given the comments made in Sections 7.2 and 10 above (fieldwork constraints and site's former usage), it would be prudent to allow for the off-site disposal of some grossly contaminated soil. Further advice should be sought from a specialist contractor, with experience of brownfield remediation, regarding an appropriate contingency.

11.7 Summary of potential contaminant linkages & mitigation

11.7.1 In terms of the proposed redevelopment plausible contaminant linkages, and feasible remediation options, can be summarised as follows:

Receptors	Pathways	Contaminants	Plausible contaminant linkage? (and remediation options where required)
Human health (Future residents and members of the public) ◊	Consumption of contaminated vegetables Ingestion	Metals in the made ground	Yes - Isolation beneath at least 600mm/450mm clean soil cover in garden and landscaped areas
Buildings	Migration & accumulation of explosive gas	Landfill Methane	To be assessed on completion of monitoring and gas risk assessment

◊ transient risks to construction workers will be addressed by the adoption of appropriate health and safety measures in accordance with the Health and Safety at Work Act 1974 and regulations made under the Act including for example the COSHH Regulations.

11.8 Waste classification

11.8.1 Disposal of the made ground off site is generally not considered appropriate, economically viable, nor in line with current Government philosophy regarding sustainable development. However, some excess arisings may be generated by excavations for foundations, sewers etc. Disposal to landfill (or an appropriate soil / aggregate transfer station) may be the most practical solution, if redistribution and retention on site is not feasible.

11.8.2 Following excavation and stockpiling, sampling will be required prior to disposal.

11.8.3 As there is no WRAP protocol for soils, the characterisation, sampling and classification of soils arising from brownfield sites has been incorporated within the Environment Agency's Technical Guidance WM3[6]. Classification of soils as non-hazardous or hazardous in accordance with WM3 is quite a complex process, although it ultimately results in a simple classification as hazardous or non-hazardous. Note: inert is not a class under WM3; WAC testing is required to determine whether a waste soil can be considered inert.

11.8.4 If waste soil is classed as hazardous following classification under WM3, and destined for landfill, waste acceptance criteria (WAC) leachate testing will need to be undertaken. Similarly, if waste soil destined for landfill is classed as non-hazardous under WM3, and suspected to be inert, WAC leachate testing will need to be undertaken. However, non-hazardous soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required.

11.8.5 WAC analysis is different to the 'routine' laboratory testing (such as that included earlier in this Section) undertaken in order to determine hazardous properties. Lithos typically only include WAC analysis if significant off-site disposal (of soil classified as hazardous waste) is anticipated.

11.8.6 It is critical if material is to be exported from site that this is allocated an appropriate waste code, following the steps within WM3. Waste carriers transporting, and sites accepting, this material should have a corresponding code within their permits. It is the responsibility of those generating the waste (i.e. the Developer), to ensure that the waste is handled and disposed of appropriately.

[6] *Technical Guidance WM3 – Guidance on the classification and assessment of waste. Environment Agency 2015*

11.8.7 Soil treatment facilities (STFs) provide an alternative to landfill. STFs are regulated by the Environment Agency and allow soils to be treated and screened (effectively recycled to be used at other sites). Export to an STF does not require WAC testing and suitability of various soil types will be dependent on material waste codes, which may be allocated after consideration of the data in Section 110 but will often need supplementing with further testing after soils have been stockpiled (see also advice in Section 15.3).

11.8.8 Most STFs are permitted to accept soils with waste code 17 05 04 (i.e. soils which do not exhibit hazardous properties). Lithos has a list of permitted STFs and can help identify one local to this development site.

11.8.9 As discussed in Section 8.2, worn tarmac hardstand and a cobbled street is present.

11.8.10 This **tarmac** could be recycled and crushed to yield a 6F3 selected granular material, provided the recovered bitumen content is less than 10% (determined in accordance with BS598-1[7]). Crushed tarmac could also be blended with crushed concrete etc to generate 6F2 graded material. 6F2 can contain up to 50% recycled tarmac/asphalt (provided it does not pose a contamination risk to controlled waters and, if the proportion of asphalt is greater than 20%, the recovered bitumen content is less than 2%).

11.8.11 However, if off-site disposal is anticipated, tarmac assessment is based on the amount of coal tar present, this will vary depending on the age of the tarmac. The assessment is based on the amount of benzo(a)pyrene and has a concentration limit of 50mg/kg.

11.8.12 Contractors exporting waste from the site should review the site investigation data and make their own assessment. Alternatively, Lithos could undertake this assessment once exported waste streams have been identified.

12 HAZARDOUS GAS

12.1 General

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

Source	Receptors	Hazard	Pathway	Initial risk
On-site made ground	Human health	Asphyxiation & explosion	Vertical migration, ingress & accumulation	**Very Low**: made ground essentially inert, with little degradable matter
	Buildings	Explosion		
On-site sandstone quarry Off-site landfill and Sandstone quarry (possibly backfilled)	Human health	Asphyxiation & explosion	Lateral migration, ingress & accumulation	**Very Low**: off-site quarry recorded as old pre 1922, landfill to the NE is now developed with housing
	Buildings	Explosion		

12.1.2 Given the above gas monitoring wells have been installed in 6 window sample boreholes across the site. Details of the installations are given on the exploratory hole logs presented in Appendix G to this the report.

[7] *BS598 (2003) Sampling and examination of bituminous mixtures for roads and other paved areas.*

12.1.3 The generation potential of the gas source was initially considered to be Very Low and this has been confirmed by the monitoring results obtained. Consequently, in accordance with CIRIA Report C665[8], given the proposed residential end use, 6 visits have been scheduled over a 3-month period.

12.2 Scope of works

12.2.1 To date, the wells have been monitored on two occasions for groundwater levels and soils-gases, and the results are presented in Appendix L.

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

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

12.3 Monitoring results

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

Well	Response zone	Range of methane concentrations (% v/v)	Range of carbon dioxide concentrations (% v/v)	Range of steady flow rates (litre/hour)
WS01	1.5m- 2.0m (Thornhill Rock, sandstone)	ND	3.1 – 4.8	ND
WS02	1.5m- 2.0m (Thornhill Rock, sandstone)		1.5 – 2.6	
WS03	1.0m – 1.6m (Cohesive Residual Soil) 1.6m – 2.0m (Thornhill Rock, sandstone)		**6.3 - 6.4**	
WS04	1.0m – 1.5m (Cohesive Residual Soil) 1.5m – 2.0m (Granular Residual Soil)		0.9 – 1.2	
WS05	1.0m – 1.8m (Cohesive Residual Soil) 1.8m – 2.0m (Thornhill Rock, sandstone)		0.8 – 1.4	
WS06	1.0m – 1.4m (Cohesive Residual Soil) 1.4m – 2.7m (Granular Residual Soil)		1.2 – 4.8	

Values in **bold** breache trigger value level 1 (5% v/v)
ND = Not detected

12.4 Discussion (methane & carbon dioxide)

12.4.1 As the site has only been visited on two occasions, no worthwhile interpretation of the results can be undertaken at this stage.

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

12.4.3 A hazardous gas risk assessment incorporating all of the results will be issued on completion of monitoring in October 2024.

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

12.5 Radon

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

12.5.2 Basic radon measures comprise a radon resistant barrier* (membrane) laid within the floor construction and across the wall cavity in accordance with BR211:2023[9]. The joints between the sheets that form the membrane and cross the cavity **must** be sealed, along with all service penetrations, to make the construction as airtight as possible. A separate cavity tray should be installed in the cavity one brick course above the radon membrane. In order to withstand the installation and follow on construction process membranes should be no less than 400 microns thick.[10]

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

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

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

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

13 GEOTECHNICAL TESTING

13.1 General

13.1.1 A total of 20 samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.

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

13.2 Atterberg limits

13.2.1 The plasticity indices of 10 samples of cohesive residual soil have been determined; results are summarised below.

Soil type	No. samples tested	Moisture content range % (average)	Range of Plasticity Indices % * (average)	Shrinkability
Cohesive Residual Soil	10	11 – 18 (15)	6 – 24 (13)	Low

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

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

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

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

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

13.2.2 One of the 10 samples tested recorded a modified plasticity index above 20% (i.e. medium shrinkability). Given the number of samples tested and the consistent ground conditions, for the purposes of foundation design, it is recommended that the cohesive residual soil be regarded as being of **Low** shrinkability.

13.3 Particle size distribution

13.3.1 The grading of one sample of cohesive residual soil has been determined by wet sieving and the results are summarised in the table below:

Sample & depth	Field description	% passing 37.5mm sieve	% passing 20mm sieve	% passing 2mm sieve	% fines	Material description (based on grading & plasticity)
TP05	Slightly sandy slightly gravelly CLAY	92	87	75	54	Slightly sandy, slightly gravelly CLAY

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

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

13.3.4 Fines (silt and clay) were found to comprise 54% of the material sampled. Therefore, the cohesive residual soil encountered on this site can therefore be regarded as shrinkable.

13.3.5 However, it should be noted that the cohesive residual soil at this site was described as gravelly (fine to coarse), with a low to high cobble content, meaning that the fines % across the site may be lower on average.

13.4 Soluble sulphate and pH

13.4.1 In accordance with BRE SD1[11], this site has been classified as brownfield with a mobile groundwater regime.

13.4.2 It is envisaged foundations will extend to depths of about 0.75m to 1m through made ground and natural strata and samples taken from this depth range have been submitted for pH and water-soluble sulphate (2:1 soil/water extract).

13.4.3 The concentrations of sulphate in the aqueous natural soil extracts of 13 samples were determined. In addition, 9 samples of made ground were tested as part of the contamination suite. The pH value of each sample has also been determined.

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

Soil type	No. samples tested	Lowest pH values (average)	Highest soluble sulphate concentration (mg/l)
Reworked Natural Ground	1	6.9 (6.9)	43
Granular Made Ground	6	7.9 (8.8)	1400
Cohesive Made Ground	2	6.6 (7.3)	60
Cohesive Residual Soil	8	5.4 (6.6)	200
Granular Residual Soil	3	6.2 (6.7)	20
Thornhill Rock	2	6.9 (7.0)	14

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

13.4.5 Of the 22 samples tested only 1 sample of natural ground recorded a pH value of below 5.5 (TP02, at 2.1m). This is considered insignificant due to the number of samples tested with pH values above 5.5, particularly considering the remaining 12 samples of natural ground (in which this cohesive residual soil is derived) are all above a pH value of 5.5. Therefore, concentrations of chloride and nitrate are considered insignificant.

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

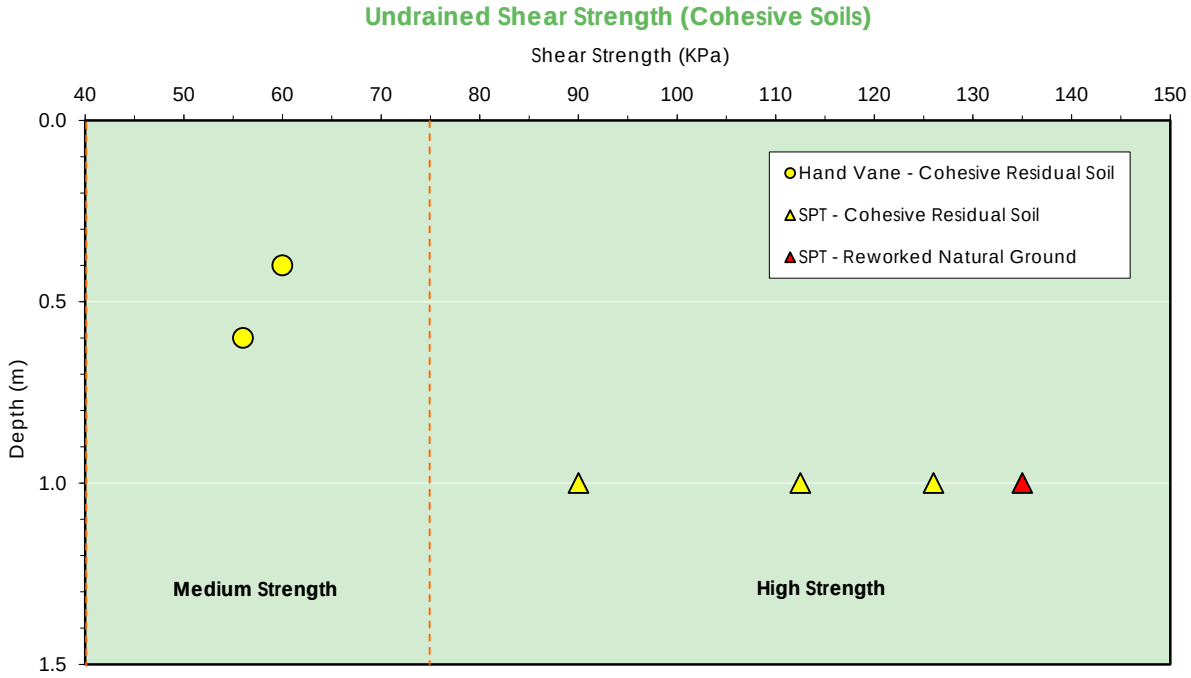
13.5 Undrained shear strength testing

Hand shear vane testing

13.5.1 Hand shear vane testing was undertaken within trial pits in-situ to around 0.6m depth in shallow cohesive residual soils. Hand vanes became increasingly difficult and impractical with depth due to the increasing gravel and cobble content.

13.5.2 The results are summarised within the plot below and illustrate that the shallow cohesive soils (around 0.5m) are of medium strength (typically >55kPa), increasing to high strength at 1.0m depth (typically > 90kPa).

13.5.3 The plot below provides a summary of undrained shear strengths.



13.6 Standard penetration test (SPT)

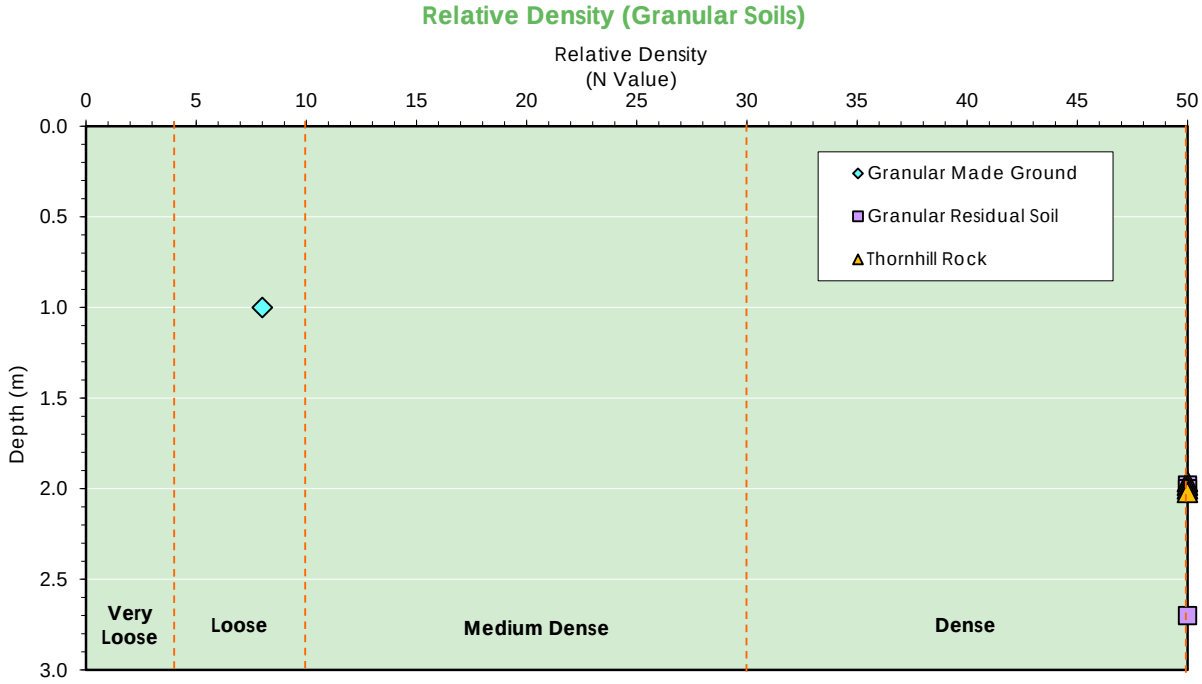
13.6.1 The in-situ relative density of granular soils was established by carrying out Standard Penetration Tests (SPTs) during the drilling of the window sample boreholes.

13.6.2 The SPT results are summarised in below:

Stratum	Number of SPTs	Ave. SPT 'N' value	Estimated strength or density
Granular Made Ground	1	8	Loose
Granular Residual Soil	3	50	Dense
Thornhill Rock	4	50	Dense

13.6.3 The reported blow counts suggest natural strata is dense, with the granular made ground being loose. However, instability in the unlined borehole is considered to be the probable cause of low the blow count within the granular made ground and the true density is more likely to fall within the medium dense range.

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



14 GEOTECHNICAL ISSUES

14.1 Conceptual site model

14.1.1 Ground conditions comprise medium to high strength clays over dense gravels, with Thornhill Rock Sandstone at relatively shallow depth (WS02 at 1.1m to TP03 at 2.8m). Thornhill Rock was typically encountered at shallower depth in the northwest and deeper in the east.

14.1.2 Made ground was encountered at surface across the site (with glass, plastic, metal and ceramic identified); to a depth of 1.1m to 1.3m under the container storage yard and to depth of 0.5m to 2.0m in the footprint of former buildings along Providence Street.

14.1.3 Obstructions (whole bricks, floor slabs and blockwork & brick walls) were identified within the footprint of former buildings along Providence Street (TPs 01, 02 & 03)

14.2 Mining & quarrying

14.2.1 This site is located within a Coal Mining Development Low Risk Area.

14.2.2 This site is underlain at shallow depth by Thornhill Rock (sandstone) bedrock and the shallowest coal seam (Joan Coal) is anticipated to lie c. 30m – 40m below the surface. Whilst the site lies within a Coal Authority Low Risk area, an intrusive mining investigation was not considered necessary.

14.2.3 A former sandstone quarry located within the site boundary and another immediately south of the site. The former sandstone quarry within the site is located beyond the net developable area and the sandstone quarry immediately south was undergoing development with residential dwellings at the time of the investigation.

14.3 Site regrade and/or ground improvement

14.3.1 Made ground currently underlies the container storage yard in the northwest and is present within the footprint of the former buildings along Providence Street, with made ground topsoil present across the cleared area (to depths of 200mm to 300mm). The made ground was encountered to an average depth of about 1.3m; maximum of 2.0m.

14.3.2 This made ground is considered to be of variable and poor strength and is therefore not considered a suitable foundation material. It has also yielded elevated concentrations of a number of inorganic determinands and contains materials (e.g. whole brick, concrete, metal, wood, coal, etc), which would generally be considered undesirable as a near-surface material in garden areas.

14.3.3 Given the substantial volume of made ground present, export to landfill is not considered economically viable.

14.3.4 Consideration should be given to turnover (excavation, screening and replacement in engineered layers) of the full thickness of made ground beneath the site (particularly along Providence Street). Turnover is considered an appropriate ground improvement solution since significant excavation of the made ground will be required in any case to remove the soil/fill grossly contaminated with hydrocarbons and relict foundations.

14.3.5 Because turnover enables inspection of the full thickness of fill, the developer and their prospective property purchasers, are provided with the reassurance that no significant hazard is left undetected. This is considered advantageous from a perception viewpoint. Furthermore, any potential for surface water infiltration, which would drive potential leaching of contaminants, should be reduced by compaction.

14.3.6 Screened and engineered fill should yield CBR values in excess of 3%, thereby reducing abnormals associated with the construction of estate roads and car parking areas. Excavations through the engineered fill, for drainage etc and foundations will not encounter significant obstructions or grossly contaminated ground and should be stable with little overbreak.

14.3.7 Excavation of the uppermost 500mm or so of natural soils beneath made ground could be undertaken in order to generate a sufficient volume of 'clean' subsoil for placement across the proposed development in gardens and landscaped areas. This subsoil would be best placed during the construction phase; i.e. it should be left in stockpile(s) on completion of the site preparatory works.

14.3.8 Prior to placement of any fill, the excavation base should be **surveyed**, in order that fill thicknesses can be plotted and appropriate foundation solutions determined.

14.3.9 There are a number of advantages to such a 'soil inversion' operation; most notably:

- Ground levels will remain essentially as existing (i.e. there is no need to raise levels by 600mm to accommodate soil cover).
- Reduced traffic movements - there should be no need to export any significant volume of made ground off-site, and no need to import subsoil to site.

14.3.10 The above solution is considered to be in line with current government philosophy regarding sustainable development. Turnover works should be undertaken in accordance with the CL:AIRE Code of Practice (v2, March 2011), and a Materials Management Plan (MMP) should be prepared prior to commencement.

14.3.11 Given existing topography (the site is sloping southeast, with gradients of around to 1 in 8 v:h), some site regrade is anticipated, with the need for underbuild and possibly retaining walls.

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

14.3.13 Any digital terrain modelling undertaken, or commissioned, should consider implications for the foundation recommendations outlined below.

14.3.14 Shallow natural ground underlying this site is often clayey, therefore consideration should be given to the implication of undertaking earthworks in poor/wet weather when the ground surface is likely to become difficult to cross with heavy machinery.

14.3.15 Wherever possible, Lithos recommend that excavated soils are retained on site. However, if this is not possible the comments in Section 11.8 should apply.

14.4 Foundation recommendations

General

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

14.4.2 Further investigation should be commissioned if any apartment blocks with higher line loads (say >120kN/m run) are proposed. Such investigation would include rotary cored boreholes and geotechnical analysis (UCS and point load) of recovered rock samples.

14.4.3 We have assumed that final development levels will not differ significantly from ground levels existing at the time of investigation, if ground levels are to be changed revision of these recommendations will be required.

14.4.4 Any digital terrain modelling undertaken, or commissioned, by the developer should consider implications for the foundation recommendations outlined below.

14.4.5 Foundation depths (and types) will depend on thicknesses of fill following any earthworks regrade.

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

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

14.4.1 Shallow soils beneath this site predominantly comprise Cohesive Residual Soils, over Granular Residual Soils and Thornhill Rock (sandstone bedrock). It is possible that strip footings might be suitable for two or three storey houses founded in the cohesive soils.

Strip/trench fill footings

14.4.2 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for the majority of two or three storey houses constructed at the site. Footings will be founded in stiff clay, dense gravel or competent rock. This solution is viable where the made ground is less than about 2.5m thick.

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

14.4.4 Where existing buildings are to be demolished (within the container storage yard in the northwest), all concrete slabs and service ducts will require breaking out prior to re-development. However, relict foundations could probably be left in-situ and an allowance made for local breaking out, or (probably better) chased-out and removed during the necessary site preparatory works; see Section 14.3.

14.4.5 Foundations of plots placed over relict foundations (beneath the container storage yard and within the footprint of former buildings along Providence Street) should be taken to greater depth than the relict foundations and into natural ground of adequate bearing capacity.

14.4.6 Foundations will be required to be placed below a line drawn up at 45^{o} from the base of any service or similar excavation.

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

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

14.4.9 Whilst strip or trench fill footings generally represent a simple and inexpensive foundation solution, there are a number of potential disadvantages associated with their use on this site:

- The made ground contains elevated concentrations of some inorganic contaminants and a 600mm thick cover of clean subsoil (see Section 11.6) has been recommended. Subject to final remediated development levels, this cover is likely to increase footing depth/underbuild.
- Disposal of arisings will be required.
- Foundation and drainage excavations may encounter significant obstructions resulting in significant overbreak.
- Foundation and drainage excavations will almost certainly require shoring in made ground.

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

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

Cohesive Residual Soils

14.4.12 Atterberg tests suggest that natural cohesive soils at the site are of low shrinkability. A minimum founding depth of 750mm (not accounting for any existing or proposed vegetation) is therefore required for all soils on the site where strip footings are proposed.

14.4.13 In accordance with NHBC Standards, founding depths in cohesive soils should be taken from original or finished ground level, whichever is the lower, to the underside of the footing.

14.4.14 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated the entire net developable area (and about 90% of the entire site) may be affected by trees.

14.4.15 A number of immature (likely self-seeded) trees were noted across the cleared area, these will require removal prior to construction. A number of these trees are likely to lie within the footprint of proposed plots. In theory, this could result in foundation depths of >2.5m. However, in accordance with NHBC Standards Chapter 4.2, if the trees are <50% of their mature height at the time of removal, a default distance to the proposed foundation of 2m can be applied to foundation depth calculations. This will likely result in few (if any) foundation depths of >2.5m. This should be confirmed by a detailed tree survey prior to vegetation removal, and removal should take place as soon as possible.

14.4.16 Furthermore, the net developable area (north/centre) has undergone significant clearance, with many tree stumps (typically 100mm to 300mm in diameter) across the cleared area, but especially in the north along Providence Street. It would be prudent to arrange for a surveyor to pick-up the location of all stumps (and stump diameters) prior to development.

14.4.17 Without a definitive layout it is difficult to say, but it is considered highly likely that a number of these felled trees (stumps) will have a significant impact on the plots that they are located within.

14.4.18 A number of mature trees were present within the net developable area at the time of the intrusive investigation. It is understood that these trees will be retained in any final development.

14.4.19 Trench fill foundations should be designed in accordance with NHBC Standards, Chapter 4.2. Heave precautions (a suitable approved compressible void former) should be used on the internal face of all external walls where the foundation is within the zone of influence of trees and greater than 1.5m deep.

14.4.20 Any trench fill foundation deeper than 2.5m will need to be designed by a Chartered Engineer, whose status is accepted by NHBC (NHBC Standards, Technical Requirement R5); however, it is likely that the presence of bedrock will result in few, if any, foundations being deeper than 2.5m.

14.4.21 It would therefore be prudent to prepare a detailed foundation schedule and seek approval from NHBC in order to determine likely foundation abnormals.

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

- A foundation length of 8m
- A foundation breadth of 0.6m

- A foundation thickness of 225mm
- A foundation depth of 0.75m depth
- An undrained shear strength of 55kPa for the shallow firm clay (typical minimum recorded on site)

14.4.23 Assuming the foundation geometry detailed above, minimal settlements would be anticipated. This is considered to be acceptable. However, further advice should be sought from the Structural Engineer responsible for foundation design.

Granular Residual Soil (sandy, clayey Gravel)

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

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

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

14.4.26 Assuming the foundation geometry detailed above, minimal settlements would be anticipated. This is considered to be acceptable. However, further advice should be sought from the Structural Engineer responsible for foundation design.

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

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

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

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

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

Bedrock (Thornhill Rock, Sandstone)

14.4.32 The Thornhill Rock sandstone bedrock is generally considered to have a safe bearing capacity of at least 300kPa and minimal settlements would be anticipated.

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

Piled foundations

14.4.34 Piled foundations may be an option for dwellings constructed in areas of deeper made ground (Container storage yard and along Providence Street) and significant tree influence.

14.4.35 Whilst not encountered during the investigation, made ground > 2.5m thick is considered possible within the footprint of former buildings along Providence Street and underlying the container storage yard in the northwest.

14.4.36 Existing and former tree influence will exceed 2.5m depth, granular residual soil/bedrock were not found to lie beyond this depth (deepest in SA04 at 2.3m). Piling may provide more economical than engineer-designed trench-fill foundations >3m depth.

14.4.37 The following general comments relating to piling are provided for guidance, and further advice should be sought from a specialist-piling contractor. Piles are likely to be end bearing in bedrock, therefore in accordance with BS 8004[12] and EC7[13], piling contractors may require further boreholes extended a minimum 5m into competent bedrock using rotary coring techniques.

14.4.38 Should any impenetrable shallow obstructions be encountered, i.e. boulders etc, they should either be grubbed-up, or alternatively the piling layout could be re-designed (although this might also require design of foundations able to span and/or cantilever as necessary).

14.4.39 The made ground contains demolition rubble (whole bricks, floor slabs and blocks), and the depths to competent bedrock are likely to vary significantly over relatively short distances. Consequently, in order to ensure that piles are founded within natural bedrock (and not any overlying quarry backfill), it may be prudent to advance piles to greater depth, so that they are embedded at least 3m into bedrock.

14.4.40 Warranty providers generally require pile lengths to be at least 3m (measured from pile cut off level to pile toe level). Short piles are likely to become dislodged during pile trimming operations, creating additional costs associated with remedial works. Where depths to bedrock vary significantly beneath a plot, pre-boring of piles may be necessary to reach required depths.

14.4.41 Piled foundations should extend into the underlying bedrock. The safe working load that may be supported on a pile is dependent on the pile diameter, its founding depth and the method of installation.

14.4.42 As piles would be founded in bedrock, they will be essentially end bearing, although there may also be some shaft adhesion in the made ground and cohesive residual soils.

14.4.43 Consequently, preliminary estimates for pile lengths in the order of 3.0m.

14.4.44 Given the presence of cohesive soils, it is essential that pile design allows for down-drag (negative skin friction).

[12] *BS 8004 (2015) - Code of practice for foundations.*

[13] *BS EN 1997-1:2007. Eurocode 7: Geotechnical design – Part 2: Ground investigation & testing*

14.4.45 In accordance with NHBC Standards, Chapter 4.2, heave precautions should be provided where a plot is within the zone of influence of trees. Table 3b in Chapter 4.2 defines the zone of influence as a function of tree height (between 0.5 and 1.25) dependant on the water demand. Figure 6 in Chapter 4.2 shows where heave precautions are required for pile foundations.

14.4.46 It is recommended that flexible service connections are used on this site, especially where they enter the buildings, in order to avoid any possible damage due to self-settlement of the weak strata once the site is developed.

14.4.47 Driven piles may lessen the volume of potentially contaminated made ground requiring off-site disposal (cf arisings associated with say trench fill). However, driving can induce some ground vibration. Assessment of any vibration risk to adjacent structures and/or existing site features should be undertaken by pile designer.

14.4.48 Should any impenetrable shallow obstructions be encountered, i.e. old foundation, they should either be grubbed-up, or alternatively the piling layout could be re-designed (although might also require design of foundations able to span and/or cantilever as necessary).

14.4.49 New houses can be built off ring beams designed to span the piles. In order to bond them to the piles, the tops of the piles must be broken out to expose the reinforcement, which can then be tied to that of the beams.

14.4.50 Ground conditions at this site are considered likely to require provision of a piling mat (working platform) and further advice should be sought from the appointed specialist-piling contractor regarding the proposed plant loadings and resulting pressures. This data, together with a knowledge of the strength and variability of the near-surface ground conditions is required in order that design of a mat can be undertaken in accordance with guidance provided in the 2004 BRE document, "BR 470: Working platforms for tracked plant".

14.4.51 The design of working platforms for tracked plant is a geotechnical design process and should be carried out by a competent person. The following parties should have input into the design:

- Permanent works designer, to consider additional uses for platform material as part of the overall development
- Principal contractor, to define any other purposes for which the platform might be used
- Contractor or subcontractor, to specify requirements for the platform, including gradients, ramps and edges

14.4.52 Piles can provide an enhanced pathway for the vertical migration of mobile contaminants. The Environment Agency may therefore object to the adoption of piles as a foundation solution. However, objection is considered unlikely given the nature of the contamination encountered, and the fact that contamination is limited to the topsoil and the made ground that is currently resting on underlying residual soils.

14.4.53 Pile design should be undertaken in accordance with the Environment Agency's guidance booklet "Piling into Contaminated Sites".

Summary of foundation recommendations

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

Areas	Foundation solution(s)	Remarks (influencing factors)
A –Development area, felled trees (stumps) and immature trees	Strip/trench fill footings to 0.75m in cohesive residual soils and to 0.6m in granular residual soils.	Where cohesive soils are in excess of 2.5m, within tree influence, deepened foundations or piles will be required. Low shrinkability clays, in excess of 85kPa from 1.0m. N values of granular soils are dense (50) from 2.0m. If rock is encountered at shallow depth, foundations should be placed entirely on rock
B - Footprint of former buildings & storage container yard	Deepened strip/trench fill footings to between c. 1.0 to 2.0m. Piles or engineer designed trenchfill where made ground is encountered to >2.5m depth.	If rock is encountered at shallow depth, foundations should be placed entirely on rock

14.4.55 A 'simple' foundation zoning plan is presented as Drawing 4985/8 in Appendix B.

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

14.5 Floor slabs

14.5.1 Floors for low rise housing (2-3 storeys) constructed on piled foundations typically utilise reinforced concrete ground beams which rest on pre-cast or in-situ pile caps. A suspended 'Beam and Block' ground floor is then usually constructed using concrete or polystyrene blocks placed between further concrete beams suspended across the ring beams.

14.5.2 Suspended floor slabs should be utilised where the depth of made ground or engineered stone exceeds 600mm in accordance with NHBC Standards Chapter 5.1 (to negate potential settlement problems).

14.5.3 It is estimated that the thickness of made ground is likely to exceed 600mm beneath at least 30% of the plots.

14.5.4 Where shallow foundations are within the influence of existing or proposed trees (and are underlain by shrinkable soils), NHBC require a suspended floor slab, with sub-floor void. The floor slab is most commonly a precast block and beam construction, but alternatively could comprise a suspended timber floor, or a slab cast on a suitable compressible void former. Ground-bearing and cast in-situ suspended slabs (other than those cast on a void former) are not acceptable where foundations are within the influence of trees.

14.5.5 In accordance with NHBC Standards Chapter 4.2, a minimum void height of 200mm should be adopted for a precast block and beam (or suspended timber) floor; this includes a 150mm ventilation allowance. If a suspended, cast in-situ slab (on a void former) is proposed, a minimum clear void height of 50mm should be adopted; of course, the actual thickness of the void former will be significantly greater.

14.5.6 Beyond the influence of existing or proposed trees, it is considered that the natural ground is generally suitable for the use of ground bearing floors. However, ground bearing slabs should not be cast on topsoil. Where plots are elevated for design reasons, the depth of engineered stone below a ground bearing slab should not exceed 600mm, in accordance with NHBC guidance.

14.5.7 The natural ground beneath this site includes cohesive soils and is therefore subject to seasonal variation in moisture content. If ground slabs were constructed on desiccated soil, heave of the slab would occur on re-hydration of the ground. If any significantly desiccated soil is present, a suspended floor slab, with sub-floor void will be required.

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

14.5.9 Floor slab design should be finalised/take account of the results of the gas monitoring and protection measures required, which will be detailed in Lithos' gas risk assessment, to be issued on completion of monitoring in October 2024.

14.6 Designated concrete mixes

14.6.1 Designated mixes are considered in BRE SD1[14] and BS 8500[15]. However, in addition to soil chemistry (sulphate class), there are a number of other considerations relating to structural design that need to be taken into account when determining an appropriate concrete mix.

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

14.7 Excavations

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

14.7.2 Groundwater should be controlled in accordance with CIRIA Report R113[16].

14.7.3 Excavations within cohesive and granular residual soil should remain stable in the short term but if left open for any significant period of time may require shoring most notably in granular soils and made ground.

14.7.4 The stability of even shallow excavations within made ground is likely to be poor, and therefore allowance should be made for shoring when excavating within areas where made ground is anticipated.

14.7.5 Bedrock was encountered in the majority of exploratory holes across the site. Based on the exploratory hole logs, excavation greater than 2.0m is likely to prove difficult across about 50% of the net developable area. It would therefore be prudent to allow for excavation of hard rock in any deep excavations such as those that may be required for drainage etc.

14.8 Drainage

14.8.1 Drainage Engineers could use the infiltration rates reported in Section 9 to determine the feasibility of soakaways as a solution for the discharge of surface water run-off.

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

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

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

14.8.2 Given water table depth it is considered possible that springs will appear down-gradient, meaning carful positioning of any soakaways will be required.

14.8.3 However, consideration should be given to the location of soakaways given the significant thicknesses of made ground encountered on-site. It should be noted that soakaways cannot be allowed to infiltrate into made ground due to the risk of settlement caused by wash out of fine soil particles.

14.8.4 Furthermore, soakaways should not be constructed adjacent to any retaining features, steep slopes, or the c. 10m near vertical drop located along the southern boundary.

14.8.5 Yorkshire Water have published a guide[17] for developers and designers outlining their design requirements for surface water attenuation assets. However, further to changes in drainage policy over recent years, independent water authorities (including IWNL, ICOSA, LEEF etc) now adopt more housing schemes than the traditional authorities such as Yorkshire Water. Consequently, the CIRIA C753 has become the more commonly used guidance for the design of SuDS features (including attenuation assets).

14.8.6 Based on observations made during the investigation, soakaways constructed in natural granular soils or weathered bedrock might provide a suitable drainage solution for surface water run-off at this site.

14.8.7 However, CIRIA C753:2015 states that: "*A minimum distance of 1m between the base of the infiltration system and the maximum likely groundwater level should always be adopted. This is to minimise the risk of groundwater rising into the infiltration component and reducing the available storage volume, to protect the functionality of the infiltration process by ensuring a sufficient depth of unsaturated material and to protect the groundwater from any contamination in the run-off*".

14.9 Highways

14.9.1 The natural soils present at shallow depth (anticipated formation) are predominantly cohesive. Based on visual inspection of the natural materials and the recorded plasticity indices at the site, published guidance[18] and tables[19] indicate that the cohesive residual deposits would be expected to provide a CBR value of at least 3%. These values should be verified prior to or during construction.

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

14.9.3 Made ground is present across two areas the site and consultation with the adopting authority, regarding the specification of the highways, is strongly recommended.

14.9.4 The made ground present beneath this site is highly variable in terms of both composition, and strength/density. Furthermore, it often contains a significant amount of oversize (boulders, whole bricks, floor slabs etc) and obstructions (old foundations and cellar walls etc), which represent potential 'hard-spots'.

[17] *Design Requirements for Surface Water Attenuation Assets, February 2017.*
[18] *CD225 Design for new pavement foundations Revision 1 (Design Manual for Roads and Bridges)*
[19] *The Structural Design of Bituminous Road, TRRL Laboratory Report 1132 (Table C1, page 36)*

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

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

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

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

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

14.9.9 Crushing of demolition/hardstand/foundation arisings will generate aggregate, which (subject to confirmatory testing) should be suitable for use as unbound pavement materials within the highways.

14.10 External works

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

14.10.2 It is possible that retaining walls will be utilised at this site, therefore when designing retaining walls, consideration should be given to Clause 10.2.3 of NHBC standards which states that flexible retaining walls such as gabion and timber structures should not be used to provide support to homes, garages, roads, drives, car parking areas or drainage systems.

14.10.3 Modelling should take account of the presence of highwalls and deep made ground (former quarries) as these may have an impact on proposed layout and earthworks design.

15 REDEVELOPMENT ISSUES

15.1 General

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

15.1.2 Even after an appropriate preliminary investigation and ground investigation, with exploratory holes on a closely spaced grid (say trial pits at 30m centres), a geoenvironmental appraisal is typically based on inspection of the ground underlying less than 0.5% of the total site area (and much less at depths in excess of about 2.5m). Consequently, there is always a possibility that unanticipated ground conditions will be encountered during the construction phase.

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

15.2 Remediation strategy

15.2.1 Redevelopment of this site will almost certainly be subject to planning conditions relating to remediation and validation. Once a specific, preferred development strategy has been decided, Lithos could liaise with local Planning Authority and Warranty Provider and prepare a detailed Remediation Strategy document for approval.

15.2.2 The Remediation Strategy document would include:

- General background information, including site location, site description and a summary of ground investigation data
- An overview of existing constraints on development and the aims of the proposed remediation works
- Specific details of the anticipated site remediation/preparatory works
- Details of site supervision and verification
- A summary of implications for redevelopment

15.2.3 The Remediation Strategy will describe what is required, but not how it is achieved; the appointed Contractor would normally be expected to undertake an Options Appraisal, and then prepare a Method Statement.

15.2.4 The anticipated remediation works are summarised below:

- General site clearance of surface materials and vegetation.
- Demolition of buildings and removal or storage containers.
- Break-up of slabs and hardstand.
- Post demolition investigation of the ground beneath the former buildings and slabs, which were inaccessible during the earlier investigations.
- Crushing of all suitable artificial hard material (i.e. concrete/brick etc).
- Turnover (excavation, screening and replacement in engineered layers, with appropriate compaction) of the full thickness of made ground to enable:
  - Removal of oversize materials from the made ground in the footprint of the former buildings along Providence Street
  - Inspection of the made ground
  - Removal of below ground obstructions
  - Preparation of the ground for highway construction
- Excavation of natural soils from beneath made ground to source 'clean' subsoil for use in gardens and landscaped areas.
- Excavation of contaminated Topsoil and Made Ground. This should be confirmed with subsequent laboratory testing.
- Backfill of all resultant excavations, with appropriate compaction.
- Some site re-grade is anticipated due to topography.
- Provision of a minimum **600mm** thick cover layer of 'clean' soils where made ground or contaminated soils remain beneath garden areas.
- Provision of a minimum **450mm** thick cover layer of 'clean' soils where made ground or contaminated soils remain beneath landscaped areas (within the net developable area) associated with the development.

15.2.5 The remediation contractor should survey reduced levels during the proposed turnover, prior to the placement of any fill.

15.2.6 Subsoil excavated during the site preparatory works for subsequent use as cover in gardens and landscaped areas, would be best placed during the construction phase; i.e. it should be left in stockpile(s) on completion of the site preparatory works.

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

15.2.8 It is strongly recommended that the demolition contractor chase-out all significant buried structures, and survey-in the resultant excavations before making them safe by backfilling. At the very least, relevant features should be surveyed-in before "hiding" them beneath a veneer of rubble. Similarly, it would be prudent to complete a drainage survey prior to blading rubble across the site to leave it safe and secure.

15.3 Control of excavation arisings

15.3.1 Excavations into made ground are likely to yield contaminated arisings. The groundworker should carefully segregate (and stockpile separately) made ground arisings from arisings of "clean" natural soils, in order that an excessive volume of unsuitable material is not generated.

15.3.2 The groundworker should appreciate the need for good materials management. Most notably the importance of not mixing different materials within a given stockpile; i.e. there should be separate stockpiles of: topsoil; grubbed-up concrete hardstand; tarmac; Ash & Clinker; fuel-contaminated soil (if encountered); excess clean, natural soil arisings; general construction waste etc.

15.3.3 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed. See also comments in Section 11.8 regarding asbestos.

15.3.4 Made ground arisings could be:

- Redistributed (not made ground topsoil) beneath concrete oversite, or areas of hardstanding, where they would be satisfactorily isolated from end users; only if suitable (i.e. not compressible, rich in deleterious matter etc).
- Isolated beneath the 600mm thick cover layer in garden or landscaped areas.
- Exported from site to a suitably licensed landfill facility.

15.3.5 Natural ground arisings should be suitable for use as subsoil in the proposed soil cover.

15.4 Placement of topsoil

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

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

15.4.3 Subsequent trafficking over the loosened subsoil should be minimised.

15.4.4 Topsoil and subsoil should not be placed during or immediately after heavy rain.

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

15.5 Good practice guidance

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

- CIRIA C741[20]
- EA Pollution Prevention Guidelines[21]:
  - PPG6 - Working at construction and demolition sites
  - PPG2 - Above ground oil storage tank
  - PPG7 – The safe operation of refuelling facilities
  - PPG21 – Incident Response Planning

15.5.2 Site preparatory works associated with this project are likely to involve both the re-use of natural and made ground soils on site, and the import of natural soils from another development site (following treatment at an authorised Hub site). Therefore, the Contractor should prepare a Materials Management Plan (MMP) in accordance with the CL:AIRE Code of Practice (v2, March 2011) [22].

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

15.6 New utilities

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

15.6.2 It is recommended that trenches for services including site drainage and water supply are cut over size in order to isolate pipe materials from potential contaminants and to enable maintenance to be conducted in "clean" material.

15.6.3 Water Companies have a statutory duty to supply wholesome water, which could be compromised by the selection of an inappropriate pipe material. For example, compounds such as petroleum hydrocarbons and solvents can permeate commonly used plastics pipes, and/or corrosive chemicals can reduce the service life of metallic pipes. Guidance has been developed for the selection of pipes in brownfield sites and is contained in a UKWIR Report[23].

15.6.4 This site is brownfield, and therefore consideration of soil contaminant concentrations is required. Samples taken must be representative of the soil conditions in which the water pipes are proposed to be laid; normally water pipes are laid 0.7m to 1.3m below finished ground level.

15.6.5 At the time of writing, the proposed route(s), and total length, of water supply pipes were unknown. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance has not been undertaken. In addition, remediation earthworks are anticipated, and ground currently present along proposed supply pipe routes will almost certainly be redistributed. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance has not been undertaken.

15.6.6 However, given the proposed remediation works, the Verification Report should include the results of further testing within 15m of the proposed route(s) of water supply pipes. In the meantime, it is considered likely that the adopting Water Authority will request the use of barrier pipe mains, with plastic coated copper house connections, given that residual organic contaminants will still be present post-remediation, albeit at acceptable concentrations.

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[20] *CIRIA C741 (2015) - Environmental Good Practice on Site*

[21] *Whilst this has formally been withdrawn it can still be accessed via the EA archives and provides useful information on managing risks.*

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

[23] *UKWIR Report 10/WM/03/21 – 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'.*

15.7 Health & safety issues - construction workers

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

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

15.7.3 The bulk of the made ground will be retained on site. This made ground contains contaminants at concentrations above the guidance threshold values for an end use that includes domestic gardens. Workers involved in excavations for foundations, drainage, utilities etc are likely to come into direct contact with the made ground.

15.7.4 Although workers will only be exposed to the contaminated soil for a relatively short time, the contaminants represent a risk, and simple precautionary measures are required, i.e. good personal hygiene and basic personal protective equipment.

15.7.5 Consequently, during the remediation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. General guidance on these matters is given in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land". In summary, the following measures are suggested to provide a minimum level of protection:

- All ground workers should be issued with protective clothing, footwear and gloves. Personnel should be instructed in why and how they are to be used.
- Hand-washing and boot-washing facilities.
- Care should be taken to minimise the potential for off-site migration of contamination by the provision of dust suppression control and wheel cleaning equipment during the construction works.
- Good practices relating to personal hygiene should be adopted on the site.
- The contractor should satisfy the Health & Safety Executive with regard to any other matters concerning the health, safety and welfare of persons on the site.

15.8 Potential development constraints

15.8.1 It is considered highly likely that topography will require significant regrade earthworks, most notably in the centre of the site where levels are steepest.

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

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

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

15.8.5 The utility companies may seek to restrict changes in site level if the depth of cover above their services were adversely affected by any development proposals. This aspect requires further clarification.

16 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

16.1 General

16.1.1 The site is located immediately south of Providence Street in Earlsheaton c. 1.3km east of Dewsbury town centre. It is understood that the site is to be redeveloped with c. 30 residential dwellings, associated gardens, POS and adoptable roads and sewers. A site layout (sketch masterplan) has been provided by JRP Associates (Drawing reference; 24 5721 SK04, dated July 2024) which is reproduced as Drawing 4985/2 in Appendix B to this report.

16.1.2 Natural ground comprising a veneer of topsoil over cohesive and granular residual soil was encountered across the centre of site (cleared woodland) to depths of 1.5m to 2.8m (average 2.0m). Thornhill Rock, sandstone bedrock, was encountered in 10 exploratory holes from 1.1m to 2.8m (average 1.7m) depth. Excavation with a JCB 3CX was noted as difficult in many exploratory holes form c. 2.0m depth.

16.1.3 Made ground topsoil (typically 200mm to 300mm in thickness) was encountered in 8 exploratory holes across the cleared area.

16.1.4 Deeper made ground was encountered in 5 exploratory holes to between 0.5m and 2.0m depth (average 1.3m), underlying the container storage yard and within the footprint of former buildings along Providence Street.

16.1.5 It is considered likely that further made ground is present beneath both locations to a greater extent to what was encountered during the investigation.

16.2 Mining & quarrying

16.2.1 This site is located within a Coal Mining Development Low Risk Area.

16.2.2 This site is underlain at shallow depth by Thornhill Rock (sandstone) bedrock and the shallowest coal seam (Joan Coal) is anticipated to lie c. 30m – 40m below the surface. Whilst the site lies within a Coal Authority Low Risk area, an intrusive mining investigation was not considered necessary.

16.2.3 There are known areas of former sandstone quarrying located within the site boundary (beyond the net developable area) and another immediately south of the site.

16.3 Hazardous gas

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

16.3.2 Gas monitoring is currently underway, and a Gas Risk Assessment with be issued in October 2024.

16.4 Contamination & remediation

16.4.1 A significant number of samples have levels of arsenic and lead in exceedance of Lithos' screening values.

16.4.2 The placement of a clean cover system (likely to be 600mm/450mm based on the existing information) will be required.

16.4.3 It is anticipated that further made ground exists beneath the container storage yard and within the footprint of former buildings. This **may** identify the need for more significant remediation works.

16.5 Foundations

16.5.1 It is considered that traditional strip/trench fill footings will be the most suitable foundation solution for two & three storey domestic dwellings constructed at this site. However, it should be noted that the entire developable area could be affected by either trees or made ground, so deepening of foundations is required.

16.5.2 These footings will be founded in medium to high strength clays (cohesive residual soil) and dense sands and gravels (granular residual soil).

16.5.3 Bedrock (Thornhill Rock sandstone) is anticipated at shallow depth, if encountered foundations should be placed entirely on rock.

16.5.4 Where significant thicknesses of made ground or areas of significant tree influence in deeper cohesive residual soil are encountered piled foundations may be the most suitable foundation solution.

16.6 Flooding

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

16.7 Drainage

16.7.1 Based on observations made during the investigation, soakaways constructed in natural granular residual soils (or shallow bedrock) might provide a suitable drainage solution for surface water run-off at this site.

16.8 Highways

16.8.1 Based on visual inspection of the shallow natural materials and published guidance, the cohesive and granular residual soils should provide a CBR value of at least 3%. This value should be verified prior to or during construction.

16.8.2 However, made ground is present across parts of the site, typically to depths of around 1.3m, and consultation with the adopting authority, regarding the specification of the highways, is strongly recommended.

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

16.9 Further works

16.9.1 Given the constraints discussed in Sections 6.2 & 7.2 (container storage yard) a simple post-demolition/ site clearance trial pit investigation will be required in order to remove residual uncertainties with respect to ground, and provide more definitive recommendations with respect to contamination and foundations.

16.9.2 If the area of woodland (beyond the net developable area) is accessible to the public, it would be prudent (due to the contamination found within the topsoil across the cleared area) to undertake some topsoil/surface sampling across this area and assess it as POS.

Appendix A

General Notes

01 - Environmental setting
Generic notes – geoenvironmental investigations

General

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

Geology, mining & quarrying

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

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

Landfills

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

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

Radon

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

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

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

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

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

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

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

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

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

Hydrogeology

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

- Groundwater quality
- Recorded pollution incidents
- Licensed groundwater abstractions

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

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

The maps display the following aquifer designations:

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

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

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

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

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

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

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

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

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

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

Hydrology

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

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

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

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

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

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

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

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

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

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

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

COMAH & explosive sites

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

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

Preliminary conceptual site model

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

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

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

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

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

02 - Ground investigation fieldwork
Generic notes – geoenvironmental investigations

General

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

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

Exploratory hole locations

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

Investigation techniques

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

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

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

In-situ testing

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

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

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

Sampling

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

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

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

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

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

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

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

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

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

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

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

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

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

Groundwater

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

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

Description of strata

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

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

03 – Geotechnical laboratory testing
Generic notes – geoenvironmental investigations

General

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

- Atterberg limits & moisture contents
- Soluble sulphate & pH

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

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

- Grading
- Compaction tests
- Particle density

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

Atterberg limits & moisture content

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

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

I'p = Ip * (%< 425µm/100)

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

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

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

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

Soluble sulphate and pH

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

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

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

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

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

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

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

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

Oedometer (Consolidation) tests

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

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

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

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

Triaxial tests

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

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

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

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

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

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

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

Determination of analytical suite

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

Common contaminants

Common **Inorganic** Contaminants include:

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

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Methods of analysis (organic compounds)

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

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

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

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

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

Current UK guidance

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

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

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

Soil screening values used by Lithos

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

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

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

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

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

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

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

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

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

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

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

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

D - Commercial/industrial with landscaping

E – Importation of soil cover

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

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

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

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

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

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

Inorganic Tier 1 values for scenarios A to E

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

Organic Tier 1 values for scenarios A to E

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

* *For a residential end use*

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

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

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

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

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

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

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

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

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

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

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

Statistical Assessment

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

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

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

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

Current guidance requires that:

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

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

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

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

However, broadly speaking the following applies:

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

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

Other screening values used by Lithos

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

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

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

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

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

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

Waste classification & WAC

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

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

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

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

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

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

Possible action in event of Tier 1 exceedance

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

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

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

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

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

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

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

05 – Hazardous gas
Generic notes – geoenvironmental investigations

General

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

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

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

Sources

Potential sources of hazardous gas include:

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

Generation

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

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

Migration

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

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

Gas monitoring procedure

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

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

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

Current guidance

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

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

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

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

A – All developments except low rise housing

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

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

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

B – Low rise housing.

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

Table 8.7 NHBC Traffic light system for 150 mm void

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

Notes:

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

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

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

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

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

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

06 - Soakaways
Generic notes – geoenvironmental investigations

Background

Soakaways have been the traditional way to dispose of stormwater from buildings and paved areas remote from a public sewer or watercourse. In recent years, soakaways have been used within urban, fully-sewered areas to limit the impact on discharge of new upstream building works, and to avoid costs of sewer up-grading outside a development.

Soakaways are increasingly seen as a more widely applicable option alongside other means of stormwater control and disposal. Soakaways must store the immediate stormwater run-off and allow for its efficient infiltration into the adjacent soil. They must discharge their stored water sufficiently quickly to provide the necessary capacity to receive run-off from a subsequent storm. The time taken for discharge depends upon the soakaway shape and size, and the surrounding soil's infiltration characteristics. Soakaways can be constructed in many different forms and from a range of materials.

BRE Digest 365, DG365: 1991 describes design and construction procedures, explains how to calculate rainfall design values and soil infiltration rates, and gives design examples. Further advice is provided in **NHBC** Standards Chapter 5.3 (Section 9 & Appendix F), **Building Regulations** Section 3 of Approved Document H (Drainage & Waste Disposal), and Chapter 13 of **CIRIA's** SUDS Manual (C753:2015).

Soakaways should generally be built on land lower than or sloping away from buildings and be sited **at least 5m** from the foundations of a building.

BRE365 states that '**Groundwater should not rise to the level of the base of the soakaway** during annual variations in the water table' this is further reinforced in Chapter 13 of CIRIA C753:2015 which states that: "*A minimum distance of 1m between the base of the infiltration system and the maximum likely groundwater level should always be adopted. This is to minimise the risk of groundwater rising into the infiltration component and reducing the available storage volume, to protect the functionality of the infiltration process by ensuring a sufficient depth of unsaturated material and to protect the groundwater from any contamination in the run-off*". There may be a requirement to install groundwater monitoring wells at a site in order to monitor seasonal variations in groundwater level at least over a wet winter period.

Soakaways should **not be sited on sloping sites**, an assessment should also be made to ensure that infiltrating water will not cause a rise in groundwater levels, waterlogging of downhill areas or springs, and that slopes are not made unstable.

Made ground (and ground within 5m of deep fill) is not generally regarded as suitable for soakaways, due to the potential for inundation settlement and the leaching of contaminants.

Chalk: CIRIA C574:2002 notes that concentrated ingress of water into the chalk can initiate dissolution, particularly in low-density chalk. For this reason, soakaways should be sited well away from foundations for structures, roads or railways:-

- in areas where dissolution features are known to be prevalent, soakaways should be avoided but, if unavoidable, should be sited at least 20m away from foundations etc
- where the chalk is of low density (weak), or where density is not known, soakaways should be sited at least 10m away from foundations
- where the chalk is of medium density, or higher (moderately weak), soakaways should be sited at least 5m away from foundations

Test methodology

Lithos undertake soakaway tests in general accordance with BRE Digest 365 "Soakaway Design". The BRE Digest recommends that each soakaway pit is filled and allowed to drain three times to near empty; the three fillings to be on the same or consecutive days. However, each test can take over 2 hours to complete. Consequently, at site investigation / feasibility stage, testing is usually undertaken in a 'broad sweep', relatively widely spaced; often only 1 or 2 fills. The drainage designer reviews SI data and if soakaways look feasible, commences design with the incorporation of soakaways. Prior to finalising design, the Drainage Engineer will usually recommend further soakaway testing: (a) within 25m of proposed chamber locations; and (b) to include 3 fills.

Whilst in theory 3 fills is fine, in practice it is often not straightforward. Where drainage rates are quick (draining < 1 hour), allowing 3 fills per pit within a day, even larger water bowsers (say 2,300 gallon/10,000 litre) will run out of water after testing in two pits. Re-filling can take 2 to 3 hours depending on available water supplies etc. So, it is typically only possible to do fully compliant BRE 365 testing in 4 pits a day.

Where infiltration is moderate (a fill drains in say 2 to 4 hours), soakaways may be considered feasible, but it will not usually be possible to complete 3 fills in a day. Therefore, it becomes necessary to leave pits open overnight (usually with a consequent need for herras fencing, site security etc, or the use of stone backfill).

Infiltration rates

Infiltration rates for each soakaway test are calculated (where possible) in accordance with BRE Digest 365. This design takes into account the time of emptying the soakaway pit between 25% and 75% of its effective depth. The effective depth is calculated from the starting water level to the soakaway pit base. Where the water level did not fall to 25% effective depth, the data was interpolated in order to obtain a representative infiltration rate.

Soakaway design

Soakaway design should be carried out by a suitably qualified and experienced Drainage Engineer, in accordance with BRE Digest 365 using the infiltration rates calculated from soakaway testing during a ground investigation.

It is generally assumed that soakaways become impracticable on residential developments when:

- A chamber type design requires a square pit with side length in excess of 1.8m, or an effective depth greater than 1.5m.
- A trench type design requires a length greater than about 10m, or an effective depth greater than 1.5m.

Increasing the soakaway effective depth might offer a solution, but consideration should be given to:

- Standing groundwater level
- Depth to base of permeable strata
- Cost of excavation

Soakaway percolation in some rock types is predominately via the vertical joints within the rock mass. The relatively small-scale soakaway test pits may not intercept such joints and this can result in variable test results. However, it is likely that the larger surface area of a completed soakaway within the development will intercept such joints.

The drainage designer submits designs for approval to:

- The Lead Local Flood Authority (LLFA), usually part of the Local Authority (e.g. NYCC). The LLFA are a consultee to the planning authority. They review the full technical design to ensure that proposals (both plots & highways) are satisfactory. The LLFA may also set standards for soakaway design (NYCC have, and these now require 3 fills and soakaway testing within 25m of proposed chamber locations).
- Local Authority Highways Dept. The Highways Authority adopt highways drainage, so review drainage design (via approval of a Section 38 submission). They also visit site to inspect construction.
- Building warranty provider (e.g. NHBC, Premier etc), if soakaways are proposed for roof & driveway waters.

Appendix B

Drawings

Reproduced from OS Explorer map 1:25,000 scale by permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationery Office. Crown copyright. All rights reserved. Licence number 100049696.

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CLIENT	PRECIOUS HOLDINGS (WAKEFIELD) LTD
JOB TITLE	PROVIDENCE STREET, EARLSHEATON
DRAWING TITLE	SITE LOCATION PLAN
DRAWN	DP
DATE	14 03 2024
CHECKED	ASw
DATE	14 03 2024
STATUS	FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑
SCALE	1:25,000
SHEET	A4
DRAWING NO.	4985/1
REVISION	

NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM JRP ASSOCIATES SKETCH MASTERPLAN DRAWING - REFERENCE; 24 5721 SK04 , DATED JUL 24

REV.	DESCRIPTION	DATE

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CLIENT

PRECIOUS HOLDINGS (WAKEFIELD) LTD

JOB TITLE

PROVIDENCE STREET, EARLSHEATON

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
DP	19 07 2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	19 07 2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	4985/2	

N
W E
S

NOTES

- WOODLAND & OVERGROWN AREAS
- GRASS & CLEARED WOODLAND
- BUILDINGS/STORAGE CONTAINERS
- GRAVEL SURFACING
- COBBLED STREET
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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Tel 01937 545330

CLIENT

PRECIOUS HOLDINGS (WAKEFIELD) LTD

JOB TITLE

PROVIDENCE STREET, EARLSHEATON

DRAWING TITLE

SITE FEATURES

DRAWN	DATE	STATUS
DP	29 05 2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	29 05 2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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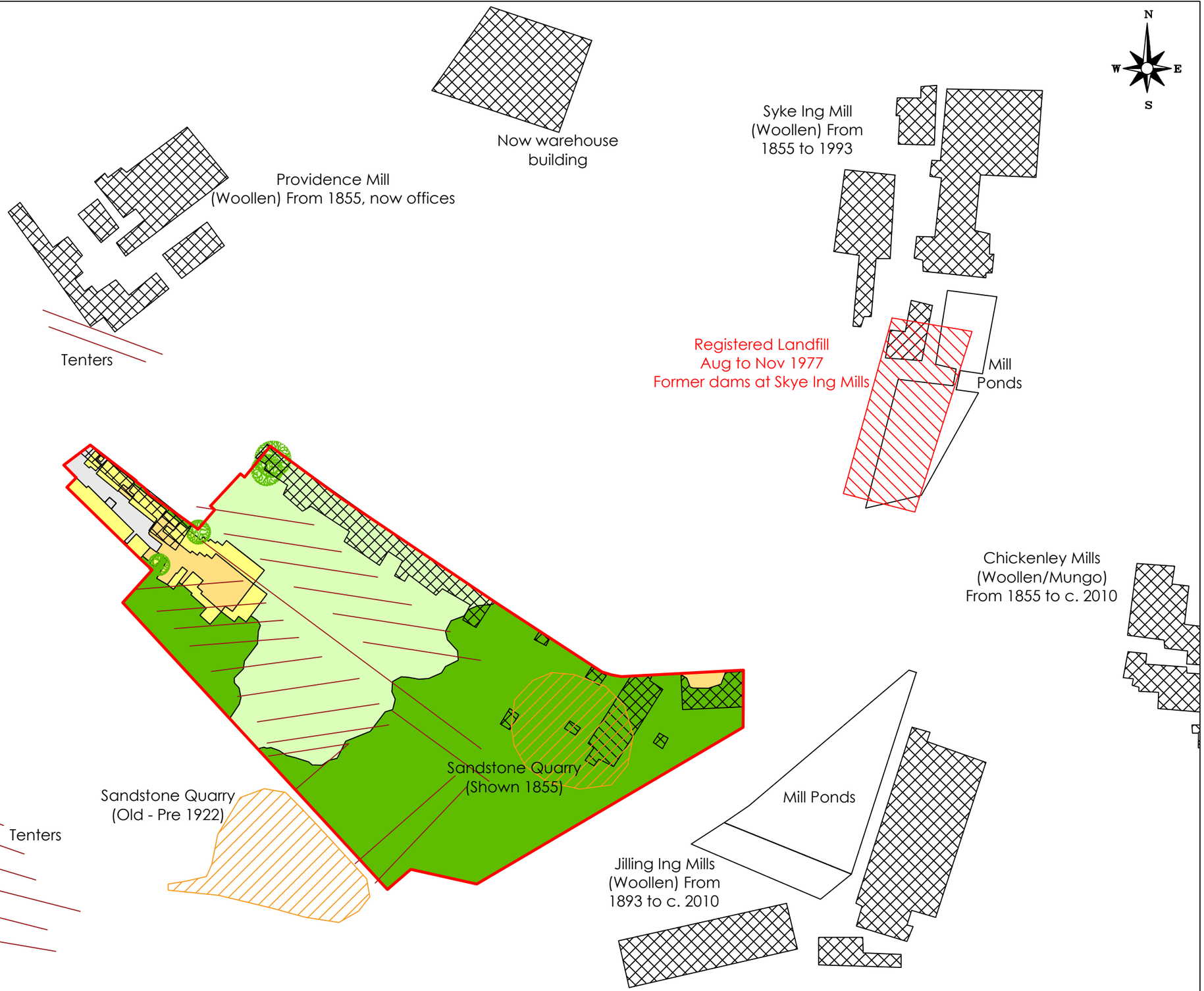

NOTES

- WOODLAND & OVERGROWN AREAS
- GRASS & CLEARED LAND
- BUILDINGS/STORAGE CONTAINERS
- GRAVEL SURFACING
- COBBLED STREET
- APPROXIMATE FORMER QUARRY
- APPROXIMATE FORMER LANDFILL
- APPROXIMATE FORMER BUILDING
- TENTER FRAMES
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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CLIENT

PRECIOUS HOLDINGS (WAKEFIELD) LTD

JOB TITLE

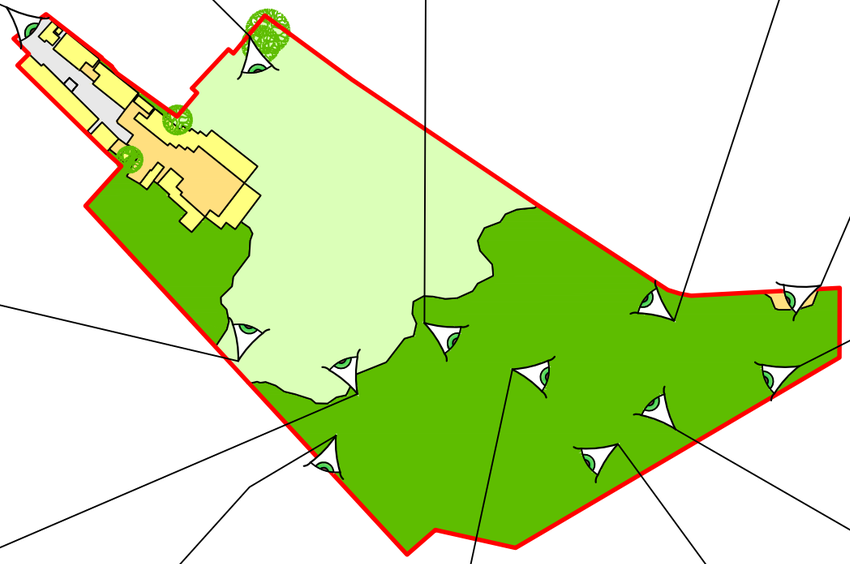
PROVIDENCE STREET, EARLSHEATON

DRAWING TITLE

HISTORIC SITE FEATURES

DRAWN	DATE	STATUS
DP	29 05 2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	29 05 2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1500	A3	4985/3A	



N

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S

NOTES

- WOODLAND & OVERGROWN AREAS
- GRASS & CLEARED LAND
- BUILDINGS/STORAGE CONTAINERS
- GRAVEL SURFACING
- COBBLED STREET
- APPROXIMATE SITE BOUNDARY
- LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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

Tel 01937 545330

CLIENT

PRECIOUS HOLDINGS (WAKEFIELD) LTD

JOB TITLE

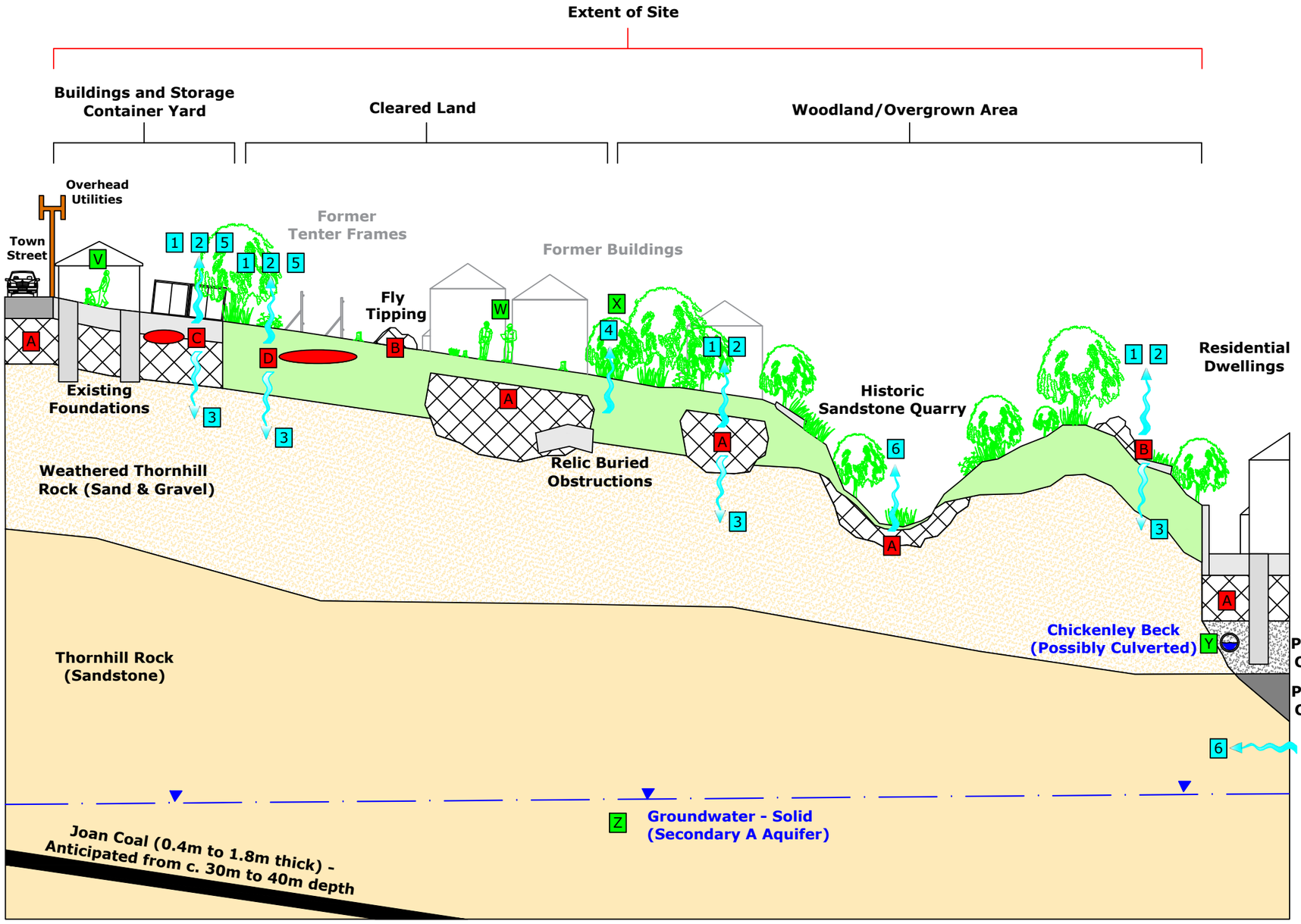
PROVIDENCE STREET, EARLSHEATON

DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	DATE	STATUS
DP	29 05 2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	29 05 2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
NOT TO SCALE	A3	4985/4	



SOURCES	PATHWAYS	RECEPTORS
A MADE GROUND (INORGANICS)	1 DERMAL CONTACT	V END USERS (RESIDENTS)
B TIPPED MATERIALS (INORGANICS & ASBESTOS)	2 INGESTION/INHALATION	W SITE WORKERS
C LEAKAGE/SPILLAGE (ORGANICS)	3 LEACHING OF CONTAMINANTS	X VEGETATION
D WOOLLEN MANUFACTURING PRACTICES (INORGANICS & ORGANICS)	4 UPTAKE BY PLANTS	Y SURFACE WATERS
	5 VOLATILISATION	Z GROUNDWATER
	6 MIGRATION OF GAS	

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING
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Tel 01937 545330

CLIENT
PRECIOUS HOLDINGS (WAKEFIELD) LTD

JOB TITLE
PROVIDENCE STREET, EARLSHEATON

DRAWING TITLE
PRELIMINARY CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
DP	14 03 2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	14 03 2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	4985/5	

NOTES

- TRIAL PIT LOCATION
- SOAKAWAY LOCATION
- WINDOW SAMPLE LOCATION
- WOODLAND & OVERGROWN AREAS
- GRASS & CLEARED LAND
- BUILDINGS/STORAGE CONTAINERS
- GRAVEL SURFACING
- COBBLED STREET
- APPROXIMATE FORMER QUARRY
- APPROXIMATE FORMER LANDFILL
- APPROXIMATE FORMER BUILDING
- TENTER FRAMES
- APPROXIMATE SITE BOUNDARY

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

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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Tel 01937 545330

CLIENT

PRECIOUS HOLDINGS (WAKEFIELD) LTD

JOB TITLE

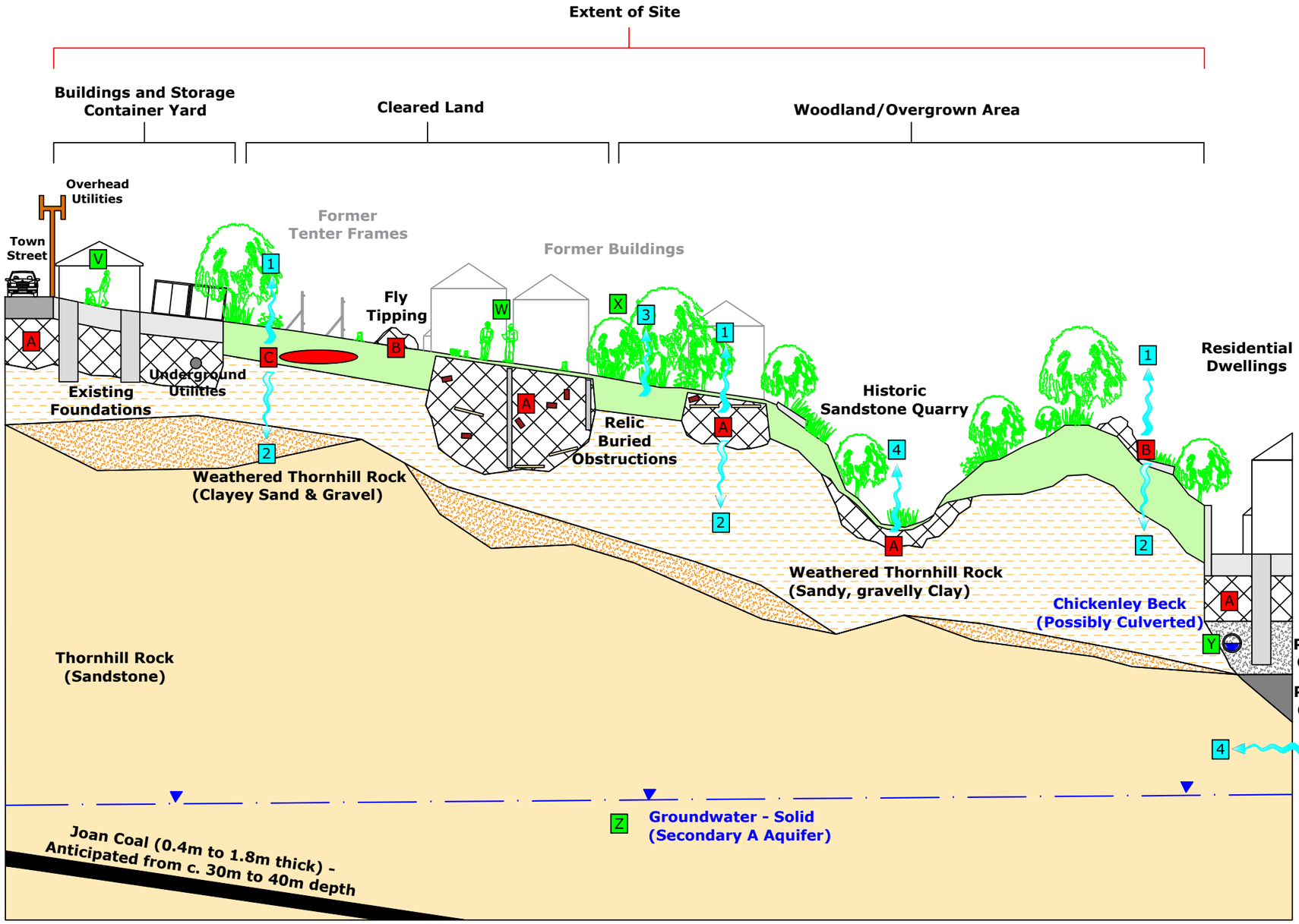
PROVIDENCE STREET, EARLSHEATON

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS

DRAWN	DATE	STATUS
DP	21 06 2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	21 062024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	4985/6	



SOURCES	PATHWAYS	RECEPTORS
A MADE GROUND (INORGANICS)	1 INGESTION/INHALATION	V END USERS (RESIDENTS)
B TIPPED MATERIALS (INORGANICS & ASBESTOS)	2 LEACHING OF CONTAMINANTS	W SITE WORKERS
C WOOLLEN MANUFACTURING PRACTICES (INORGANICS)	3 UPTAKE BY PLANTS	X VEGETATION
	4 MIGRATION OF GAS	Y SURFACE WATERS
		Z GROUNDWATER

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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Tel 01937 545330

CLIENT

PRECIOUS HOLDINGS (WAKEFIELD) LTD

JOB TITLE

PROVIDENCE STREET, EARLSHEATON

DRAWING TITLE

REVISED CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
DP	08 07 2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	08 07 2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	4985/7	

NOTES

APPROXIMATE DEVELOPABLE AREA

AREA A - STRIP/TRENCHFILL FOOTINGS TO 0.75M IN STIFF COHESIVE RESIDUAL SOIL OR TO 0.6M IN GRANULAR RESIDUAL SOIL

AREA B - DEEPENED STRIP/TRENCHFILL FOUNDATIONS IN STIFF COHESIVE / GRANULAR RESIDUAL SOILS

FOUNDATIONS WITHIN BOTH AREA A & B MAY REQUIRE DEEPENING DUE TO TREE INFLUENCE

IF ROCK IS ENCOUNTERED AT SHALLOW DEPTH FOUNDATIONS SHOULD BE PLACED ENTIRELY ON ROCK

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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

Tel 01937 545330

CLIENT

PRECIOUS HOLDINGS (WAKEFIELD) LTD

JOB TITLE

PROVIDENCE STREET, EARLSHEATON

DRAWING TITLE

SIMPLE FOUNDATION ZONING PLAN

DRAWN	DATE	STATUS
DP	18 07 2024	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	18 07 2024	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	4985/8	

Appendix C

Commission

003/4985/REG

14th February 2024

Mr D Precious
Precious Holdings (Wakefield) Ltd
Unit 7, Basketworks
172 Wakefield Road
Ossett
Wakefield
WF5 9AQ

LITHOS CONSULTING

Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

T 01937 545 330

www.lithos.co.uk

Dear Dave

Providence Street, Earlsheaton

Further to your recent invitation, please find attached our proposal for undertaking a site investigation on the above land. We understand that proposed development will include c. 30 traditional 2 storey domestic dwellings with associated gardens, POS and adoptable roads and sewers; although no layout is available yet.

We understand that outline planning permission is being sought for residential development and that the site is allocated in the Kirklees local plan (HS50).

Review of the information supplied suggests that the site consists of a single parcel of overgrown land but with shipping containers in the west. The gross site area is 1.6 ha, but the biodiversity requirements mean the net developable area is 0.86 ha.

Much of the site appears to be heavily vegetated and may not currently be accessible for ground investigation, which is best undertaken following **vegetation clearance**. Furthermore, there may be ecological constraints (e.g. nesting birds), and it is recommended that you consult a qualified ecologist to confirm the absence of any protected plant or animal life prior to commencement of trial pitting.

Brief review of internet data suggests the site:

- Appears to have remained essentially undeveloped throughout its history;
- Is located c. 80m of a known landfill site (former dams at Syke Ing Mills);
- Is not within a groundwater source protection zone;
- Is in an area where the risk of encountering UXO is considered low; and
- Is located within a Coal Mining Development Low Risk Area.

Brief examination of the relevant geological map suggests the site is underlain by Sandstone bedrock likely completely weathered near surface to a sandy Gravel.

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

We will need a Promap or topo survey in CAD format, to provide a base plan for technical drawings etc. If you do not have one, we could obtain for an E\O of £***.

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

This proposal allows for the following works:

Desk study: See separate quote.

Fieldwork: We have allowed for a day's trial pitting and a day's dynamic sampling using a mini percussion drilling rig. All trial pits and boreholes will be supervised and logged by an experienced geoenvironmental engineer.

Trial pitting will enable us to determine the:

- Nature of any made ground
- Nature, distribution and thickness of shallow soils
- Suitability of the ground for soakaways
- Suitability of the ground for founding structures and highways

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

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

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

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

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

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

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

Mini-boreholes are proposed here in order to:

- Allow the installation of gas monitoring wells.
- Allow investigation around buildings (including those still in use)

This investigation should yield sufficient data to enable a foundation zoning plan, and possibly a detailed Foundation Schedule. However, if ground conditions are found to be more variable than anticipated, a 'tighter' grid of pits will be necessary prior to preparation of a detailed Foundation

Schedule. This proposal does not allow for the preparation of a detailed Foundation Schedule, but we will provide a quote on completion of the site investigation if requested.

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

Given the presence of a nearby area of landfill within, we have allowed for the installation of wells in 6 boreholes and monitoring for hazardous **gas** (and any shallow groundwater).

The generation potential of this gas source is considered likely to be Very Low. Therefore, in accordance with CIRIA Report C665, we have initially allowed for 6 visits over a 3-month period. A hazardous gas risk assessment will be issued on completion of monitoring.

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

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

Testing: This will comprise routine **geotechnical** soils analysis, including 10 moisture content & Atterberg limits, and 10 pH & water-soluble sulphate.

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

At this stage, we have no reason to expect wide areas of the site to be underlain by significant thicknesses of made ground. Consequently, we have only allowed for **contaminant** testing of up to 12 made ground samples, plus a further 10 samples of topsoil to confirm its suitability for re-use. The test suite will include heavy metals, speciated PAH, and banded TPH (with supplementary speciation as/where appropriate).

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

Within in our proposal we have allowed for the screening (ID) of 22 samples for asbestos. In the event that positive IDs are reported, it is likely that we will need to schedule further analysis (asbestos quantification), in order to determine the significance of the results. Asbestos quantification is currently a relatively expensive test and consequently we have not allowed for it at this stage. We will inform you immediately after receipt of results if we consider asbestos quantification is required.

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

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

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

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

A completed copy of the **HBF** Contaminated Land Assessment Form will be included in an Appendix to our Report. However, the proposed route(s), and total length, of water supply pipes are not currently known and no allowance has been made for laboratory testing of soil samples in line with UKWIR guidance.

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

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

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

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

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

Details of welfare will be included within the Method Statements. However, this investigation is expected to be completed within 2 working days and therefore it is not considered reasonably practicable to provide formal welfare facilities, and our proposal makes no allowance for so doing.

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

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

It is likely that the site is underlain by many "private" services and drains etc which will not be shown on statutory utility plans. Consequently, it would be appreciated if copies of plans showing these services could be made available to our field engineer, and\or someone with site knowledge could advise us with respect to safe locations for our exploratory holes.

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

If no other designers or contractors have been appointed, Lithos could perform the role of Principal Contractor but only for the duration of the site investigation outlined in this proposal. If you require us to perform the role of Principal Contractor, please make this clear in your instruction. It should be noted that we are not suitably qualified to perform this role where other designers or contractors are also appointed.

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

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

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

Terms & conditions: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed. However, given the likely need for a subsequent letter(s) of reliance in favour of a Developer(s), your attention is drawn to Clauses **10.1 & 10.2** which relate to capped liability. If these Clauses are of concern, you should inform us prior to instruction; revision may be possible.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely

Redacted

Mark Perrin
Director
for and on behalf of
LITHOS CONSULTING LIMITED

1 DEFINITIONS AND INTERPRETATION

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

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

"Documents" means all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of us, and whether in paper form or stored electronically or on disk, or otherwise;

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Project" means the project described in the Proposal and any enquiry from you on which we have based our Proposal;

"Proposal" means the offer document prepared by us in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by us pursuant to the Agreement and as set out in the Proposal and includes any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment" as amended from time to time.

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

2 APPOINTMENT

2.1 You agree to engage us and we agree to provide the Services in accordance with the provisions of this Agreement.

3 OUR OBLIGATIONS

3.1 We shall perform the Services using the reasonable standard of skill and care normally exercised by qualified members of our profession, performing similar services under similar conditions.

3.2 We shall use all reasonable endeavours to perform the Services in accordance with relevant environmental and safety legislation.

4 YOUR OBLIGATIONS

4.1 Throughout the period of this Agreement you shall afford to us, or procure for our benefit, access to any site where access is required for the performance of the Services.

4.2 You accept responsibility for ensuring that we are notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards, which you shall clearly mark on the ground or identify on accurate location plans supplied to us prior to the commencement of the Services. You shall also inform us in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. You shall indemnify us against all costs, losses, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If you discover any conflict, defect or other fault in the information or designs provided by us pursuant to the Agreement, you will advise us in writing of such defect, conflict or other fault and we shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

5 COPYRIGHT

5.1 The copyright in all Intellectual Property prepared by or on behalf of us in connection with the Project for delivery to you shall remain vested in us.

5.2 You shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable you to copy and use the Intellectual Property but solely for your own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by us.

5.3 Should you wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, you must obtain our prior written consent. The giving of such consent shall be at our absolute discretion and shall be upon such terms as we may require. We shall not be liable to you for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on our behalf.

5.4 Ownership of any proposals submitted to you that are not subsequently confirmed as part of the Services to be provided for you remain with us and such proposals must not be used as the basis for any future work undertaken by you or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of you being in default of payment of any fees or other amounts due, we may suspend further use of the licence on giving no less than 2 calendar days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

6 CONFIDENTIALITY

6.1 Neither you nor we shall at any time disclose to any person any confidential information concerning the business, affairs, customers, clients or suppliers of the other party or of any member of the group of companies to which the other party belongs, except as permitted by clauses 6.2 and 6.4.

6.2 Each party may disclose the other party's confidential information:

(a) to its employees, officers, representatives, contractors, sub-contractors or advisers who need to know such information for the purposes of exercising the party's rights or carrying out its obligations under or in connection with this Agreement. Each party shall ensure that its employees, officers, representatives, contractors, sub-contractors or advisers to whom it discloses the other party's confidential information comply with this paragraph 6; and

(b) as may be required by law, to a court of competent jurisdiction or any governmental or regulatory authority.

6.3 Neither you nor we shall use any other party's confidential information for any purpose other than to exercise our rights or perform our respective obligations under or in connection with this Agreement.

6.4 Subject to the above and our privacy policy which can be found on www.lithos.co.uk, we shall be permitted to use information related to the Services we provide in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

7 ASSIGNMENT

7.1 You may assign the benefit of this Agreement on two occasions with our prior written consent (not to be unreasonably withheld) and any additional assignments shall be with our prior consent.

7.2 We may at any time assign, mortgage, charge, subcontract, delegate, declare a trust over or deal in any other manner with any or all of our rights and obligations under this Agreement.

8 INSURANCE

8.1 We shall maintain a professional indemnity insurance policy covering our liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION POUNDS) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, We shall maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under this Agreement, provided such insurance is available at commercially reasonable rates and terms.

8.2 If for any period such insurance is not available at commercially reasonable rates and terms, we shall inform you and shall obtain in respect of such period such reduced level of professional indemnity insurance as is available and as would be fair and reasonable in the circumstances for us to obtain.

9 PAYMENT

9.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

9.2 You shall pay you any VAT properly chargeable on the Services and any amount expressed as payable to us under this Agreement is exclusive of VAT unless stated otherwise.

9.3 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

9.4 If you dispute the amount included for payment in an invoice then you must serve a written notice on us no later than 14 calendar days before the final date for payment. If no notice is given within the required timeframe the amount due shall be the amount stated in the invoice.

9.5 If you fail to pay any monies in accordance with the foregoing payment provisions, we shall be entitled to charge interest on any monies owed to us, such interest to be at a rate of 4% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis. The parties acknowledge that our liability under this clause 10.5 is a substantial remedy for the purposes of section 9(1) of the Late Payment of Commercial Debts (Interest) Act 1998.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, our total liability under or in connection with this Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either the level of insurance cover referred to within clause 8.1 above, or 20 times the total value of invoices issued to you for the Services.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against us after the expiry of a period of six years from the date of the completion (or termination) of the Services under this Agreement.

10.3 Whilst we usually scan for potential exploratory locations with a Cable Avoidance Tool, we shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 We shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by us or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless we have been advised in writing of the same by you and have been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

11 DELAY

We shall comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond our reasonable control and in the event of any such circumstances arising we undertake to complete the Services within a reasonable period, but will not be liable to you for any delay as a result.

12 TERMINATION

12.1 The Agreement may be terminated by either of us in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of termination must be given to the party which is insolvent by the other party.

12.2 If for any reason our Services are suspended for a period in excess of three calendar months then we shall be entitled to terminate our appointment under this Agreement in respect of the Services by no less than seven days written notice to you.

12.3 If you fail to pay in full any sum due under the terms of this Agreement by the final date for payment for that sum and no effective pay less notice is issued, we may serve written notice to you demanding payment within 14 days of such notice. If you fail to comply with such notice, we shall be entitled to terminate our employment under this Agreement forthwith.

12.4 Any termination of our appointment howsoever caused shall be without prejudice to our rights to require payment for all Services performed up to the date of such termination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

13 THIRD PARTY RIGHTS

The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

14 COLLATERAL WARRANTIES & LETTERS OF RELIANCE

We shall consider and may consent to a request from you for us to enter into a collateral warranty or letter of reliance with a third party with regard to the Services provided under this Agreement. The giving of such consent shall be at our absolute discretion and providing we agree to our standard form of collateral warranty or letter of reliance (subject to any reasonable changes to be approved by us at our absolute discretion) and in return for payment of a fee (to be notified at the time of the request).

15 NOTICES

15.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by pre-paid first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to our respective registered office addresses.

15.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by pre-paid first class post.

16 ENTIRE AGREEMENT

16.1 The Agreement constitutes the complete and entire agreement between us with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against us in respect of the Services can only be made in contract under the provisions of this Agreement and not otherwise under the law or tort or otherwise.

16.2 No amendments, modifications or variation of this Agreement shall be valid unless made in writing and agreed to by us; such agreement must be recorded in writing by at least one of us.

16.3 We shall not be bound by any standard or printed terms or conditions furnished by you in any of your documents unless we specifically state in writing separately from such documents that we intend such terms and conditions to apply.

17 DISPUTES, JURISDICTION AND GOVERNING LAW

17.1 This Agreement shall be governed by and construed in accordance with English law and we irrevocably and unconditionally submit to the jurisdiction of the English Courts.

17.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between us may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

From: Jon Dunbavin Redacted
Sent: Tuesday, May 21, 2024 11:17 AM
To: Redacted
Cc: Redacted
Subject: FW: FW: Land at Providence Street Earlsheaton - request for a quote for a topo

Good morning everyone.

Further to my confirmation of your instructions I now attach the topo survey so that you can commence your individual work streams.

Reg I have client instructions for the intrusive if you could please gear up for this.

Vikki, upon outline consent we will be flipping this site on to a house builder probably a Keepmoat, Gleeson, NorthCountry Homes type of operation so could you please bear this in mind for house types, mix and layout.

Could you all please review your time frames and come back to me with an indication of when first drafts would be ready.

I look forward to hearing from you

regards

JD

Jonathan Dunbavin
Managing Director
ID Planning
9 York Place
Leeds
LS1 2DS

Redacte

Appendix D

Historical OS Plans

LITHOS CONSULTING

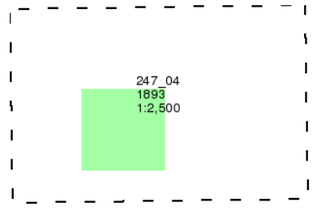
Yorkshire

Published 1893

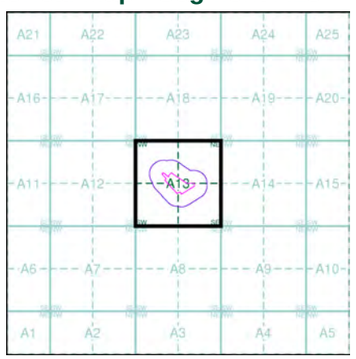
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



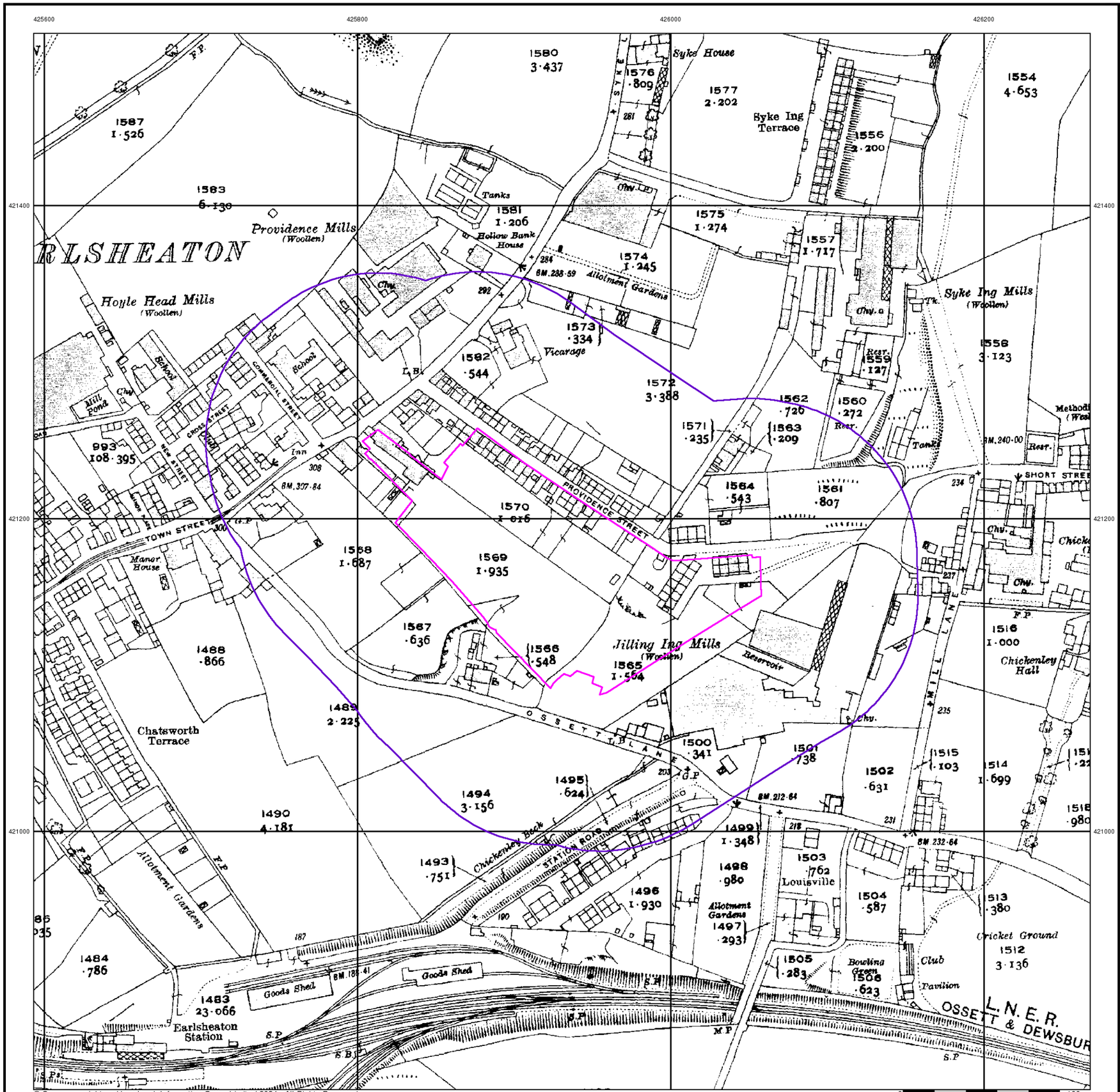
Order Details

Order Number:	338263309_1_1
Customer Ref:	PO22045/DP/4983
National Grid Reference:	425930, 421180
Slice:	A
Site Area (Ha):	1.98
Search Buffer (m):	100

Site Details

Providence Street, Earlsheaton, DEWSBURY, WF12 8HZ

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

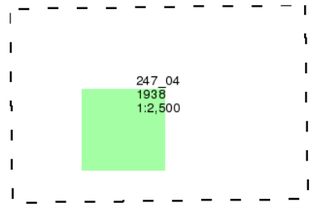
Yorkshire

Published 1938

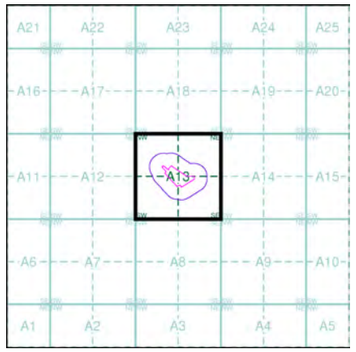
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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National Grid Reference:	425930, 421180
Slice:	A
Site Area (Ha):	1.98
Search Buffer (m):	100

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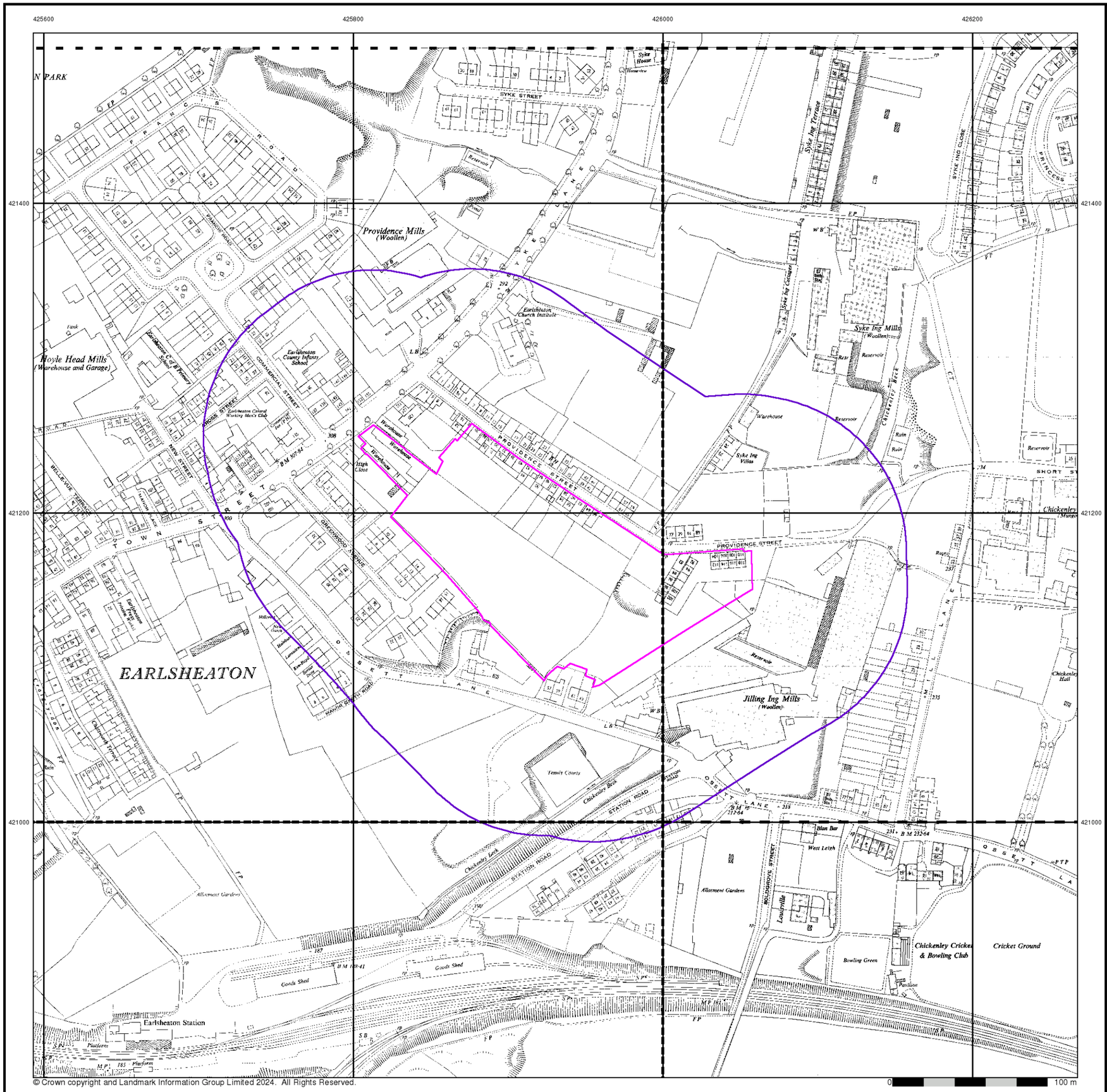


LITHOS CONSULTING

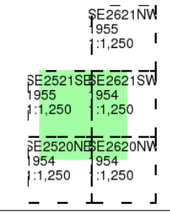
Ordnance Survey Plan

Published 1954 - 1955

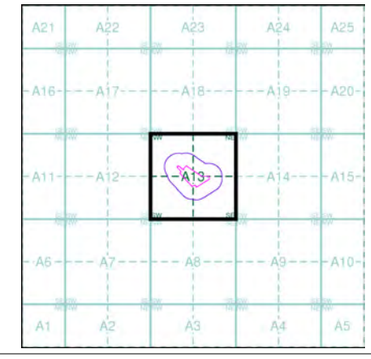
Source map scale - 1:1,250

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	338263309_1_1
Customer Ref:	PO22045/DP/4983
National Grid Reference:	425930, 421180
Slice:	A
Site Area (Ha):	1.98
Search Buffer (m):	100

Site Details

Providence Street, Earlsheaton, DEWSBURY, WF12 8HZ

Landmark INFORMATION GROUP

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Fax: 0844 844 9951
Web: www.envirocheck.co.uk

LITHOS CONSULTING

Ordnance Survey Plan

Published 1960 - 1976

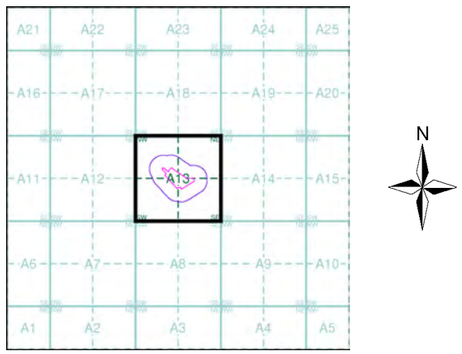
Source map scale - 1:1,250

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

SE2521NE 1964 1:1,250	SE2621NW 1960 1:1,250
SE2521SE 1976 1:1,250	SE2621SW 1960 1:1,250
SE2520NE 1971 1:1,250	SE2620NW 1974 1:1,250

Historical Map - Segment A13



Order Details

Order Number:	338263309_1_1
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Site Area (Ha):	1.98
Search Buffer (m):	100

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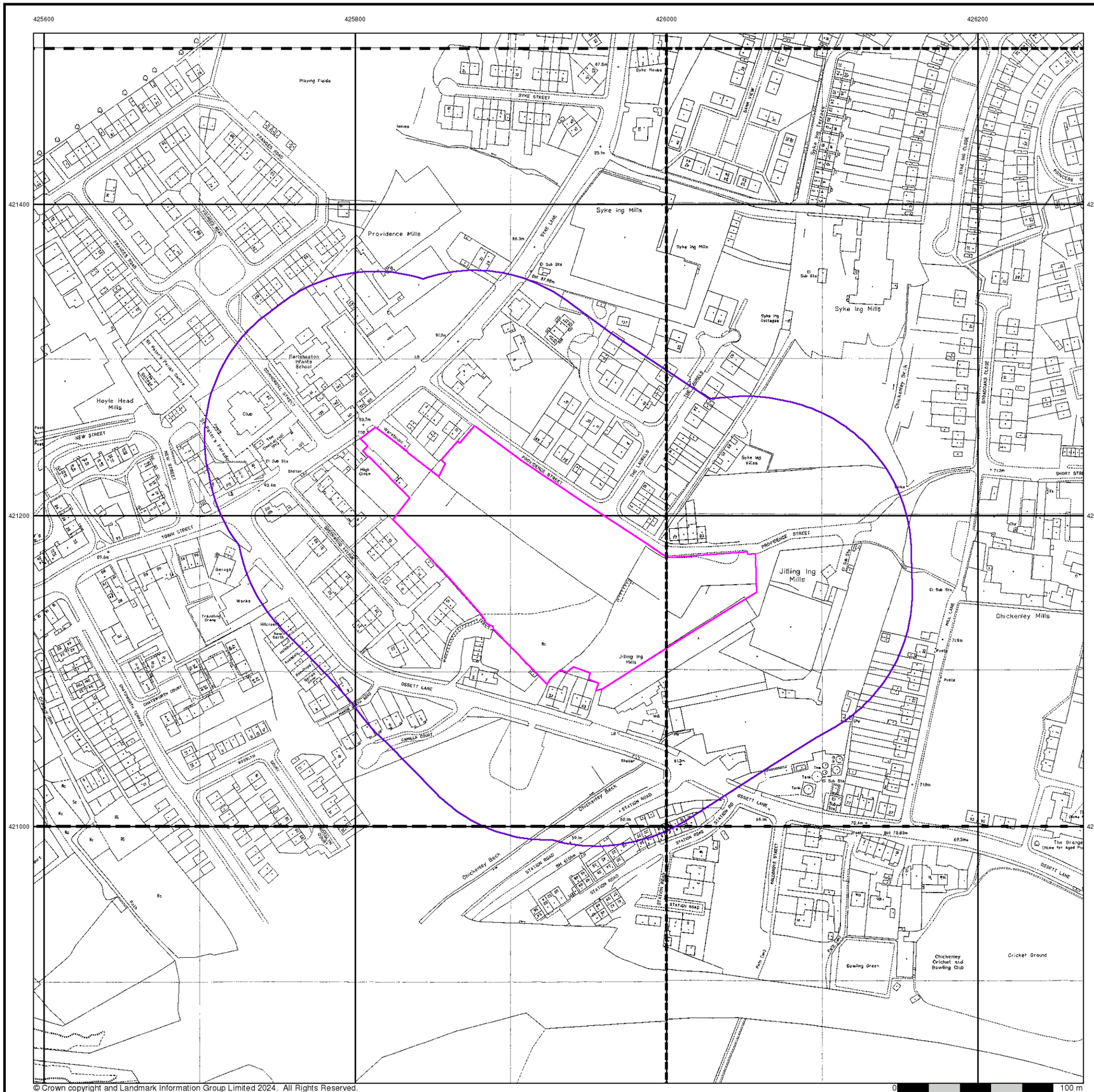
Web: www.envirocheck.co.uk



LITHOS CONSULTING

Large-Scale National Grid Data

Published 1992

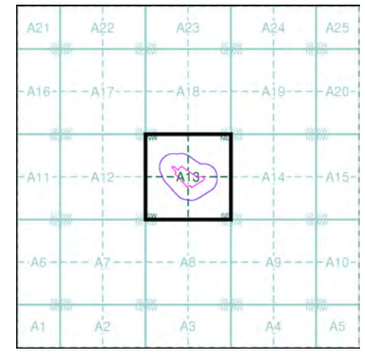
Source map scale - 1:1,250

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

SE2521NE 1992 1:1,250 | SE2621NW 1992 1:1,250
SE2521SE 1992 1:1,250 | SE2621SW 1992 1:1,250
SE2520NE 1992 1:1,250 | SE2620NW 1992 1:1,250

Historical Map - Segment A13



Order Details

Order Number:	338263309_1_1
Customer Ref:	PO22045/DP/4983
National Grid Reference:	425930, 421180
Slice:	A
Site Area (Ha):	1.98
Search Buffer (m):	100

Site Details

Providence Street, Earlsheaton, DEWSBURY, WF12 8HZ

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Fax: 0844 844 9951
Web: www.envirocheck.co.uk

10k Raster Mapping

Published 2006

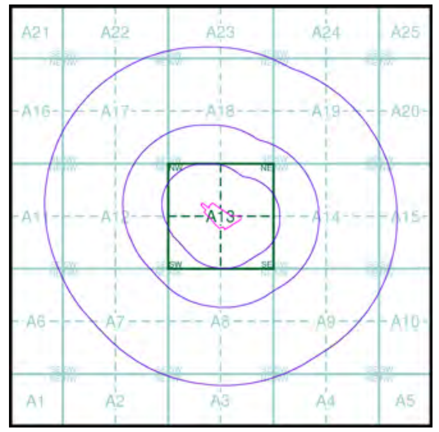
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey`s 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)

SE22SW 2006 1:10,000	SE22SE 2006 1:10,000
SE21NW 2006 1:10,000	SE21NE 2006 1:10,000

Historical Map - Slice A



N

Order Details

Order Number: 338263309_1_1
Customer Ref: PO22045/DP/4983
National Grid Reference: 425930, 421180
Slice: A
Site Area (Ha): 1.98
Search Buffer (m): 1000

Site Details

Providence Street, Earlsheaton, DEWSBURY, WF12 8HZ

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix E

Search Responses & other Correspondence

Envirocheck® Report:

Datasheet

Order Details:

Order Number:
338263309_1_1

Customer Reference:
PO22045/DP/4983

National Grid Reference:
425930, 421180

Slice:
A

Site Area (Ha):
1.98

Search Buffer (m):
1000

Site Details:

Providence Street
Earlsheaton
DEWSBURY
WF12 8HZ

Client Details:

Mr M Perrin
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

Contents

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination.
For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.
In this datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

Report Version v53.0

LITHOS CONSULTING

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1	Yes	Yes	Yes	n/a
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 2		7	12	14
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls	pg 10				4
Integrated Pollution Prevention And Control	pg 11		4		6
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls	pg 13		2	2	4
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 14		Yes		
Pollution Incidents to Controlled Waters	pg 14		5	4	12
Prosecutions Relating to Authorised Processes					
Registered Radioactive Substances					
River Quality	pg 18				1
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register	pg 18		2	4	5
Water Abstractions	pg 20				4 (*15)
Water Industry Act Referrals	pg 24				1
Groundwater Vulnerability Map	pg 24	Yes	n/a	n/a	n/a
Groundwater Vulnerability - Soluble Rock Risk			n/a	n/a	n/a
Groundwater Vulnerability - Local Information			n/a	n/a	n/a
Bedrock Aquifer Designations	pg 25	Yes	n/a	n/a	n/a
Superficial Aquifer Designations			n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences	pg 25		Yes	n/a	n/a
Flooding from Rivers or Sea without Defences	pg 25		Yes	n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
OS Water Network Lines	pg 26		8	2	33

Summary

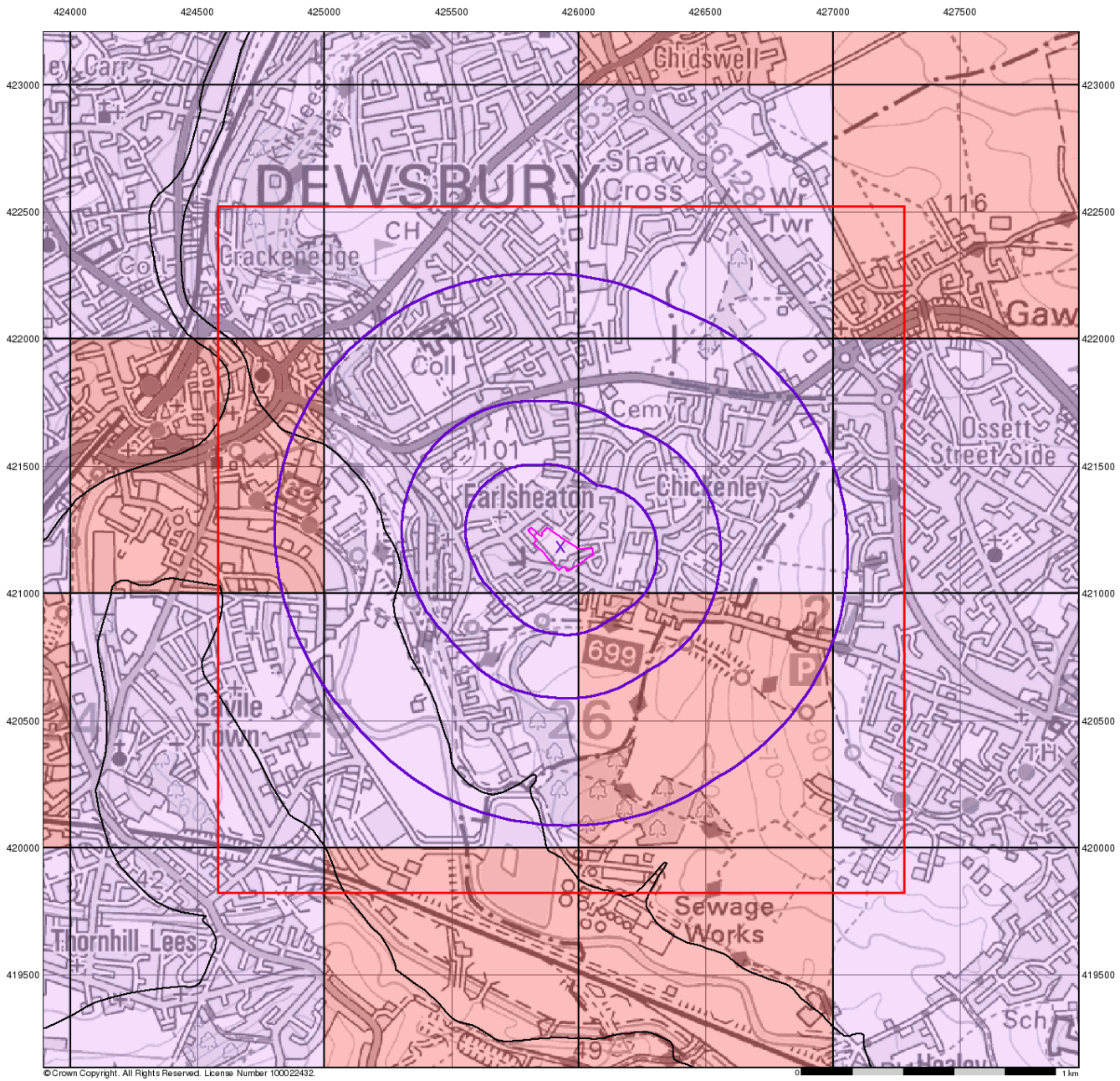
Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Waste					
BGS Recorded Landfill Sites	pg 31				3
Historical Landfill Sites	pg 31		1	1	4
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)	pg 32				3
Local Authority Landfill Coverage		1	n/a	n/a	n/a
Local Authority Recorded Landfill Sites					
Potentially Infilled Land (Non-Water)	pg 33	1	5	1	20
Potentially Infilled Land (Water)	pg 34		3		8
Registered Landfill Sites	pg 35		1		1
Registered Waste Transfer Sites	pg 36				1
Registered Waste Treatment or Disposal Sites					
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Geological					
BGS 1:625,000 Solid Geology	pg 37	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 37	Yes		Yes	Yes
BGS Recorded Mineral Sites	pg 40	1	2		7
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
CBSCB Compensation District			n/a	n/a	n/a
Coal Mining Affected Areas	pg 41	Yes	n/a	n/a	n/a
Mining Instability	pg 42	Yes	n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain				n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 42	Yes		n/a	n/a
Potential for Compressible Ground Stability Hazards	pg 42		Yes	n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 42	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 42		Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 42	Yes		n/a	n/a
Radon Potential - Radon Affected Areas	pg 42	Yes	n/a	n/a	n/a
Radon Potential - Radon Protection Measures	pg 42	Yes	n/a	n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries	pg 43	2	31	12	78
Fuel Station Entries	pg 54			1	1
Points of Interest - Commercial Services	pg 54	1	5	1	25
Points of Interest - Education and Health					
Points of Interest - Manufacturing and Production	pg 56		6	2	14
Points of Interest - Public Infrastructure	pg 58			8	11
Points of Interest - Recreational and Environmental	pg 60		3	4	3
Gas Pipelines					
Underground Electrical Cables					

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland					
Areas of Adopted Green Belt	pg 62		1	1	2
Areas of Unadopted Green Belt	pg 62		1		2
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones					
Ramsar Sites					
Sites of Special Scientific Interest					
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					



LITHOS CONSULTING

Groundwater Vulnerability

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

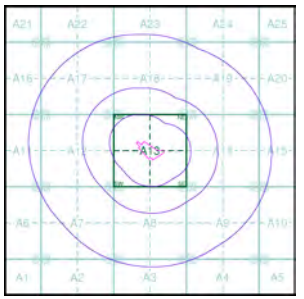
Agency and Hydrological

Bedrock Aquifers	Superficial Aquifers
High Vulnerability, Principal Aquifer	High Vulnerability, Principal Aquifer
High Vulnerability, Secondary Aquifer	High Vulnerability, Secondary Aquifer
Medium Vulnerability, Principal Aquifer	Medium Vulnerability, Principal Aquifer
Medium Vulnerability, Secondary Aquifer	Medium Vulnerability, Secondary Aquifer
Low Vulnerability, Principal Aquifer	Low Vulnerability, Principal Aquifer
Low Vulnerability, Secondary Aquifer	Low Vulnerability, Secondary Aquifer

Unproductive Aquifer

Soluble Rock

Site Sensitivity Context Map - Slice A



Order Details

Order Number:	338263309_1_1
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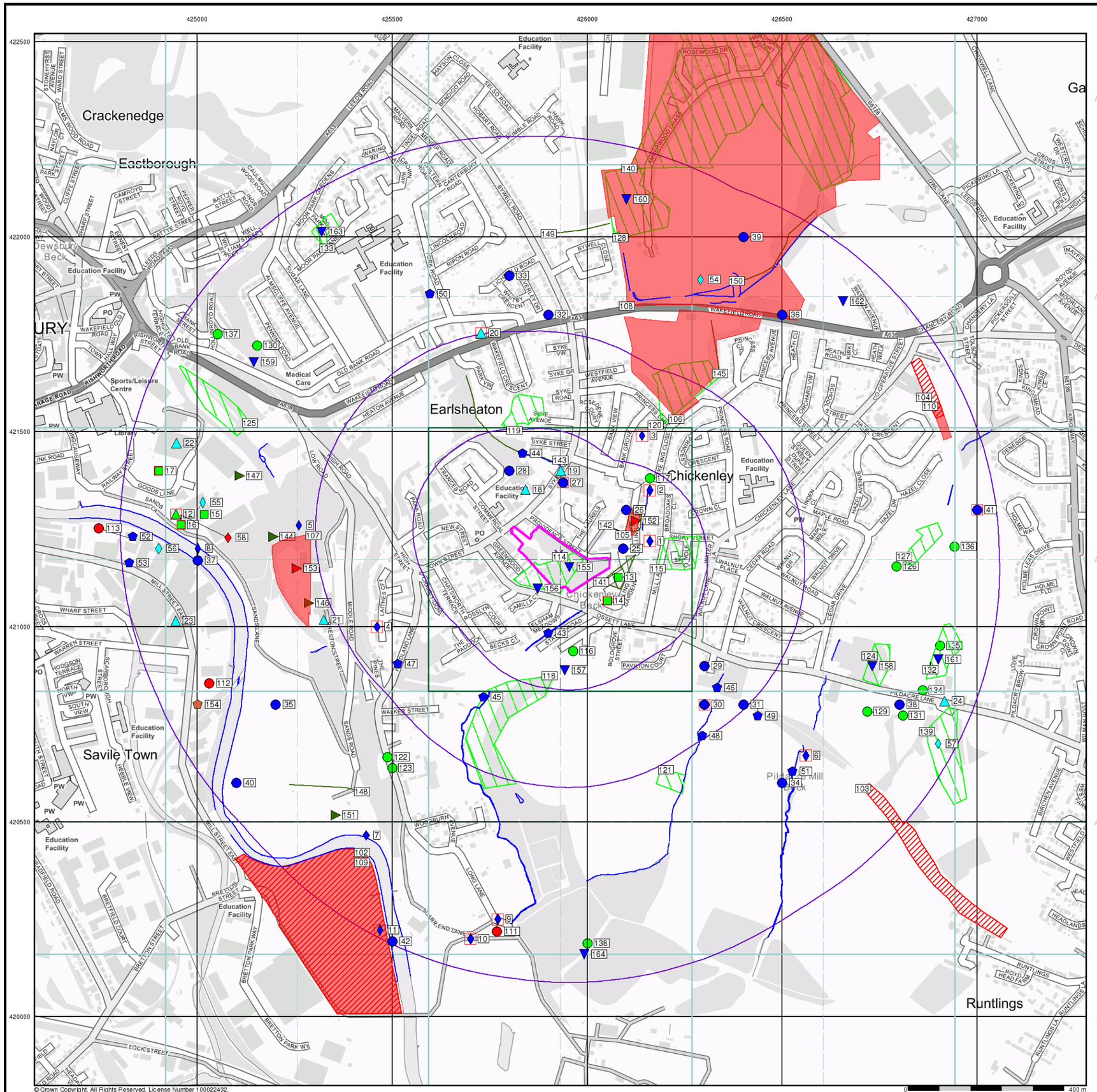


LITHOS CONSULTING

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Map ID

Several of Type at Location

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Hazardous Substances

COMAH Site | Explosive Site | NIHHS Site

- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

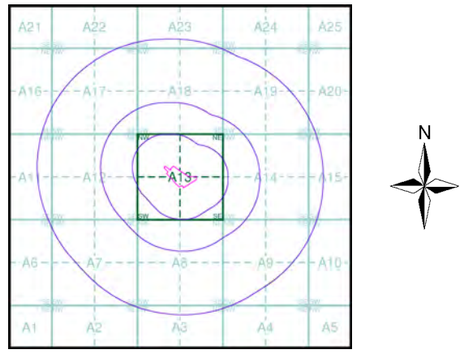
Geological

- BGS Recorded Mineral Site

Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Site Sensitivity Map - Slice A



Order Details

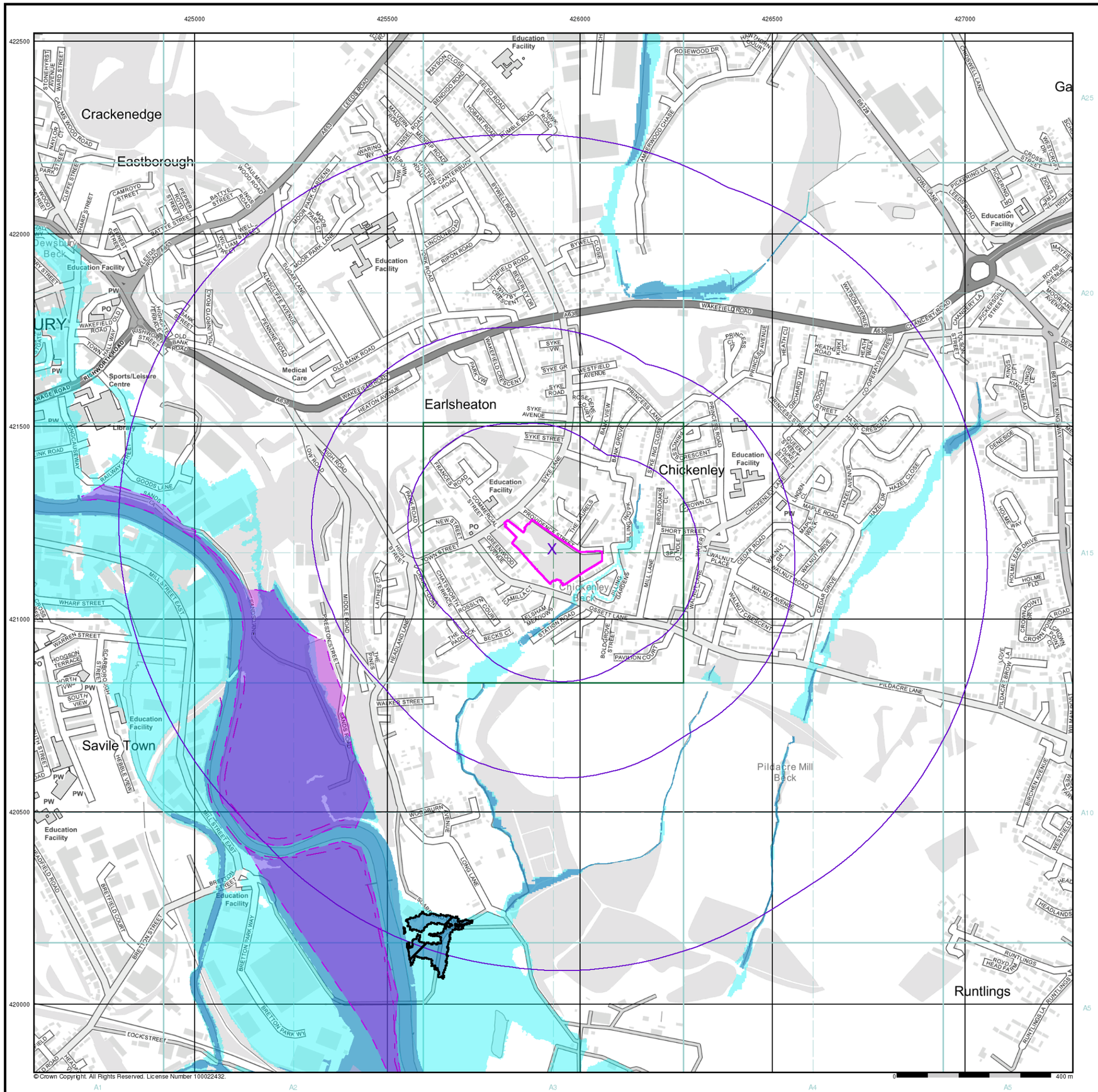
Order Number:	338263309_1_1
Customer Ref:	PO22045/DP/4983
National Grid Reference:	425930, 421180
Slice:	A
Site Area (Ha):	1.98
Search Buffer (m):	1000

Site Details

Providence Street, Earlsheaton, DEWSBURY, WF12 8HZ

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

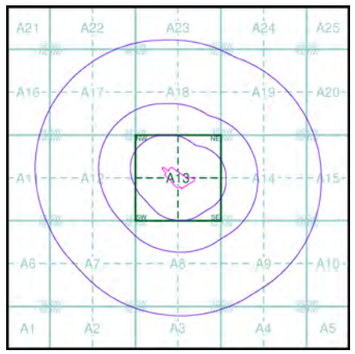
General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A



Order Details

Order Number:	338263309_1_1
Customer Ref:	PO22045/DP/4983
National Grid Reference:	425930, 421180
Slice:	A
Site Area (Ha):	1.98
Search Buffer (m):	1000

Site Details

Providence Street, Earlsheaton, DEWSBURY, WF12 8HZ

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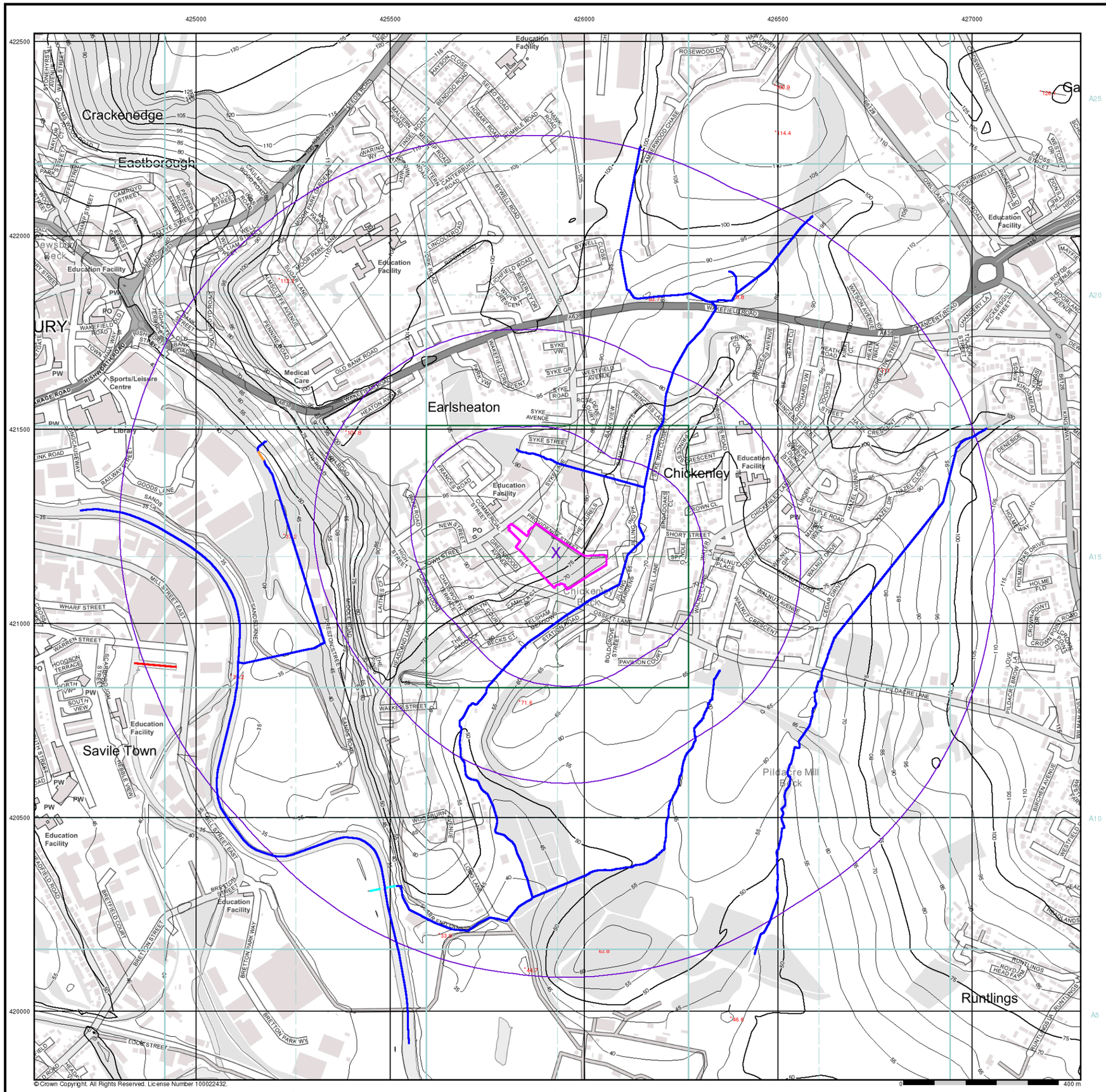
Web: www.envirocheck.co.uk



LITHOS CONSULTING

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

OS Water Network Data

- Canal
- Reservoir
- Foreshore
- Marsh
- Tidal River
- Inland River
- Drain
- Other
- Lake
- Transfer
- Lock Or Flight Of Locks
- Sea

Contours (height in meters)

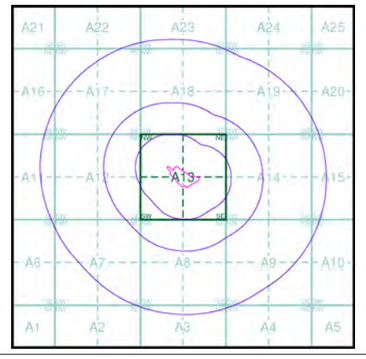
Standard Contour 105

Master Contour 100

Spot Height 167.3

- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



N

Order Details

Order Number:	338263309_1_1
Customer Ref:	PO22045/DP/4983
National Grid Reference:	425930, 421180
Slice:	A
Site Area (Ha):	1.98
Search Buffer (m):	1000

Site Details

Providence Street, Earlsheaton, DEWSBURY, WF12 8HZ

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

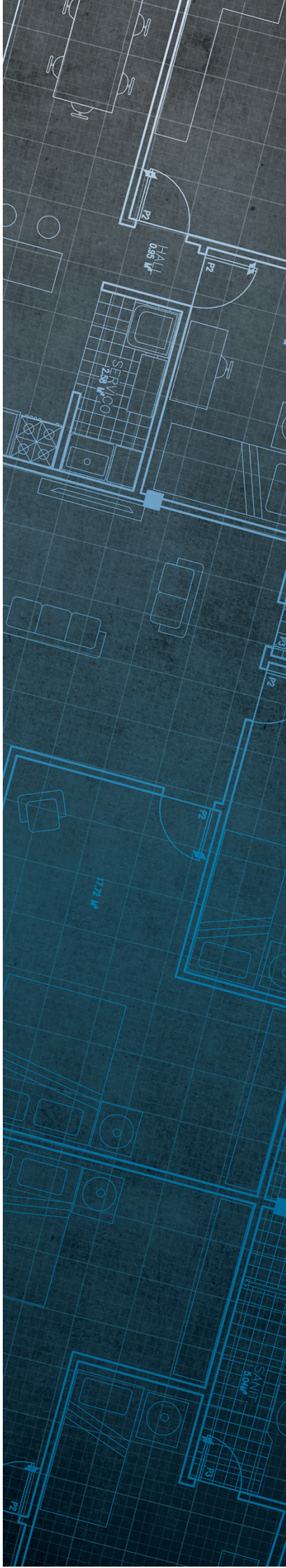
The Coal Authority

Consultants

Coal Mining Report

Providence Street
Earlsheaton
Dewsbury
Kirklees
WF12 8HZ

Date of enquiry:	**7 March 2024**
Date enquiry received:	**7 March 2024**
Issue date:	**7 March 2024**
Our reference:	**51003410025001**
Your reference:	**PO22048/DP/4985**



Consultants
Coal Mining Report

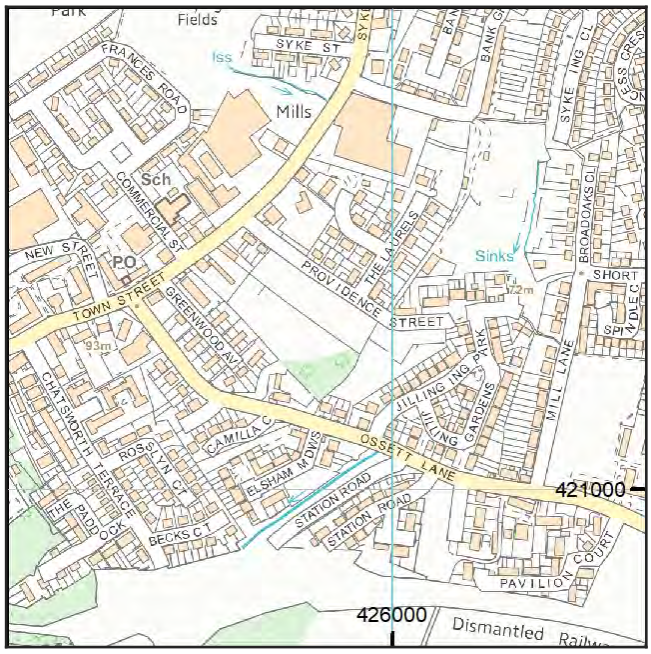
This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

LITHOS CONSULTING

Enquiry address

Providence Street
Earlsheaton
Dewsbury
Kirklees
WF12 8HZ



Approximate position of property

How to contact us

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+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

@coalauthority
/company/the-coal-authority
/thecoalauthority
/thecoalauthority

Section 1 – Mining activity and geology

Past underground mining

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
unnamed	BLACK BED	Coal	62NX	324	South	2.6	South	66	1953
unnamed	BLACK BED	Coal	6J1X	325	South-East	2.5	South	76	1953
unnamed	BLACK BED	Coal	6J0A	328	Beneath Property	1.4	South-East	76	1949
unnamed	BLACK BED	Coal	6I2C	341	Beneath Property	2.5	South-East	76	1948

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:

M82	M71	M76
M83	PO0	M88
M75	M81	1559

Our records show we have more plans than those shown above which could affect the enquiry boundary.

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

Outcrops

No outcrops recorded.

Geological faults, fissures and breaklines

No faults, fissures or breaklines recorded.

Opencast mines

None recorded within 500 metres of the enquiry boundary.

Coal Authority managed tips

None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations
None recorded within 50 metres of the enquiry boundary.

Remediated sites
None recorded within 50 metres of the enquiry boundary.

Coal mining subsidence
The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas
None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes
None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining
None recorded.

Coal mining licensing
None recorded within 200 metres of the enquiry boundary.

Court orders
None recorded.

Section 46 notices
No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

Withdrawal of support notices
The property is in an area where a notice to withdraw support was given in 1956.

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

The following potential risks have been identified and as part of your risk assessment should be investigated further.

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.

Development advice

The site is within an area of historical coal mining activity. Should you require advice and/or support on understanding the mining legacy, its risks to your development or what next steps you need to take, please contact us.

For further information on specific site or ground investigations in relation to any issues raised in Section 4, please call us on 0345 762 6848 or email us at groundstability@coal.gov.uk.

Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk.**

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

Opencast mines
Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips
Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations
Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites
Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence
Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas
Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission. Please note, if there are no recorded instances of mine gas reported, this does not mean that mine gas is not present within the vicinity. The Coal Authority Mine Gas data is limited to only those sites where a Mine Gas incident has been recorded.

Mine water treatment schemes
Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining
Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing
Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders
Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices
Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices
Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land
Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

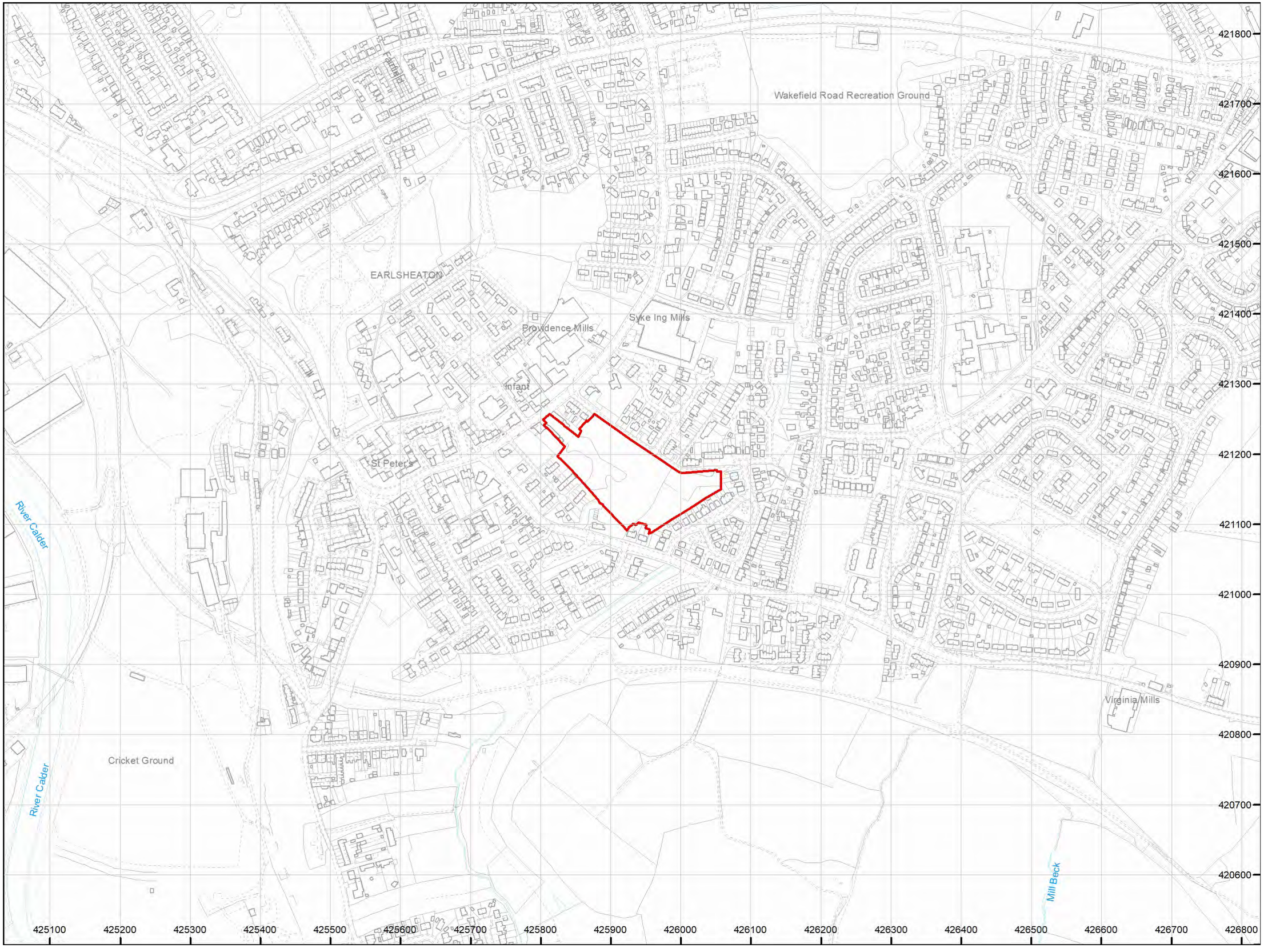
The Coal Authority

Summary of findings

The map highlights any specific surface or subsurface features within or near to the boundary of the site.

Key

Approximate position of the enquiry boundary shown



How to contact us
0345 762 6848 (UK)
+44 (0)1623 637 000 (International)
www.groundstability.com

GeoReports

British Geological Survey

Dan Platford
Lithos Consulting Limited
Parkhill
Walton Road
Wetherby
LS22 5DZ

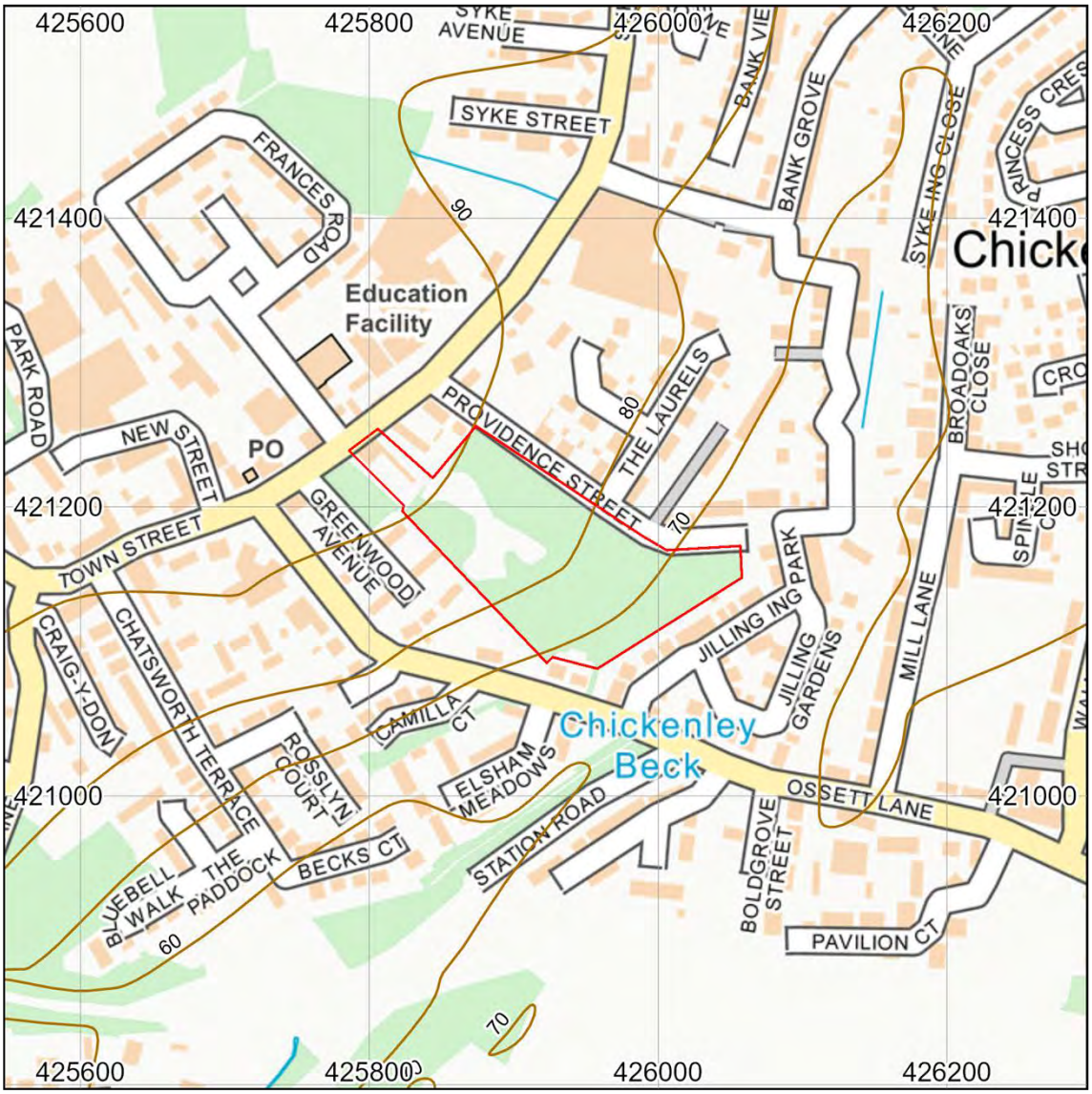
Radon Report

Advisory report on the requirement for radon protective measures in new buildings, conversions and extensions to existing buildings. The report also indicates whether a site is located within a radon Affected Area

Report Id: ***BGS_338585/54472***

Client reference: PO22501

Search location



Contains OS data © Crown Copyright and database right 2024. OS OpenMap Local: Scale: 1:5 000 (1cm = 50 m)
Search location indicated in red

This report describes a site located at National Grid Reference 425922, 421172. Note that for sites of irregular shape, this point may lie outside the site boundary. Where the client has submitted a site plan the assessment will be based on the area given.

Radon Report: UK

When extensions are made to existing buildings in high radon areas, or new buildings are constructed in these areas, the Building Regulations for England, Wales, Scotland and Northern Ireland require that protective measures are taken against radon entering the building.

This report provides information on whether radon protective measures are required. Depending on the probability of buildings having high radon levels, the Regulations may require either:

1. No protective measures
2. Basic protective measures
3. Full protective measures

This is an advisory report on the requirement for radon protective measures in new buildings, conversions and extensions. The report also indicates whether a site is located within a radon Affected Area

Requirement for radon protective measures

The determination below follows advice in *BR211 Radon: Guidance on protective measures for new buildings (2023 edition), which also provides guidance on what to do if the* result *indicates that protective measures are required.*

Is the property in an area where radon protective measures are required for new buildings or extensions to existing ones as described in publication BR211 (2023 edition) Radon: Guidance on protective measures for new buildings?

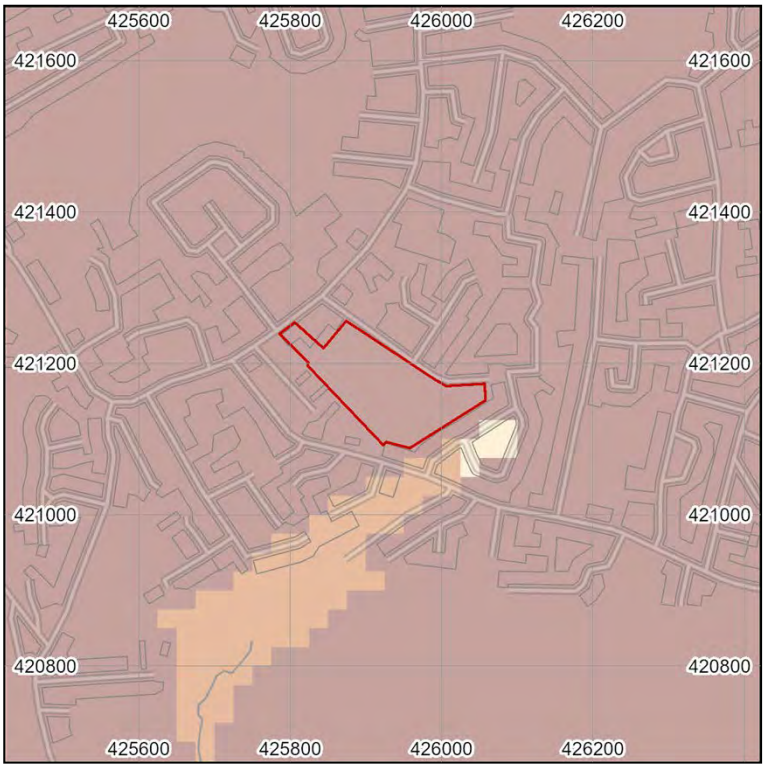
BASIC RADON PROTECTIVE MEASURES ARE REQUIRED FOR THE REPORT AREA.

More details of the protective measures required are available in *BR211 Radon: Guidance on protective measures for new buildings (2023 Edition)*.

Whether or not the radon level in a building is above or below the radon Action Level can only be established by having the building tested. The UKHSA provides a radon testing service which can be accessed at www.ukradon.org or by telephone (01235 822622).

If you require further information or guidance, you should contact your local authority building control officer or approved inspector.

Radon Affected Area



	% Homes estimated to be at or above the action level
	0-1%
	1-3%
	3-5%
	5-10%
	10-30%
	30-100%

Scale: 1:10 000 (1cm = 100 m)
Search area indicated in red

Is the property in a radon Affected Area as defined by the UK Health Security Agency (UKHSA) and if so what percentage of homes are estimated to be at or above the Action Level? **YES**

Additional Information

THE PROPERTY IS IN A RADON AFFECTED AREA WHERE 3 TO 5% OF HOMES ARE ESTIMATED TO BE AT OR ABOVE THE ACTION LEVEL.

The UKHSA recommends a radon 'Action Level' of 200 Becquerels per cubic metre of air (Bq m^{-3}) for the annual average of the radon gas concentration in a home. Where 1% or more of homes are estimated to be at or above the Action Level the area should be regarded as a radon Affected Area.

This report informs you whether the property is in a radon Affected Area and the percentage of homes that are estimated to be at or above the radon Action Level at this location. Being in an Affected Area does not necessarily mean there is a high radon level within the property; the only way to determine the radon level is to carry out a radon measurement.

The UKHSA advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels at or above the Action Level (200 Bq m^{-3}) should be remediated. Householders with levels between the Target Level (100 Bq m^{-3}) and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers. Whether or not a home is in fact above or below the Action Level or Target Level can only be established by having the building tested. The UKHSA provides a validated radon testing service which can be accessed at www.ukradon.org.

The information in this report provides an answer to one of the standard legal enquiries on house purchase in England and Wales, known as Law Society CON29 Enquiries of the Local Authority (2016); 3.14 Radon Gas: Do records indicate that the property is in a “Radon Affected Area” as identified by the UKHSA. The data can also be used to advise house buyers and sellers in Scotland and Northern Ireland.

If you are buying a new build property in a Radon Affected Area, you should ask the builder whether radon protective measures were incorporated in the construction of the property.

If you are buying a currently occupied property in a radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were at or above the radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and if the results of re-testing confirmed the effectiveness of the measures.

Further information on radon is available from the UKHSA at www.ukradon.org.

What is radon?

Radon is a naturally occurring radioactive gas, which is produced by the radioactive decay of radium which, in turn, is derived from the radioactive decay of uranium. Uranium is found in small quantities in all soils and rocks, although the amount varies from place to place. Radon released from rocks and soils is quickly diluted in the atmosphere. Concentrations in the open air are normally very low and do not present a hazard. Radon that enters enclosed spaces such as some buildings (particularly basements), caves, mines, and tunnels may reach high concentrations in some circumstances. The construction method and degree of ventilation will influence radon levels in individual buildings. A person's exposure to radon will also vary according to how particular buildings and spaces are used.

Inhalation of the radioactive decay products of radon gas increases the chance of developing lung cancer. If individuals are exposed to high concentrations for significant periods of time, there may be cause for concern. In order to limit the risk to individuals, the Government has adopted an Action Level for radon in homes of 200 becquerels per cubic metre (Bq m^{-3}). The Government advises householders that, where the radon level is at or above the Action Level, measures should be taken to reduce the concentration.

Radon in workplaces

The Ionising Radiation Regulations 2017 require employers to take action when radon is present above a defined level in the workplace. Advice may be obtained from your local Health and Safety Executive Area Office or the Environmental Health Department of your local authority. The BRE publishes a guide (BR293)**: Radon in the workplace.** BRE publications may be obtained from the BRE Bookshop, Tel: 01923 664262, email: bookshop@bre.co.uk website: www.brebookshop.com

Contact Details

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General Terms & Conditions

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- The data, information and related records supplied in this Report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

Report issued by
BGS Enquiry Service

10. Low Laithes Colliery Shaft	
[2816 2232]; Surface level c+91.4	
Coal Measures: Warren House Coal	- at 57.6
Top Haigh Moor Coal	1.03 at 119.79
Flockton Thick Coal (two leaves)	2.67 at 192.02
Middleton Main Coal	0.99 at 281.64
Total depth	uncertain
11. Old Roundwood Colliery Shaft	
[2994 2054]; Surface level c+82.3	
Coal Measures: coal	0.46 at 1.37
Warren House Coal	0.91 at 56.85
Horbury Rock	26.75 at 87.25
?27 Yard Coal	0.23 at 93.47
?Swallow Wood Coal	0.36 at 101.85
Haigh Moor Rock	5.56 at 122.37
Top Haigh Moor Coal	0.97 at 127.86
Low Haigh Moor Coal	0.76 at 137.77
Coal	0.20 at 147.12
Coal	0.74 at 165.25
Coal	0.46 at 169.11
Coal	0.41 at 180.31
Joan Coal	0.38 at 205.05
Flockton Thick Coal	0.58 at 220.17
Flockton Thin Coal	0.53 at 240.82
First Brown Metal Coal	0.71 at 258.55
Second Brown Metal (Old Hards) Coal	0.34 at 264.06
Third Brown Metal Coal	0.30 at 270.13
Middleton Little Coal	0.34 at 283.15
Middleton Main (New Hards) Coal	0.97 at 313.39
Total depth	uncertain
14a. Runtlings No 1 Borehole	
[2693 2008]; Surface level +68.42	
Coal Measures: Top Haigh Moor Coal	0.15+ at c13
Flockton Thick Coal (top bed: cannel)	0.20 at 90.04
Total depth	91.95
16. Bank Top Colliery Shaft	
[2583 2151]; Surface level +94.5	
Coal Measures: Joan Coal	0.61 at 50.90
Flockton Thick Coal (cannel)	0.25 at 65.63
Flockton Thin Coal	0.66 at 82.04
Total depth	84.43

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Appendix F

Trial Pit Logs

Trial Pit Log

Trialpit No **SA01** Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425870.00 - 421234.00 Level:	Date 19/06/2024
Location: Earlsheaton, Dewsbury		Dimensions (m): 2.9 × 0.6, Depth 2.40	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T					MADE GROUND: Dark greyish brown slightly gravelly sandy CLAY with frequent rootlets and roots less than 20mm in diameter. Gravel is angular to subrounded fine to coarse of mixed lithologies, glass, metal, brick, plastic and concrete. (MADE GROUND TOPSOIL)
				0.30			Firm brown slightly sandy slightly gravelly silty CLAY with rare rootlets. Gravel is subangular to subrounded fine to coarse mixed lithologies. (COHESIVE RESIDUAL SOIL)
	0.40	D	HVP=60	0.50			Stiff light yellowish brown sandy gravelly CLAY with a high cobble content. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	0.60	D					*From 0.5m, too gravelly for vanes.*
	0.70	B					
				1.50			Medium strong light orangish brown medium grained SANDSTONE. Recovered as sandy angular to subangular tabular fine to coarse gravel with high cobble content and a low boulder content. (THORNHILL ROCK)
							From 1.5m advanced with breaker to 2.4m.
				2.40			End of pit at 2.40 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

Trial Pit Log

LITHOS CONSULTING

Trialpit No **SA02** Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425882.00 - 421185.00 Level:	Date 19/06/2024
Location: Earlsheaton, Dewsbury		Dimensions (m): 3.1 × 0.6, Depth 2.20	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T		0.20			MADE GROUND: Dark greyish brown slightly gravelly sandy CLAY with frequent rootlets and roots less than 10mm in diameter. Gravel is angular to subrounded fine to coarse of mixed lithologies, glass, concrete and plastic. (MADE GROUND TOPSOIL)
				0.30			Firm brown slightly gravelly silty CLAY with rare rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (COHESIVE RESIDUAL SOIL)
	0.60	D					Stiff light yellowish brown sandy gravelly CLAY with a high cobble content. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
							From 0.3m, too gravelly for vanes.
							From 1.0m, difficult to excavate.
				1.20			
	1.30	D					Stiff light greyish brown mottled light grey slightly sandy slightly gravelly CLAY with a high cobble content. Gravel is subangular to rounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				1.60			Medium strong light orangish brown medium grained SANDSTONE. Recovered as sandy angular to subangular tabular gravel with a high cobble content. (THORNHILL ROCK)
							From 1.8m, advanced with breaker to 2.2m.
				2.20			End of pit at 2.20 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **SA03**

Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425899.00 - 421156.00 Level:	Date 19/06/2024
Location: Earlsheaton, Dewsbury		Dimensions (m): 2.8 × 0.6, Depth 2.30	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 0.15	J,K&T B		0.20			Dark brown slightly gravelly sandy CLAY with frequent rootlets and roots less than 60mm in diameter. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
	0.50	D					Stiff light yellowish brown slightly sandy gravelly CLAY with a high cobble content. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL) *From 0.2m, too gravelly for vanes.*
				1.10			Light yellowish brown sandy clayey angular to subangular fine to coarse GRAVEL of sandstone with a high cobble content and low boulder content. (GRANULAR RESIDUAL SOIL)
				1.70			Medium strong light orangish brown medium grained SANDSTONE. Recovered as sandy angular to subangular tabular gravel with a high cobble content and a low boulder content. (THORNHILL ROCK) *From 1.8m, advanced with breaker to 2.2m.*
				2.30			End of pit at 2.30 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No **SA04**

Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425934.00 - 421179.00 Level:	Date 19/06/2024
Location: Earlsheaton, Dewsbury		Dimensions (m): 3 × 0.6, Depth 2.50	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 0.15	J&T B					Dark brown slightly gravelly sandy SILT with frequent rootlets. Gravel is subangular to well rounded fine to coarse of mixed lithologies. (TOPSOIL)
				0.30			Stiff light yellowish brown slightly sandy gravelly CLAY with a medium cobble content. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL) *From 0.3m, too gravelly for vanes.* *From 0.6m, high cobble content.*
	0.80	D					
				2.30			Light yellowish brown sandy clayey angular to subangular fine to coarse GRAVEL of sandstone with a high cobble content. (GRANULAR RESIDUAL SOIL)
				2.50			End of pit at 2.50 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

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Trial Pit Log

Trialpit No
TP01
Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425888.00 - 421248.00 Level:	Date 19/06/2024
Location: Earlsheaton, Dewsbury		Dimensions (m): 2.9 × 0.6, Depth 1.80	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T		0.20			MADE GROUND: Dark greyish brown gravelly clayey SAND with frequent rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies, glass, brick, concrete, metal and plastic. (MADE GROUND TOPSOIL)
	0.40	J,K&T					MADE GROUND: Dark greyish brown silty SAND and angular to subangular fine to coarse GRAVEL of mixed lithologies, brick, concrete, frequent whole bricks and rare concrete slabs. (GRANULAR MADE GROUND) *From 0.2m, side wall spalling and overbreak.* *From 0.2m, sandstone block work wall along southern wall of pit.* *From 0.2m, red brick wall along eastern end of pit.* *At 0.7m, metal sign 1.5m by 0.5m.*
	1.20	J,K&T					*At 1.5m, sandstone flood slabs.*
	1.60	D		1.50			Stiff light yellowish brown mottled light grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (COHESIVE RESIDUAL SOIL) *From 1.5m, too gravelly for vanes.*
				1.80			End of pit at 1.80 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were spalling from 0.2m.

AGS

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Trial Pit Log

Trialpit No **TP02**

Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425913.00 - 421227.00 Level:	Date 19/06/2024
Location: Earlsheaton, Dewsbury		Dimensions (m): 2.8 × 0.6, Depth 2.30	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T		0.20			MADE GROUND: Dark greyish brown gravelly clayey SAND with frequent rootlets and rare roots less than 20mm in diameter. Gravel is angular to subrounded fine to coarse of mixed lithologies, brick, glass, metal and tiles. (MADE GROUND TOPSOIL)
	0.60	J,K&T					MADE GROUND: Greyish brown silty SAND and angular to subrounded fine to coarse GRAVEL of mixed lithologies, brick, concrete, frequent whole bricks and rare concrete slabs and wooden beams. (GRANULAR MADE GROUND) *From 0.3m, red brick wall along eastern end of pit.* *From 0.3m, lighter yellowish brown in colour along western end of pit with fewer bricks, possible natural or reworked natural ground.* *From 0.5m, overbreak of trial pit walls.*
	2.10	D		2.00			Very stiff light yellowish brown mottled light grey slightly sandy gravelly CLAY with a low cobble content. Gravel is angular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL) *From 2.0m, too gravelly for vanes.* *From 0.4m to 2.0m, complete side wall collapse.*
				2.30			End of pit at 2.30 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit collapsed at 2.0m.

AGS

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Trial Pit Log

Trialpit No **TP03**

Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425943.00 - 421207.00 Level:	Date 19/06/2024
Location: Earlsheaton, Dewsbury		Dimensions (m): 2.9 × 0.6, Depth 3.10	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T		0.20			MADE GROUND: Dark greyish brown gravelly clayey SAND with frequent rootlets and rare roots less than 30mm in diameter. Gravel is angular to subrounded fine to coarse of mixed lithologies, glass, brick, concrete and asphalt. (MADE GROUND TOPSOIL)
	0.30	J,K&T		0.50			MADE GROUND: Greyish brown silty SAND and angular to subrounded fine to coarse GRAVEL of mixed lithologies, bricks and concrete. Rare whole sandstone slabs. (GRANULAR MADE GROUND) *At 0.3m, buried sandstone floor slabs.*
	0.60	D	HVP=56	0.90			Firm slightly gravelly sandy SILT with rare roots less than 40mm in diameter. Gravel is angular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	1.00	D		1.60			Stiff yellowish brown slightly sandy slightly gravelly CLAY with a medium cobble content. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL) *From 0.9m, too gravelly for vanes.*
				2.80			Yellowish brown sandy clayey angular to subrounded fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL) *From 2.4m, difficult to excavate.*
				3.10			Medium strong light orangish brown medium grained SANDSTONE. Recovered as clayey sandy angular to subangular tabular gravel with a high cobble content. (THORNHILL ROCK) End of pit at 3.10 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

Trial Pit Log

Trialpit No **TP04** Sheet 1 of 1

Project Name:	Providence Street	Project No. 4985	Co-ords: 425887.00 - 421206.00 Level:	Date 20/06/2024
Location:	Earlsheaton, Dewsbury	Dimensions (m): 2.9 × 0.6, Depth 2.60		Scale 1:20
Client:	Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 0.15	J&T B		0.20			Dark brown slightly gravelly sandy SILT with frequent rootlets and rare roots less than 20mm in diameter. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
				0.40			Firm brown slightly sandy slightly gravelly SILT with rare rootlets. Gravel is subangular to well rounded fine to coarse of mixed lithologies. (COHESIVE RESIDUAL SOIL)
	0.60	D					Stiff light yellowish brown mottled light grey slightly sandy slightly gravelly CLAY with a low cobble content. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL) *From 0.4m, too gravelly for vanes.*
				1.30			Light yellowish brown sandy clayey angular to subangular fine to coarse GRAVEL of sandstone with a high cobble content. (GRANULAR RESIDUAL SOIL)
	1.40	D					*From 2.3m, difficult to excavate.*
				2.60			End of pit at 2.60 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

Trial Pit Log

Trialpit No **TP05** Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425908.00 - 421190.00 Level:	Date 20/06/2024
Location: Earlsheaton, Dewsbury		Dimensions (m): 3 × 0.6, Depth 2.30	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J,K&T		0.20			MADE GROUND: Dark brown slightly gravelly sandy CLAY with frequent rootlets and roots less then 20mm in diameter. Gravel is angular to subrounded fine to coarse of mixed lithologies, brick, metal and plastic. (MADE GROUND TOPSOIL)
				0.40			Firm brown slightly sandy slightly gravelly SILT with rare rootlets and roots less than 20mm in diameter. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	0.50	B					Stiff light yellowish brown mottled light grey slightly sandy slightly gravelly CLAY with a low cobble content. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	0.80	D					*From 0.4m, too gravelly for vanes.*
							From 1.4m, gravelly and difficult to excavate.
				1.90			Medium strong light orangish brown medium grained SANDSTONE. Recovered as sandy clayey angular to subangular tabular gravel with a high cobble content. (THORNHILL ROCK)
				2.30			End of pit at 2.30 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

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Trial Pit Log

Trialpit No
TP06
Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425877.00 - 421158.00 Level:	Date 20/06/2024
Location: Earlsheaton, Dewsbury		Dimensions (m): 2.8 × 0.6, Depth 2.30	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd			Logged DP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					Dark brown slightly gravelly SILT with frequent rootlets. Gravel is subangular to rounded fine to coarse of mixed lithologies. (TOPSOIL)
				0.30			Firm brown slightly sandy slightly gravelly SILT with rare rootlets. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				0.60			*From 0.4m, too gravelly for vanes.*
	0.70	D					Stiff light yellowish brown slightly sandy gravelly CLAY with a high cobble content. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	1.10	D					*From 1.5m, difficult to excavate.*
				1.80			Medium strong light orangish brown medium grained SANDSTONE. Recovered as sandy clayey angular to subangular tabular fine to coarse gravel with high cobble content. (THORNHILL ROCK)
				2.30			End of pit at 2.30 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

Appendix G

Window Sample Borehole Logs

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Borehole Log

Borehole No.
WS01
Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425868.00 - 421207.00	Hole Type WS
Location: Earlsheaton, Dewsbury		Level:	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd		Dates: 20/06/2024 - 20/06/2024	Logged By DP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J,K&T		0.05			MADE GROUND: Dark grey silty SAND and angular to subrounded fine to coarse GRAVEL of mixed lithologies, asphalt, ceramic and brick. (GRANULAR MADE GROUND)
		0.40	J,K&T		0.30			MADE GROUND: Dark brown mottled orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mixed lithologies, brick, ceramic and plastic. (COHESIVE MADE GROUND)
		0.60	J,K&T		0.50			MADE GROUND: Black slightly sandy slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies and brick. (COHESIVE MADE GROUND)
		1.00		N=30 (8,9/7,6,8,9)				MADE GROUND: Orangish brown slightly sandy slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and brick. (REWORKED NATURAL GROUND)
								From 1.0m, poor recovery.
		1.40	D		1.30			Medium strong light orangish brown medium grained SANDSTONE. Recovered as sandy angular to subangular fine to coarse gravel. (THORNHILL ROCK)
		2.00		50 (25 for 75mm/50 for 230mm)	2.00			End of borehole at 2.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered not encountered. 3. Co-ordinates from hand held GPS, hole not surveyed in. 4. Monitoring well installed on completion, with a slotted response zone from 1.5m to 2.0m.

AGS

Borehole Log

Borehole No. **WS02**

Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425839.00 - 421219.00	Hole Type WS
Location: Earlsheaton, Dewsbury		Level:	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd		Dates: 20/06/2024 - 20/06/2024	Logged By DP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	J,K&T		0.10			MADE GROUND: Dark grey silty SAND and angular to subangular fine to coarse GRAVEL of mixed lithologies, asphalt, brick, wood, metal and plastic. (GRANULAR MADE GROUND)
		0.70	J,K&T					MADE GROUND: Brownish grey gravelly clayey SAND. Gravel is angular to subangular fine to coarse of mixed lithologies, brick, glass and coal. (GRANULAR MADE GROUND)
								From 0.8m, poor recovery.
		1.00		N=8 (2,1/2,1,1,4)				*From 1.0m, poor recovery.*
					1.10			Medium strong light orangish brown medium grained SANDSTONE. Recovered as sandy angular to subangular fine to coarse gravel. (THORNHILL ROCK)
		2.00		50 (10,14/50 for 295mm)	2.00			End of borehole at 2.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered not encountered. 3. Co-ordinates from hand held GPS, hole not surveyed in. 4. Monitoring well installed on completion, with a slotted response zone from 1.5m to 2.0m.

Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425888.00 - 421228.00	Hole Type WS
Location: Earlsheaton, Dewsbury		Level:	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd		Dates: 20/06/2024 - 20/06/2024	Logged By DP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J,K&T		0.20			MADE GROUND: Dark greyish brown slightly gravelly sandy CLAY with frequent rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies, brick, glass and plastic. (MADE GROUND TOPSOIL)
					0.40			Firm brown slightly sandy slightly gravelly SILT with frequent rootlets. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
		0.60	D					Stiff light orangish brown mottled light grey slightly gravelly sandy CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
		1.00		N=20 (4,4/4,5,5,6)				*From 0.9m, very stiff.*
					1.60			Medium strong light orangish brown medium grained SANDSTONE. Recovered as sandy silty angular to subangular fine to coarse gravel. (THORNHILL ROCK)
		2.00		50 (25 for 115mm/50 for 265mm)	2.00			End of borehole at 2.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered not encountered. 3. Co-ordinates from hand held GPS, hole not surveyed in. 4. Monitoring well installed on completion, with a slotted response zone from 1.0m to 2.0m.

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Borehole Log

Borehole No.
WS04
Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425877.00 - 421174.00	Hole Type WS
Location: Earlsheaton, Dewsbury		Level:	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd		Dates: 20/06/2024 - 20/06/2024	Logged By DP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J&T		0.20			Dark brown slightly gravelly sandy CLAY with frequent rootlets and rare roots <20mm in diameter. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
		0.50	D		0.40			Firm brown slightly sandy slightly gravelly SILT with occasional rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies. (COHESIVE RESIDUAL SOIL)
		1.00		N=25 (8,9/9,6,5,5)				Stiff light orangish brown and light grey mottled slightly gravelly sandy CLAY. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
		1.30	D		1.50			Very dense light orangish brown sandy silty angular to subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
		2.00		50 (25 for 145mm/50 for 265mm)	2.00			End of borehole at 2.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered not encountered. 3. Co-ordinates from hand held GPS, hole not surveyed in. 4. Monitoring well installed on completion, with a slotted response zone from 1.0m to 2.0m.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
WS05
Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425920.00 - 421175.00	Hole Type WS
Location: Earlsheaton, Dewsbury		Level:	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd		Dates: 20/06/2024 - 20/06/2024	Logged By DP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J&T					Dark brown slightly gravelly sandy SILT with frequent rootlets and rare roots <30mm in diameter. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
					0.40			
		0.70	D					Stiff light yellowish brown slightly gravelly sandy CLAY. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
								From 0.7m, very stiff.
		1.00		N=48 (8,6/9,13,12,14)				
					1.80			
		1.90	D					Medium strong light orangish brown medium grained SANDSTONE. Recovered as sandy silty angular to subangular fine to coarse gravel. (THORNHILL ROCK)
		2.00		50 (25 for 145mm/50 for 255mm)	2.00			End of borehole at 2.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered not encountered. 3. Co-ordinates from hand held GPS, hole not surveyed in. 4. Monitoring well installed on completion, with a slotted response zone from 1.0m to 2.0m.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No. **WS06**

Sheet 1 of 1

Project Name: Providence Street	Project No. 4985	Co-ords: 425932.00 - 421198.00	Hole Type WS
Location: Earlsheaton, Dewsbury		Level:	Scale 1:20
Client: Precious Holdings (Wakefield) Ltd		Dates: 20/06/2024 - 20/06/2024	Logged By DP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J,K&T					MADE GROUND: Dark greyish brown gravelly clayey SAND with rare rootlets. Gravel is angular to subrounded fine to coarse of mixed lithologies, glass, plastic, metal and brick. (MADE GROUND TOPSOIL)
					0.30			Stiff light yellowish brown slightly sandy slightly gravelly silty CLAY. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
		0.80	D					
		1.00		N=28 (8,8/8,7,7,6)				
					1.40			Very dense light yellowish brown silty SAND and angular to subrounded fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
		1.60	D					
		2.00		50 (6,5/50 for 275mm)				
		2.30	D					*From 2.4m, poor recovery.*
		2.70		50 (25 for 75mm/50 for 245mm)	2.70			End of borehole at 2.70 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered not encountered. 3. Co-ordinates from hand held GPS, hole not surveyed in. 4. Monitoring well installed on completion, with a slotted response zone from 1.0m to 2.7m.

AGS

Appendix H

Chemical Results

Certificate of Analysis

Certificate Number	24-13143	*Issued:*	04-Jul-24

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference	24-13143
Client Reference ~	4985
Order No ~	PO22581
Contract Title ~	Providence Street, Earlsheaton
Description	23 Soil samples.
Date Received	27-Jun-24
Date Started	27-Jun-24
Date Completed	04-Jul-24
Test Procedures	Identified by prefix DETSn (details on request).
Notes	Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By Redacted

Kirk Bridgewood
General Manager

2139

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13143
Client Ref ~ 4985
Contract Title ~ Providence Street, Earlsheaton

				Lab No	2356827	2356828	2356829	2356830	2356831	2356832
				Sample ID ~	SA03	SA04	TP04	TP06	WS04	WS05
				Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
				Other ID ~						
				Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date ~	19/06/2024	19/06/2024	19/06/2024	19/06/2024	20/06/2024	20/06/2024
				Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Preparation										
Stones >10mm	DETSC 1003*	1	% m/m	8.0	5.0	7.0	4.0	3.0	7.0
Moisture Content	DETSC 1004	0.1	%	23	20	19	13	18	18
Metals										
Arsenic	DETSC 2301#	0.2	mg/kg	43	25	39	32	44	21
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.6	0.5	0.6	0.5	0.8	0.4
Cadmium	DETSC 2301#	0.1	mg/kg	0.1	0.3	0.3	0.3	< 0.1	0.4
Chromium	DETSC 2301#	0.15	mg/kg	28	24	20	18	18	15
Chromium III	DETSC 2301*	0.15	mg/kg	28	24	20	18	18	15
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	49	44	72	63	55	38
Lead	DETSC 2301#	0.3	mg/kg	250	350	520	270	360	140
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg	0.33	0.33	0.26	0.42	0.33	0.20
Nickel	DETSC 2301#	1	mg/kg	21	20	26	27	17	19
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	0.8	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	43	37	39	40	31	27
Zinc	DETSC 2301#	1	mg/kg	73	140	150	110	66	100
Inorganics										
pH	DETSC 2008#		pH	4.7	5.4	6.1	5.6	4.8	5.6
Total Organic Carbon	DETSC 2084#	0.5	%	6.0	6.5	9.5	5.1	8.6	4.1
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l						
Petroleum Hydrocarbons										
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg						
EPH (C10-C12)	DETSC 3311	10	mg/kg						
EPH (C12-C16)	DETSC 3311	10	mg/kg						
EPH (C16-C21)	DETSC 3311	10	mg/kg						
EPH (C21-C35)	DETSC 3311	10	mg/kg						
EPH (C35-C40)	DETSC 3311	10	mg/kg						
EPH (C10-C40)	DETSC 3311#	10	mg/kg						
PAHs										
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.56	0.06	< 0.03	< 0.03	0.07
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	0.08	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.85	0.11	0.05	0.03	0.11
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	1.0	0.10	0.05	< 0.03	0.11
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.30	0.04	< 0.03	< 0.03	0.04
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	0.45	0.05	0.04	< 0.03	0.05

Symbol key at end of report

General

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13143
Client Ref ~ 4985
Contract Title ~ Providence Street, Earlsheaton

			Lab No	2356827	2356828	2356829	2356830	2356831	2356832
			Sample ID ~	SA03	SA04	TP04	TP06	WS04	WS05
			Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
			Other ID ~						
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	19/06/2024	19/06/2024	19/06/2024	19/06/2024	20/06/2024	20/06/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.48	0.04	0.03	< 0.03	0.04
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.17	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.47	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.25	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.07	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.29	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	5.0	0.36	0.13	< 0.10	0.43

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13143
Client Ref ~ 4985
Contract Title ~ Providence Street, Earlsheaton

				Lab No	2356833	2356834	2356835	2356836	2356837	2356838
				Sample ID ~	SA01	SA02	TP01	TP02	TP03	TP05
				Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
				Other ID ~						
				Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date ~	19/06/2024	19/06/2024	19/06/2024	19/06/2024	19/06/2024	19/06/2024
				Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Preparation										
Stones >10mm	DETSC 1003*	1	% m/m	4.0	2.0	18	11	9.0	8.0
Moisture Content	DETSC 1004	0.1	%	21	25	11	16	15	17
Metals										
Arsenic	DETSC 2301#	0.2	mg/kg	42	48	5.6	23	14	30
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.6	0.7	1.8	0.5	1.0	0.3
Cadmium	DETSC 2301#	0.1	mg/kg	0.5	0.2	< 0.1	0.3	0.4	0.3
Chromium	DETSC 2301#	0.15	mg/kg	20	27	4.1	16	35	18
Chromium III	DETSC 2301*	0.15	mg/kg	20	27	4.1	16	35	18
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	77	63	9.5	35	39	62
Lead	DETSC 2301#	0.3	mg/kg	330	170	32	90	180	180
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg	0.31	0.27	< 0.05	0.14	0.07	0.31
Nickel	DETSC 2301#	1	mg/kg	25	23	3.5	18	15	21
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	38	33	15	27	25	30
Zinc	DETSC 2301#	1	mg/kg	260	120	24	84	85	110
Inorganics										
pH	DETSC 2008#		pH	5.9	5.8	9.0	7.5	8.6	6.3
Total Organic Carbon	DETSC 2084#	0.5	%	11	12	6.1	5.9	9.0	6.5
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l						
Petroleum Hydrocarbons										
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 200.0	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 200.0	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	56	< 10	< 200.0	13	11	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	200	14	1100	110	130	25
EPH (C35-C40)	DETSC 3311	10	mg/kg	30	< 10	< 200.0	30	100	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	300	21	1300	160	250	39
PAHs										
Naphthalene	DETSC 3303#	0.03	mg/kg	0.05	< 0.03	0.05	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	0.10	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	0.04	< 0.03	0.06	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.72	< 0.03	0.74	0.14	0.09	0.19
Anthracene	DETSC 3303	0.03	mg/kg	0.08	< 0.03	0.14	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	1.2	< 0.03	1.7	0.23	0.14	0.35
Pyrene	DETSC 3303#	0.03	mg/kg	1.1	< 0.03	1.6	0.21	0.12	0.29
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.38	< 0.03	0.88	0.10	0.06	0.10
Chrysene	DETSC 3303	0.03	mg/kg	0.51	< 0.03	0.95	0.11	0.07	0.12

Symbol key at end of report

General

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13143
Client Ref ~ 4985
Contract Title ~ Providence Street, Earlsheaton

			Lab No	2356833	2356834	2356835	2356836	2356837	2356838
			Sample ID ~	SA01	SA02	TP01	TP02	TP03	TP05
			Depth ~	0.10	0.10	0.10	0.10	0.10	0.10
			Other ID ~						
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	19/06/2024	19/06/2024	19/06/2024	19/06/2024	19/06/2024	19/06/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.44	< 0.03	1.5	0.13	0.08	0.11
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.17	< 0.03	0.52	0.05	< 0.03	0.04
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.25	< 0.03	1.1	0.09	0.05	0.06
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.13	< 0.03	0.46	0.04	0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	0.12	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.14	< 0.03	0.67	0.05	0.05	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	5.3	< 0.10	11	1.1	0.65	1.3

Symbol key at end of report

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13143
Client Ref ~ 4985
Contract Title ~ Providence Street, Earlsheaton

	Lab No	2356839	2356840	2356841	2356842	2356843	2356844
	Sample ID ~	WS03	WS06	WS01	TP01	TP01	TP02
	Depth ~	0.10	0.10	0.60	0.40	1.20	0.60
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	20/06/2024	20/06/2024	20/06/2024	19/06/2024	19/06/2024	19/06/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Preparation							
Stones >10mm	DETSC 1003*	1	% m/m	5.0	12	3.0	17	15	18
Moisture Content	DETSC 1004	0.1	%	31	21	12	16	17	16
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	24	30	7.6	14	8.0	8.9
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	1.0	0.6	0.3	0.7	0.7	0.5
Cadmium	DETSC 2301#	0.1	mg/kg	0.6	0.3	0.2	0.2	0.2	< 0.1
Chromium	DETSC 2301#	0.15	mg/kg	39	14	15	11	8.0	8.4
Chromium III	DETSC 2301*	0.15	mg/kg	39	14	15	11	8.0	8.4
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	61	52	22	36	16	16
Lead	DETSC 2301#	0.3	mg/kg	990	190	100	100	180	35
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l			< 10	18	21	< 10
Mercury	DETSC 2325#	0.05	mg/kg	0.28	0.42	< 0.05	0.17	0.10	< 0.05
Nickel	DETSC 2301#	1	mg/kg	17	17	17	10	6.5	8.5
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	26	25	15	20	12	13
Zinc	DETSC 2301#	1	mg/kg	230	130	87	66	46	36
Inorganics									
pH	DETSC 2008#		pH	6.7	6.8	6.9	8.1	7.9	9.3
Total Organic Carbon	DETSC 2084#	0.5	%	12	7.5	2.1	4.1	4.6	4.3
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l			3.6	9.1	4.0	9.1
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l			6.4	6.3	9.5	19
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l			43	1100	1400	98
Petroleum Hydrocarbons									
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 200.0	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 200.0	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	65	18	< 10	21	< 200.0	15
EPH (C21-C35)	DETSC 3311	10	mg/kg	250	56	< 10	220	840	67
EPH (C35-C40)	DETSC 3311	10	mg/kg	50	< 10	< 10	44	< 200.0	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	380	82	< 10	290	1100	95
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.08	0.04	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.20	< 0.03	< 0.03	0.05	0.05	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	0.14	< 0.03	< 0.03	0.04	0.05	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	1.9	0.21	< 0.03	0.64	0.61	0.07
Anthracene	DETSC 3303	0.03	mg/kg	0.28	< 0.03	< 0.03	0.18	0.18	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	2.8	0.35	< 0.03	2.4	1.7	0.12
Pyrene	DETSC 3303#	0.03	mg/kg	2.2	0.29	< 0.03	2.0	1.3	0.10
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	1.0	0.11	< 0.03	0.86	0.46	0.06
Chrysene	DETSC 3303	0.03	mg/kg	0.98	0.14	< 0.03	0.83	0.43	0.06

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13143
Client Ref ~ 4985
Contract Title ~ Providence Street, Earlsheaton

			Lab No	2356839	2356840	2356841	2356842	2356843	2356844
			Sample ID ~	WS03	WS06	WS01	TP01	TP01	TP02
			Depth ~	0.10	0.10	0.60	0.40	1.20	0.60
			Other ID ~						
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	20/06/2024	20/06/2024	20/06/2024	19/06/2024	19/06/2024	19/06/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	1.1	0.12	< 0.03	0.98	0.50	0.06
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.42	0.04	< 0.03	0.37	0.18	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.82	0.06	< 0.03	0.75	0.38	0.04
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.31	0.03	< 0.03	0.31	0.17	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.07	< 0.03	< 0.03	0.08	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.39	< 0.03	< 0.03	0.44	0.24	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	13	1.3	< 0.10	10	6.3	0.50

Symbol key at end of report
General

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13143
Client Ref ~ 4985
Contract Title ~ Providence Street, Earlsheaton

			Lab No	2356845	2356846	2356847	2356848	2356849
			Sample ID ~	TP03	WS02	WS02	WS01	WS01
			Depth ~	0.30	0.20	0.70	0.10	0.40
			Other ID ~					
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	19/06/2024	20/06/2024	20/06/2024	20/06/2024	20/06/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**					
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m	29	25	7.0	5.0	4.0
Moisture Content	DETSC 1004	0.1	%	18	13	17	13	23
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg	8.3	4.1	7.7	12	56
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.5	1.0	0.8	0.5	0.5
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.3	0.2	0.4	0.3
Chromium	DETSC 2301#	0.15	mg/kg	55	53	19	17	27
Chromium III	DETSC 2301*	0.15	mg/kg	55	53	19	17	27
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	17	89	28	34	92
Lead	DETSC 2301#	0.3	mg/kg	44	25	60	150	490
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l	< 10	< 10	< 10	< 10	< 10
Mercury	DETSC 2325#	0.05	mg/kg	0.05	< 0.05	< 0.05	0.09	0.48
Nickel	DETSC 2301#	1	mg/kg	16	18	20	22	26
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	0.7
Vanadium	DETSC 2301#	0.8	mg/kg	18	39	24	20	43
Zinc	DETSC 2301#	1	mg/kg	50	140	71	140	120
Inorganics								
pH	DETSC 2008#		pH	9.2	9.4	8.6	7.9	6.6
Total Organic Carbon	DETSC 2084#	0.5	%	2.2	2.2	2.7	1.9	8.9
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l	3.9	5.5	6.9	4.5	5.7
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l	5.3	2.8	< 1.0	< 1.0	20
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	100	30	41	36	60
Petroleum Hydrocarbons								
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	14
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	11	< 10	< 10	81
EPH (C21-C35)	DETSC 3311	10	mg/kg	26	130	86	32	290
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	49	34	14	26
EPH (C10-C40)	DETSC 3311#	10	mg/kg	44	190	130	51	420
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	< 0.03	< 0.03	0.12
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	0.03	< 0.03	< 0.03	0.07
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.03	0.32	0.16	0.13	1.3
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	0.10	0.06	0.03	0.25
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.05	0.65	0.46	0.32	3.1
Pyrene	DETSC 3303#	0.03	mg/kg	0.04	0.66	0.49	0.30	3.0
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.03	0.24	0.20	0.12	0.93
Chrysene	DETSC 3303	0.03	mg/kg	0.03	0.29	0.26	0.13	1.1

Symbol key at end of report

General

Summary of Chemical Analysis
Soil Samples

Our Ref 24-13143
Client Ref ~ 4985
Contract Title ~ Providence Street, Earlsheaton

			Lab No	2356845	2356846	2356847	2356848	2356849
			Sample ID ~	TP03	WS02	WS02	WS01	WS01
			Depth ~	0.30	0.20	0.70	0.10	0.40
			Other ID ~					
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	19/06/2024	20/06/2024	20/06/2024	20/06/2024	20/06/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**					
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.03	0.33	0.35	0.14	1.2
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.12	0.16	0.04	0.44
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.24	0.34	0.09	0.64
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.16	0.15	0.05	0.32
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	0.04	< 0.03	0.09
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.22	0.19	0.05	0.36
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	3.4	2.9	1.4	13

Summary of Asbestos Analysis
Soil Samples

Our Ref 24-13143
Client Ref ~ 4985
Contract Title ~ Providence Street, Earlsheaton

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2356827	SA03 0.10	SOIL	NAD	none	Steven Lambert
2356828	SA04 0.10	SOIL	NAD	none	Steven Lambert
2356829	TP04 0.10	SOIL	NAD	none	Steven Lambert
2356830	TP06 0.10	SOIL	NAD	none	Steven Lambert
2356831	WS04 0.10	SOIL	NAD	none	Steven Lambert
2356832	WS05 0.10	SOIL	NAD	none	Steven Lambert
2356833	SA01 0.10	SOIL	NAD	none	Steven Lambert
2356834	SA02 0.10	SOIL	NAD	none	Steven Lambert
2356835	TP01 0.10	SOIL	NAD	none	Steven Lambert
2356836	TP02 0.10	SOIL	NAD	none	Steven Lambert
2356837	TP03 0.10	SOIL	NAD	none	Steven Lambert
2356838	TP05 0.10	SOIL	NAD	none	Steven Lambert
2356839	WS03 0.10	SOIL	NAD	none	Steven Lambert
2356840	WS06 0.10	SOIL	NAD	none	Steven Lambert
2356841	WS01 0.60	SOIL	NAD	none	Steven Lambert
2356842	TP01 0.40	SOIL	NAD	none	Steven Lambert
2356843	TP01 1.20	SOIL	NAD	none	Steven Lambert
2356844	TP02 0.60	SOIL	NAD	none	Steven Lambert
2356845	TP03 0.30	SOIL	NAD	none	Steven Lambert
2356846	WS02 0.20	SOIL	NAD	none	Steven Lambert
2356847	WS02 0.70	SOIL	NAD	none	Steven Lambert
2356848	WS01 0.10	SOIL	NAD	none	Steven Lambert
2356849	WS01 0.40	SOIL	NAD	none	Steven Lambert

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 24-13143
Client Ref ~ 4985
Contract ~ Providence Street, Earlsheaton

Containers Received & Deviating Samples

Lab No	Sample ID ~	Date Sampled ~	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2356827	SA03 0.10 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356828	SA04 0.10 SOIL	19/06/24	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
2356829	TP04 0.10 SOIL	19/06/24	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
2356830	TP06 0.10 SOIL	19/06/24	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
2356831	WS04 0.10 SOIL	20/06/24	GJ 250ml, PT 1L		
2356832	WS05 0.10 SOIL	20/06/24	GJ 250ml, PT 1L		
2356833	SA01 0.10 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356834	SA02 0.10 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356835	TP01 0.10 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356836	TP02 0.10 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356837	TP03 0.10 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356838	TP05 0.10 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356839	WS03 0.10 SOIL	20/06/24	GJ 250ml, GJ 60ml, PT 1L		
2356840	WS06 0.10 SOIL	20/06/24	GJ 250ml, GJ 60ml, PT 1L		
2356841	WS01 0.60 SOIL	20/06/24	GJ 250ml, GJ 60ml, PT 1L		
2356842	TP01 0.40 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356843	TP01 1.20 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356844	TP02 0.60 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356845	TP03 0.30 SOIL	19/06/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2356846	WS02 0.20 SOIL	20/06/24	GJ 250ml, GJ 60ml, PT 1L		
2356847	WS02 0.70 SOIL	20/06/24	GJ 250ml, GJ 60ml, PT 1L		
2356848	WS01 0.10 SOIL	20/06/24	GJ 250ml, GJ 60ml, PT 1L		
2356849	WS01 0.40 SOIL	20/06/24	GJ 250ml, GJ 60ml, PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Information in Support of the Analytical Results

Our Ref 24-13143
Client Ref ~ 4985
Contract ~ Providence Street, Earlsheaton

Key:

~ Sample details are provided by the client and can affect the validity of the results
***** -not accredited.
# -MCERTS (accreditation only applies if report carries the MCERTS logo).
$ -subcontracted.
n/s -not supplied.
I/S -insufficient sample.
U/S -unsuitable sample.
t/f -to follow.
nd -not detected.

End of Report

Appendix I

Contaminated land assessment for selection of water supply pipes

The Risk assessment (RA)

Section 1: Development Details	
Development Name *(if it has one)*	
Development Address	Providence Street, Earlsheaton, Dewsbury, WF12 8HZ
OS Grid Reference *(mid point)*	SE 259 211
Developers Name	N/A
Water Company reference number *(for UU use only)*	
Please provide details below of the current and historical use of the site and adjacent sites. *If your supporting information has details of the current and historical site use, please reference below the relevant sections of your report.*	
The site was formerly occupied by tenter frames (used in the woollen industry to dry and stretch fabrics, shown until c. 1940) and buildings along Providence Street (until c. 1970). A sandstone quarry is shown in the east of the site from 1855 and a hollow remains on site, an additional sandstone quarry lies immediately beyond the southern boundary. Small warehouse buildings and a storage container yard occupy the northwest. The site now comprises primarily overgrown woodland, with a recently cleared area where the proposed development it be located.	
Section 2: Preliminary Risk Assessment	
Has your desk study and site walkover identified any land potentially affected by contamination?	☒ Yes ☐ No
If the site is potentially affected by contamination but you have not completed any intrusive site investigation please provide details below of the rationale behind the intended pipe selection. *If your supporting information has details of the rationale behind the intended pipe selection, please reference below the relevant sections of your report.*	
Site investigation completed. Topsoil and Made ground contamination (lead and arsenic) encountered, no organic contamination encountered. Further trial pitting/ window sample boreholes recommended in the northwest due to access restraints.	
Section 3: Intrusive Site Investigation	
Have you completed any intrusive site investigation?	☒ Yes ☐ No
Date(s) when the site investigation(s) undertaken	19th and 20th June 2024
At what level has groundwater been encountered?	☒ Not encountered
Table 1 (Pipeline Selection Risk Assessment Summary (PSRAS)) below classifies testing required where the preliminary risk assessment has identified land potentially affected by contamination. Please provide details below of any test groups which have not been tested and the rationale for not testing. *If your supporting information has details of the rationale behind not testing any particular test groups, please reference below the relevant sections of your report.*	
At the time of writing, the proposed route(s), and total length, of water supply pipes were unknown. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance has not been undertaken. See Lithos report 4985/2.	

If the intrusive site investigation has identified concentrations above the PE threshold (see PSRAS) and your intended pipe selection is PE please provide details below of the rationale behind the intended pipe selection. *If your supporting information has details of the rationale behind the intended pipe selection, please reference below the relevant sections of your report.*
N/A

Section 4: Site Remediation	
Please provide details below of any site remediation (which may include a change in site levels) already completed. *If your supporting information has details of the site remediation already completed, please reference below the relevant sections of your report.*	
N/A	
Has the PSRAS (Table 1) been completed using appropriate data after remediation?	☐ Yes ☐ No ☒ N/A
Please provide details below of any proposed site remediation and an analysis of whether this will affect your intended pipe selection. *If your supporting information has details of any proposed site remediation and whether this will affect your intended pipe selection, please reference below the relevant sections of your report.*	
Remediation at this site is considered necessary, a proposed 600mm cover is anticipated to be suitable with current information. However, some post demolition/site clearance trial pitting is required which may encounter further and/or more onerous contamination which will require further remedial works. Further testing may be required to confirm that soils are sufficiently cleaned up to allow the use of 'standard' PE pipework.	
Section 5: Final Use of Site	
Please provide details below of any chemicals (including fuel) to be stored on site and any other future contamination risks which may affect your intended pipe selection. *If your supporting information has details of potential contamination risks which may affect your intended pipe selection, please reference below the relevant sections of your report.*	
The site is to be redeveloped with housing; no layout has been provided to date. Construction phase groundworkers should follow good environmental practice as referenced in Lithos report 4985/2.	
What water pipe materials are intended to be used on site?	☒ PE ☐ PE Barrier Pipe Type A ☐ PE Barrier Pipe Type B Other (please specify):

Section 6: Additional Information
Please use the section below to provide any additional details to support your intended pipe selection. *If your supporting information has additional information to support your intended pipe selection, please reference below the relevant sections of your report.*
Post demolition/ site clearance trial pitting investigation & Remediation Strategy to be completed prior to any development taking place.

Section 7: Risk Assessor	
Name and relevant qualifications of person directing the risk assessment for water pipes	Mark Perrin: MSc CGEOL
Name and address of risk assessor's company	Lithos Consulting, Parkhill, Walton Road, Wetherby, LS22 5DZ
Date risk assessment performed	18/07/2024

Section 8: Declaration			
I confirm I have completed this form and provided supporting information in accordance with 'UKWIR Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' and water company's Supplementary Guidance. I also confirm that if any further site investigation is needed and carried out, I will be required to submit an additional Risk Assessment for Water Pipes with the relevant supporting information. I understand that failure to supply any of the required information may delay my application being processed.			
Name	Alan Swales	Company	Lithos Consulting
Phone Number	01937 545330	Date	18/07/2024

Table 1 - Pipe Selection Risk Assessment Summary (PSRAS)	
1) *Testing must be undertaken on the materials within which the pipes are to be laid, whether that be existing ground materials, remediated materials or imported capping materials. Please use the appropriate testing data to complete Table 1 below.* 2) *If more than one pipe selection is being made, for example, for pipes in different areas of a large site, a completed PSRAS is required for each selection.*	
What materials have been tested to populate Table 1 below?	☒ Existing ground materials ☐ Remediated materials ☐ Imported capping materials
At the time of investigation, the proposed route(s), and total length, of pipeline were unknown. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance was not undertaken. Sampling within 15m of proposed water supply pipes could be undertaken, once remediation works and infrastructure design have been completed. However, given the site's history the use of barrier water supply pipes are considered likely, subject to the remediation undertaken.	

All concentrations in mg/kg								
Test Group	**Testing Required?**	**PE threshold**	**Metal Pipes/ Barrier Pipe**	**Laboratory Detection Limit**	**Testing UKAS accredited Y/N**	**Maximum concentration at proposed pipeline depth** See Note [2]	**Maximum site concentration** See Note [3]	**Locations and depths where concentrations exceed proposed pipeline threshold**
Total VOCs	Where Preliminary Risk Assessment (PRA) has identified land potentially affected by contamination	0.5	Pass	-	-	-	Not tested	-
Total BTEX & MTBE		0.1	Pass	-	-	-	Not tested	-
Total SVOCs (excluding PAHs and those substances marked with an *)		2	Pass	-	-	-	Not tested	-
EC5-EC10 aliphatic and aromatic hydrocarbons		2	Pass	<0.1	-	-	<0.1	-
EC10-EC16 aliphatic and aromatic hydrocarbons		10	Pass	<10, <200	Y	-	**14** (<400, LOD raised due to diluted sample – likely not this high)	WS01 at 0.4m
EC16-EC40 aliphatic and aromatic hydrocarbons		500	Pass	<10, <200	Y	-	**840** (<600, LOD raised due to diluted sample – likely not this high)	TP01 at 1.2m
Phenols* (from SVOC analysis)		2	Pass	-	-	-	Not tested	-
Cresols and chlorinated phenols* (from SVOC analysis)		2	Pass	-	-	-	Not tested	-
Ethers*	Only where identified	0.5	Pass	-	-	-	Not tested	-
Nitrobenzene*		0.5	Pass	-	-	-	Not tested	-
Ketones*		0.5	Pass	-	-	-	Not tested	-
Aldehydes*		0.5	Pass	-	-	-	Not tested	-
Amines		Fail	Pass	-	-	-	Not tested	-

Corrosive	Conductivity, Redox and pH	Pass	See Note [1]	-	-	-	Not tested	-

Note [1] Threshold: For wrapped steel, corrosive if pH<7 and conductivity > 400µS/cm. For wrapped ductile iron corrosive if pH<5, Eh not neutral and conductivity > 400µS/cm. For copper, corrosive if pH<5 or >8 and Eh positive.

Note [2] Water pipes are normally laid at 0.75-1.35m below finished ground level.

Note [3] Also state if liquid free product is present in soil or groundwater.

Appendix J

Geotechnical Test Results

LABORATORY REPORT

Contract Number: PSL24/4560

Report Date:	16 July 2024
Client's Reference:	4985
Client Name:	Lithos Consulting Parkhill Walton Road Wetherby North Yorkshire LS22 5DZ
For the attention of:	**James Brown**
Contract Title:	Providence Street, Earlsheaton
Date Received:	27/6/2024
Date Commenced:	27/6/2024
Date Completed:	16/7/2024
Notes:	**Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Managing Director)

R Berriman
(Associate Director)

S Royle
(Laboratory Manager)

Redacted

L Knight
(Assistant Laboratory Manager)

D Nicholson
(Senior Technician)

T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road,
Hexthorpe,
Doncaster,
DN4 0AR
Tel: Redacted
Email: Redacted

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
SA03	2	B	0.20		Dark brown TOPSOIL.
SA04	2	B	0.20		Dark brown TOPSOIL.
TP04	2	B	0.20		Dark brown TOPSOIL.
SA01	2	D	0.40		Brown very gravelly very sandy CLAY.
SA02	2	D	0.60		Brown slightly gravelly slightly sandy very silty CLAY.
SA03	3	D	0.50		Light brown very gravelly sandy very silty CLAY.
SA04	3	D	0.80		Brown very gravelly sandy very silty CLAY.
TP01	4	D	1.60		Brown very gravelly sandy CLAY.
TP02	3	D	2.10		Brown clayey very silty GRAVEL.
TP03	4	D	1.00		Brown very gravelly sandy CLAY.
TP04	3	D	0.60		Light brown sandy very silty CLAY.
TP05	2	B	0.50		Brown very gravelly very sandy CLAY.
TP05	3	D	0.80		Brown gravelly sandy CLAY.
TP06	3	D	1.10		Light brown clayey very silty GRAVEL.

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Providence Street, Earlsheaton

Contract No:

PSL24/4560

Client Ref:

4985

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
SA01	2	D	0.40		17			34	24	10	74	Low Plasticity ML
SA02	2	D	0.60		15			38	19	19	90	Intermediate Plasticity CI
SA03	3	D	0.50		15			40	18	22	75	Intermediate Plasticity CI
SA04	3	D	0.80		18			37	18	19	76	Intermediate Plasticity CI
TP01	4	D	1.60		15			36	16	20	83	Intermediate Plasticity CI
TP02	3	D	2.10		11			36	16	20	41	Intermediate Plasticity CI
TP03	4	D	1.00		14			32	22	10	80	Low Plasticity CL
TP04	3	D	0.60		15			42	18	24	100	Intermediate Plasticity CI
TP05	3	D	0.80		14			32	16	16	80	Low Plasticity CL
TP06	3	D	1.10		11			32	17	15	40	Low Plasticity CL

SYMBOLS : NP : Non Plastic *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Providence Street, Earlsheaton

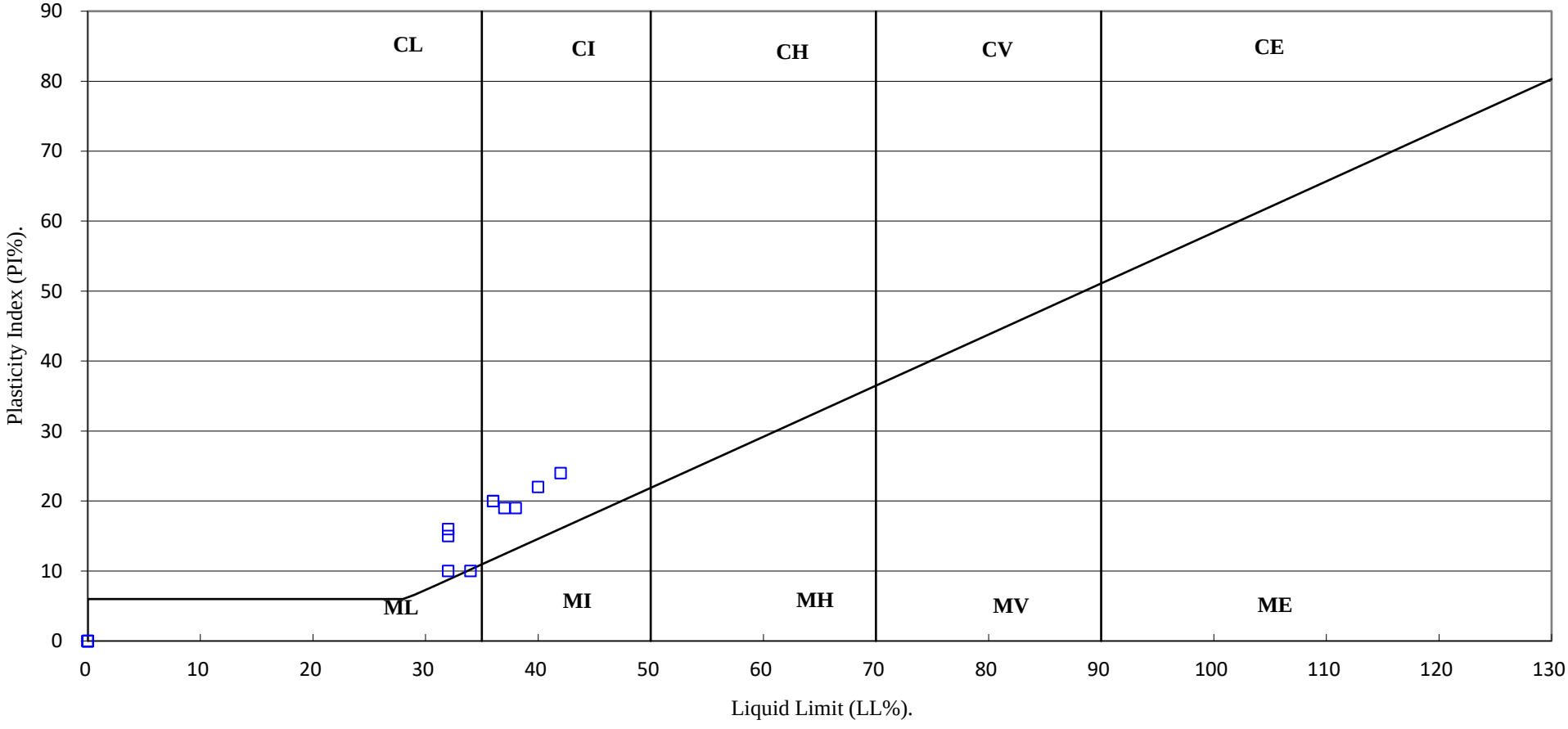
Contract No:

PSL24/4560

Client Ref:

4985

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043 / PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY	**Providence Street, Earlsheaton**	**Contract No:**
		PSL24/4560
		Client Ref:
		4985

PARTICLE SIZE DISTRIBUTION TEST

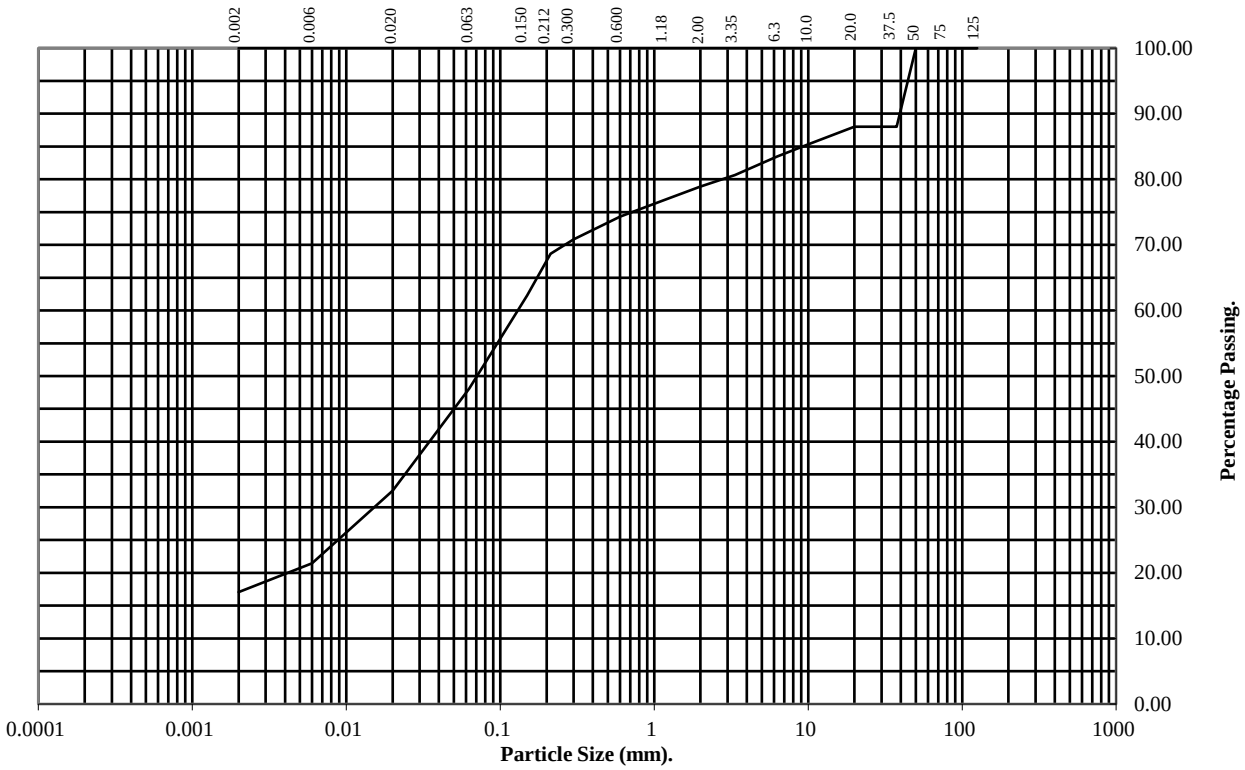
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: SA03 **Top Depth (m):** 0.20

Sample Number: 2 **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	88
20	88
10	85
6.3	83
3.35	81
2	79
1.18	77
0.6	74
0.3	71
0.212	69
0.15	62
0.063	48

Particle Diameter	Percentage Passing
0.02	33
0.006	21
0.002	17

Soil Fraction	Total Percentage
Cobbles	0
Gravel	21
Sand	31
Silt	31
Clay	17

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Providence Street, Earlsheaton

Contract No: PSL24/4560

Client Ref: 4985

PARTICLE SIZE DISTRIBUTION TEST

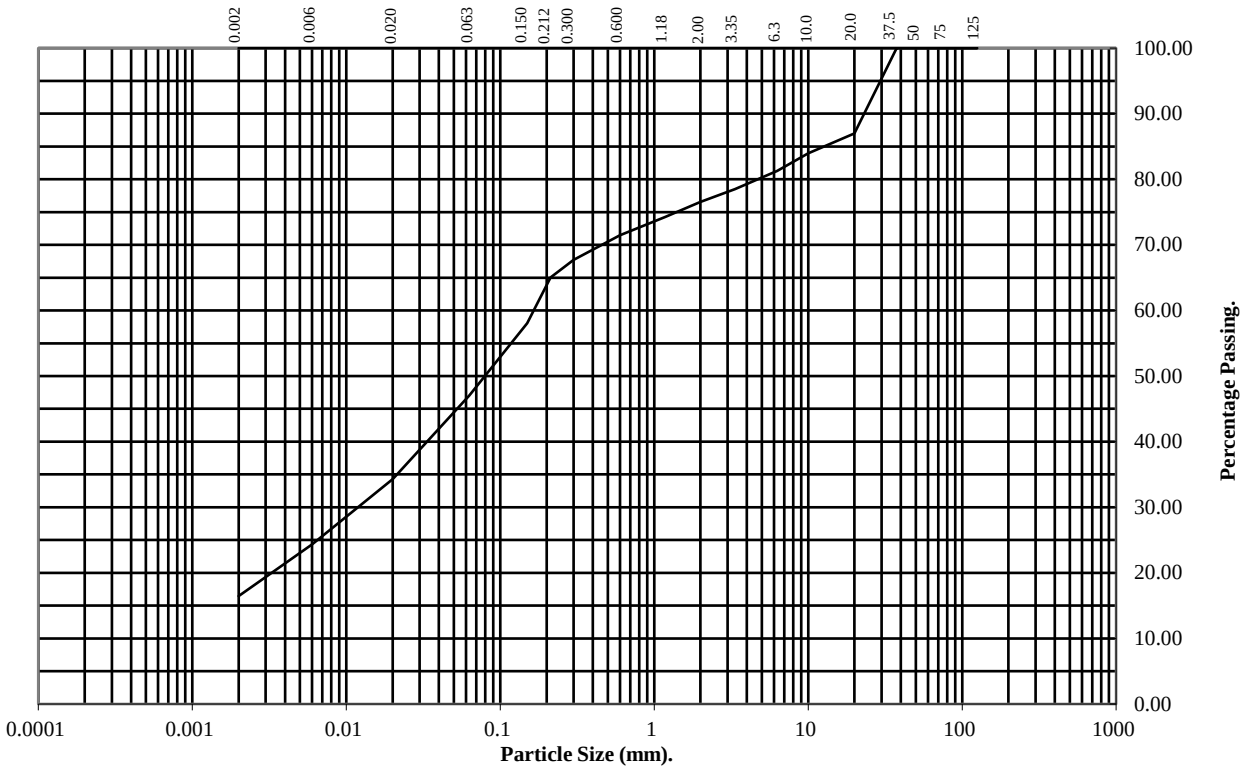
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: SA04 **Top Depth (m):** 0.20

Sample Number: 2 **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	100
20	87
10	84
6.3	81
3.35	79
2	77
1.18	74
0.6	71
0.3	68
0.212	65
0.15	58
0.063	47

Particle Diameter	Percentage Passing
0.02	34
0.006	24
0.002	16

Soil Fraction	Total Percentage
Cobbles	0
Gravel	23
Sand	30
Silt	31
Clay	16

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Providence Street, Earlsheaton

Contract No: PSL24/4560

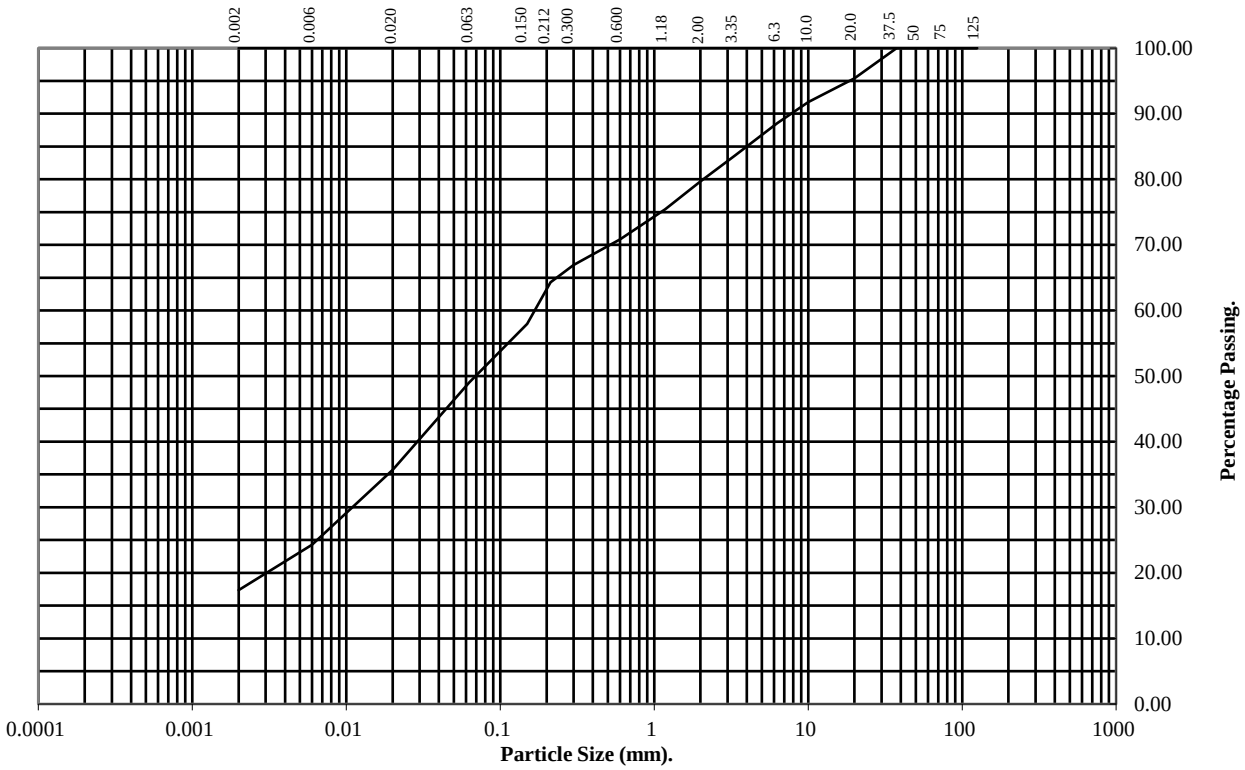
Client Ref: 4985

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number:	**TP04**	**Top Depth (m):**	**0.20**
Sample Number:	**2**	**Base Depth(m):**	
Sample Type:	**B**		



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	100
20	95
10	92
6.3	89
3.35	84
2	80
1.18	75
0.6	71
0.3	67
0.212	64
0.15	58
0.063	49

Particle Diameter	Percentage Passing
0.02	36
0.006	24
0.002	17

Soil Fraction	Total Percentage
Cobbles	0
Gravel	20
Sand	31
Silt	32
Clay	17

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Providence Street, Earlsheaton

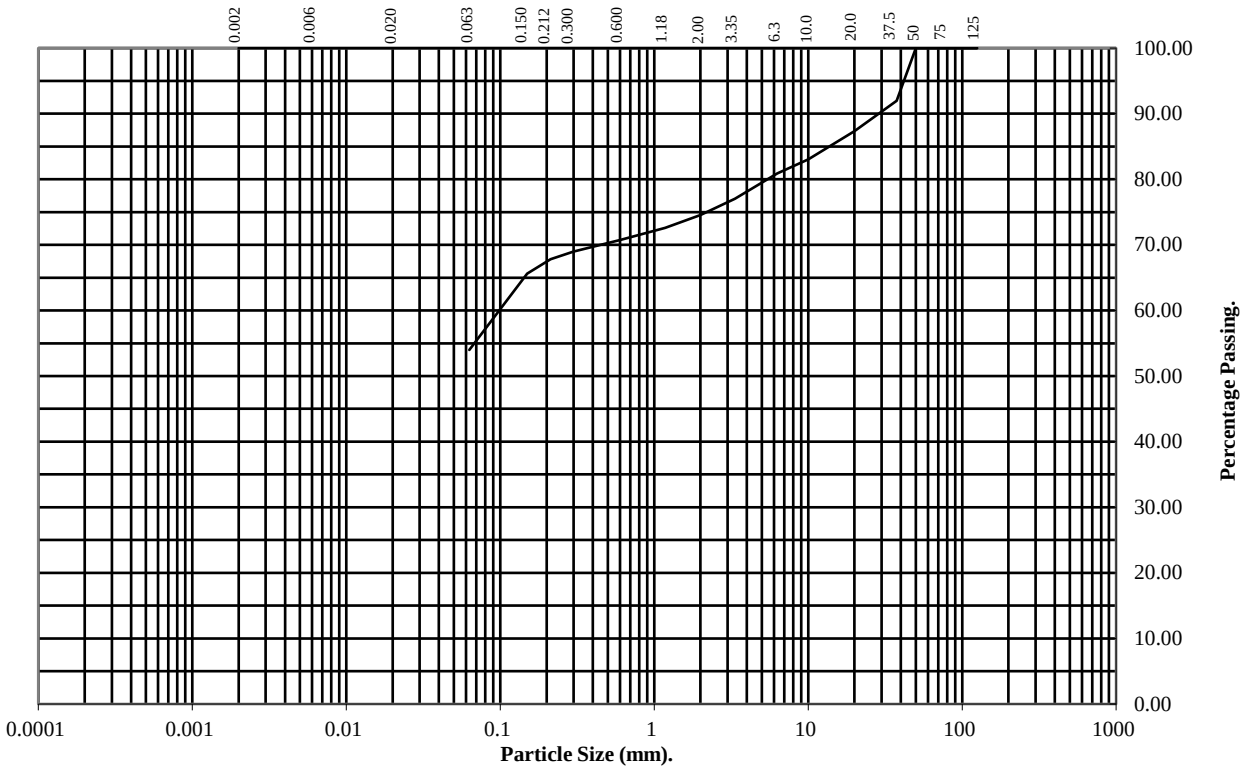
Contract No:
PSL24/4560
Client Ref:
4985

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**TP05**	**Top Depth (m):**	**0.50**
Sample Number:	**2**	**Base Depth(m):**	
Sample Type:	**B**		



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	92
20	87
10	83
6.3	81
3.35	77
2	75
1.18	73
0.6	71
0.3	69
0.212	68
0.15	66
0.063	54

Soil Fraction	Total Percentage
Cobbles	0
Gravel	25
Sand	21
Silt/Clay	54

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Providence Street, Earlsheaton

Contract No:
PSL24/4560
Client Ref:
4985

7 - 11 Harding Street
Leicester
LE1 4DH

Professional Soils Laboratory
5/7 Hexthorpe Road
Hexthorpe
Doncaster
DN4 0AR

Analytical Test Report: L24/06115/PSL - 24-47147

Your Project Reference:	**PSL24/4560 Providence Street, Earlsheaton**		
Your Order Number:	PSL24/4560	Samples Received / Instructed:	08/07/2024 / 08/07/2024
Report Issue Number:	1	Sample Tested:	08/07 to 12/07/2024
Samples Analysed:	13 soil samples	Report issued:	12/07/2024

Redacted

James Gane
Analytical Services Manager
CTS Group

Notes:

General

Please refer to Methodologies page for details pertaining to the analytical methods undertaken.

Samples will be retained for 14 days after issue of this report unless otherwise requested.

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

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.

Samples were supplied by customer, results apply to the samples as received.

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

UKAS = UKAS Accreditation, MCERTS = MCERTS Accreditation, u = Unaccredited, subUKAS - Subcontracted to a laboratory UKAS accredited for this test, subMCERTS - Subcontracted to a laboratory MCERTS accredited for this test

MCERTS Accreditation only covers the SAND, CLAY and LOAM matrices

Date of Issue: 29.05.2024
Issued by: J. Gane
Issue No: 4
Rev No: 10

7 - 11 Harding Street
Leicester
LE1 4DH

L24/06115/PSL - 24-47147

Project Reference - PSL24/4560 Providence Street, Earlsheaton

Analytical Test Results - Chemical Analysis

Lab Reference			379596	379597	379598	379599	379600	379601
Client Sample ID			-	-	-	-	-	-
Client Sample Location			SA01	SA02	SA03	TP01	TP02	TP03
Client Sample Type			D	D	D	D	D	D
Client Sample Number			2	3	3	4	3	4
Depth - Top (m)			0.40	1.30	0.50	1.60	2.10	1.00
Depth - Bottom (m)			0.40	1.30	0.50	1.60	2.10	1.00
Date of Sampling			20/06/2024	20/06/2024	20/06/2024	20/06/2024	20/06/2024	20/06/2024
Time of Sampling			-	-	-	-	-	-
Sample Matrix			Clay	Clay	Clay	Clay	Clay	Clay
Determinant	**Units**	**Accreditation**						
Water soluble sulphate (as SO_4)	(mg/l)	u	36	< 10	14	200	79	28
pH Value	pH Units	MCERTS	6.1	6.3	5.9	7.2	5.4	8.1

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L24/06115/PSL - 24-47147

Project Reference - PSL24/4560 Providence Street, Earlsheaton

Analytical Test Results - Chemical Analysis

Lab Reference			379602	379603	379604	379605	379606	379607
Client Sample ID			-	-	-	-	-	-
Client Sample Location			TP05	TP06	TP04	WS06	WS06	WS01
Client Sample Type			D	D	D	D	D	D
Client Sample Number			3	3	4	3	4	4
Depth - Top (m)			0.80	1.10	1.40	1.60	2.30	1.40
Depth - Bottom (m)			0.80	1.10	1.40	160	2.30	1.40
Date of Sampling			20/06/2024	20/06/2024	20/06/2024	20/06/2024	20/06/2024	20/06/2024
Time of Sampling			-	-	-	-	-	-
Sample Matrix			Clay	Clay	Other	Other	Other	Other
Determinant	**Units**	**Accreditation**						
Water soluble sulphate (as SO_4)	(mg/l)	u	< 10	< 10	20	< 10	12	14
pH Value	pH Units	MCERTS	6.8	7.2	6.4	7.4	6.2	6.9

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L24/06115/PSL - 24-47147

Project Reference - PSL24/4560 Providence Street, Earlsheaton

Analytical Test Results - Chemical Analysis

Lab Reference			379608
Client Sample ID			-
Client Sample Location			WS05
Client Sample Type			D
Client Sample Number			3
Depth - Top (m)			1.90
Depth - Bottom (m)			1.90
Date of Sampling			20/06/2024
Time of Sampling			-
Sample Matrix			Other
Determinant	**Units**	**Accreditation**	
Water soluble sulphate (as SO_4)	(mg/l)	u	< 10
pH Value	pH Units	MCERTS	7.1

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L24/06115/PSL - 24-47147

Project Reference - PSL24/4560 Providence Street, Earlsheaton

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 (%)
379596	-	SA01	D	2	Brown slightly gravelly silty clay	-	-	94
379597	-	SA02	D	3	Greyish brown slightly gravelly clay	-	-	77
379598	-	SA03	D	3	Brown sandy clay with rare rootlets	-	-	92
379599	-	TP01	D	4	Brown clay with rare rootlets	-	-	89
379600	-	TP02	D	3	Brown clay	-	-	70
379601	-	TP03	D	4	Brown sandy clay with rare rootlets	-	-	66
379602	-	TP05	D	3	Brown silty clay	-	-	50
379603	-	TP06	D	3	Brown clay	-	-	63
379604	-	TP04	D	4	Brown slightly sandy crushed rock	-	-	28
379605	-	WS06	D	3	Brown very sandy crushed rock	-	-	43
379606	-	WS06	D	4	Brown very sandy very gravelly crushed rock	-	-	100
379607	-	WS01	D	4	Brown very sandy crushed rock	-	-	100
379608	-	WS05	D	3	Brown slightly sandy crushed rock	-	-	100

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L24/06115/PSL - 24-47147

Project Reference - PSL24/4560 Providence Street, Earlsheaton

Sample Comments

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Comments
379596	-	SA01	D	2	
379597	-	SA02	D	3	
379598	-	SA03	D	3	
379599	-	TP01	D	4	
379600	-	TP02	D	3	
379601	-	TP03	D	4	
379602	-	TP05	D	3	
379603	-	TP06	D	3	
379604	-	TP04	D	4	
379605	-	WS06	D	3	
379606	-	WS06	D	4	
379607	-	WS01	D	4	
379608	-	WS05	D	3	

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L24/06115/PSL - 24-47147

Project Reference - PSL24/4560 Providence Street, Earlsheaton

Analysis Methodologies

Test Code	Test Name / Reference	Sample condition for analysis	Sample Preperation	Test Details
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
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

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L24/06115/PSL - 24-47147

Project Reference - PSL24/4560 Providence Street, Earlsheaton

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
C - Received in inappropriate container
H - Contains headspace
T - Temperature on receipt exceeds storage temperature
R - Sample(s) received with less than 96 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

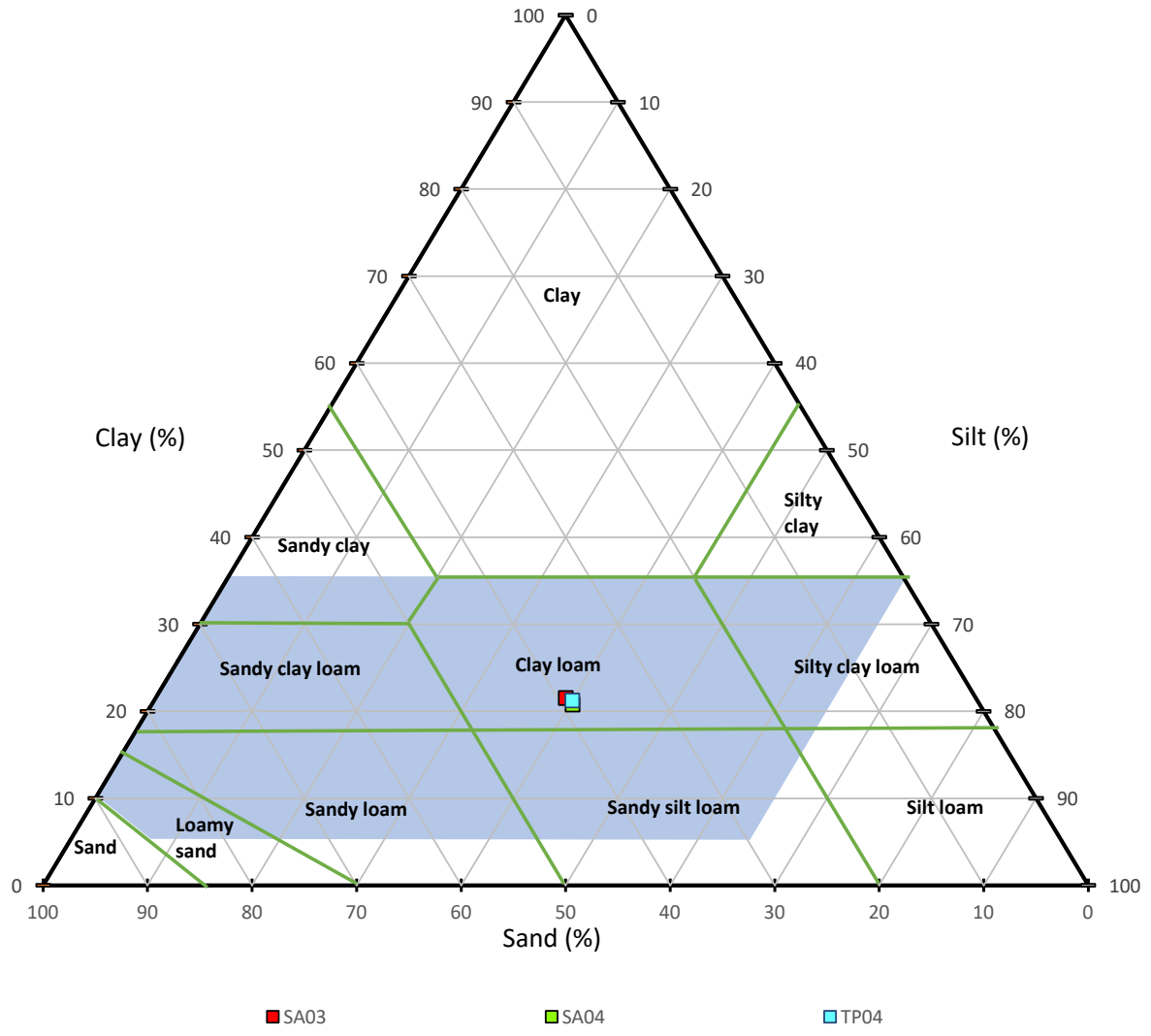
X - Exceeds sampling to extraction or analysis timescales

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Test	Deviations
379596	-	SA01	D	2	MS - CL - pH in Soils	RX
379597	-	SA02	D	3	MS - CL - pH in Soils	RX
379598	-	SA03	D	3	MS - CL - pH in Soils	RX
379599	-	TP01	D	4	MS - CL - pH in Soils	RX
379600	-	TP02	D	3	MS - CL - pH in Soils	RX
379601	-	TP03	D	4	MS - CL - pH in Soils	RX
379602	-	TP05	D	3	MS - CL - pH in Soils	RX
379603	-	TP06	D	3	MS - CL - pH in Soils	RX
379604	-	TP04	D	4	MS - CL - pH in Soils	RX
379605	-	WS06	D	3	MS - CL - pH in Soils	RX
379606	-	WS06	D	4	MS - CL - pH in Soils	RX
379607	-	WS01	D	4	MS - CL - pH in Soils	RX
379608	-	WS05	D	3	MS - CL - pH in Soils	RX

Site:	Providence Street, Earlsheaton
Lithos Job Number:	4985
Client:	Precious Holdings (Wakefield) Ltd
Lab Results Rpt Ref.	PSL24/4560
Date Report Issued:	16/07/2024

Topsoil Classification

(Testing undertaken in accordance with BS3882:2015)



= Area within which the texture of Topsoil is required to fall

= Texture Group Boundary

Appendix K
Soakaway Test Results

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	Precious Holdings (Wakefield) LTD
Engineer	Dan Williams
Job Name:	Providence Street, Earlsheaton
Job No.:	4985

Date:	**19/06/2024**
Trial Pit No.	**SA01**
Test No.	**1**

Water level not rising after 2 mins of filling, filling halted and test begun

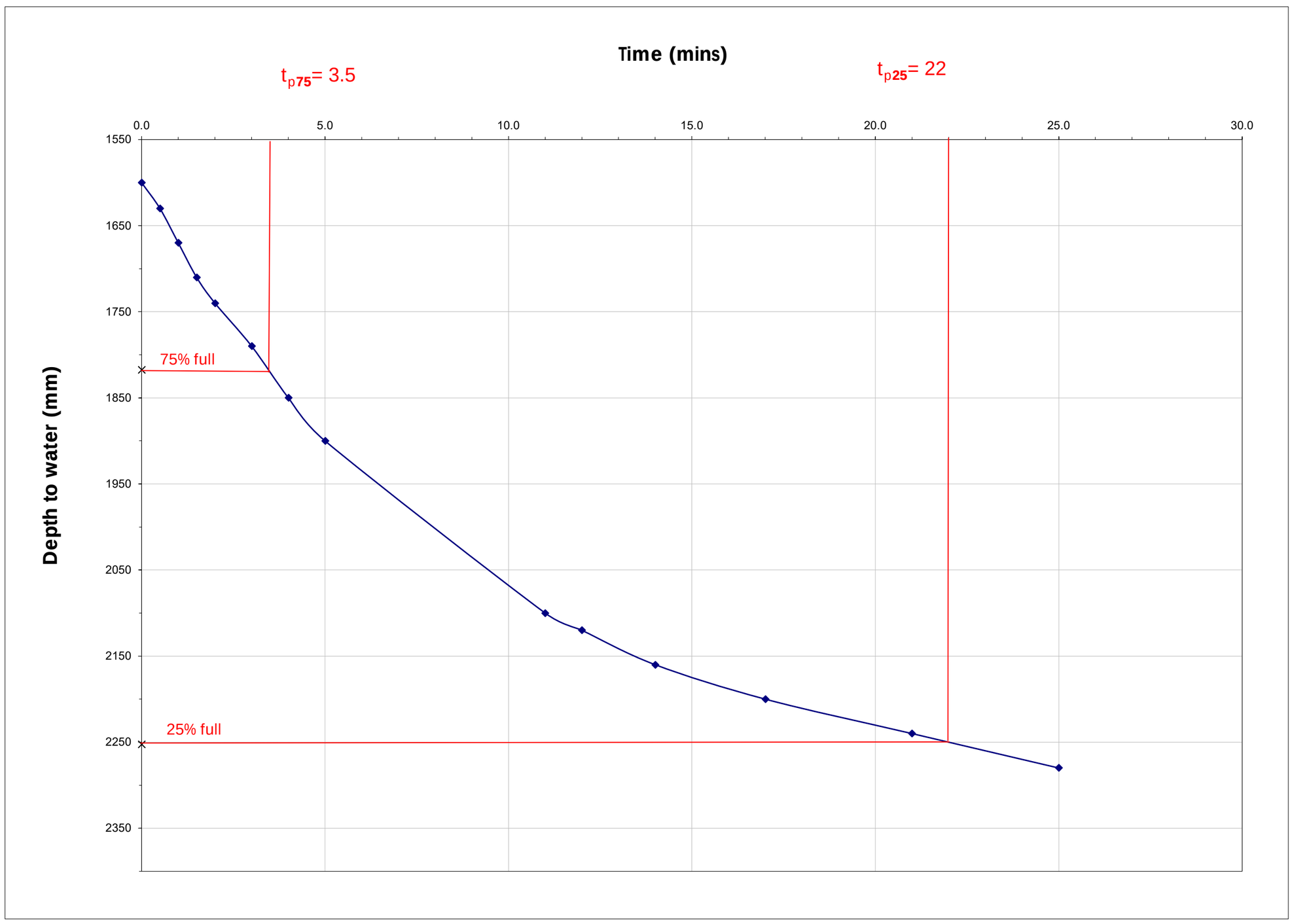
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
13:09	0.0	1.60	1600
13:09	0.5	1.63	1630
13:10	1.0	1.67	1670
13:10	1.5	1.71	1710
13:11	2.0	1.74	1740
13:12	3.0	1.79	1790
13:13	4.0	1.85	1850
13:14	5.0	1.90	1900
13:20	11.0	2.10	2100
13:21	12.0	2.12	2120
13:23	14.0	2.16	2160
13:26	17.0	2.20	2200
13:30	21.0	2.24	2240
13:34	25.0	2.28	2280

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	2.90	2900
Width	=	0.65	650
Depth	=	2.47	2470

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	2252.5	2.25
0.50	=	2035	2.04
0.75	=	1817.5	1.82

Depth at start of test (mm)	=	1600
Depth at end of test (mm)	=	2280
Base area of pit	=	1.885
a_{p50} - 50% internal surface area inc. base	=	4.9735
V_{p75-25} - Volume 75 - 25%	=	0.819975

Read from the graph:		
$t_{p\ 75}$ (min)	=	3.5
$t_{p\ 25}$ (min)	=	22



Soil infiltration rate, f, (m/s) = 1.49E-04

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	Precious Holdings (Wakefield) LTD
Engineer	Dan Williams
Job Name:	Providence Street, Earlsheaton
Job No.:	4985

Date:	**19/06/2024**
Trial Pit No.	**SA01**
Test No.	**2**

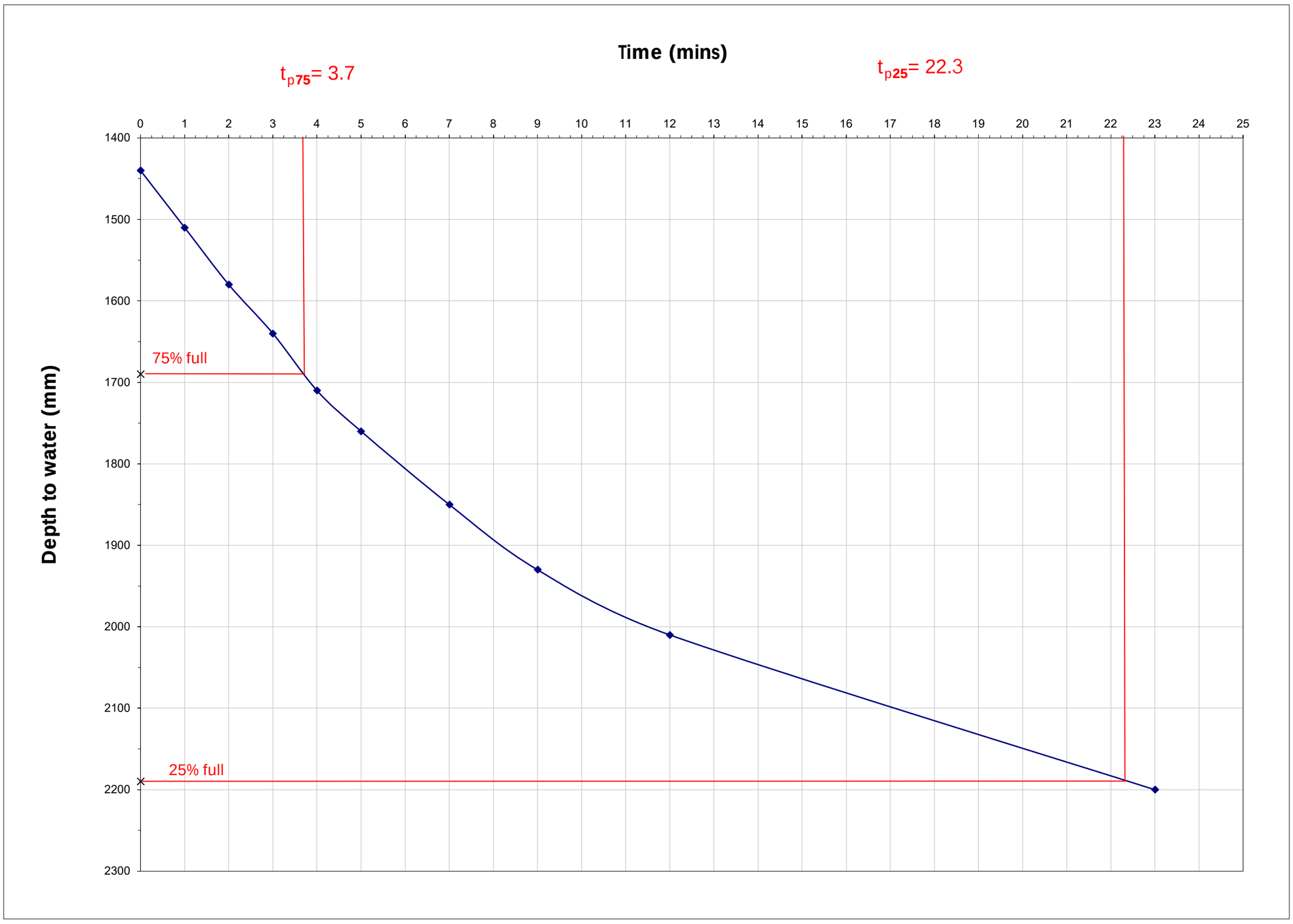
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
13:41	0	1.44	1440
13:42	1	1.51	1510
13:43	2	1.58	1580
13:44	3	1.64	1640
13:45	4	1.71	1710
13:46	5	1.76	1760
13:48	7	1.85	1850
13:50	9	1.93	1930
13:53	12	2.01	2010
14:04	23	2.20	2200

SOAKAWAY TRIAL PIT			
Dimensions		(m)	(mm)
Length	=	2.90	2900
Width	=	0.65	650
Depth	=	2.44	2440

Effective Depth (% full)		(mm)	(m)
0.25	=	2190	2.19
0.50	=	1940	1.94
0.75	=	1690	1.69

Depth at start of test (mm)	=	1440
Depth at end of test (mm)	=	2200
Base area of pit	=	1.885
a_{p50} - 50% internal surface area inc. base	=	5.435
V_{p75-25} - Volume 75 - 25%	=	0.9425

Read from the graph:		
$t_{p\ 75}$ (min)	=	3.7
$t_{p\ 25}$ (min)	=	22.3



Soil infiltration rate, f, (m/s) = 1.56E-04

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	Precious Holdings (Wakefield) LTD
Engineer	Dan Williams
Job Name:	Providence Street, Earlsheaton
Job No.:	4985

Date:	**19/06/2024**
Trial Pit No.	**SA02**
Test No.	**1**

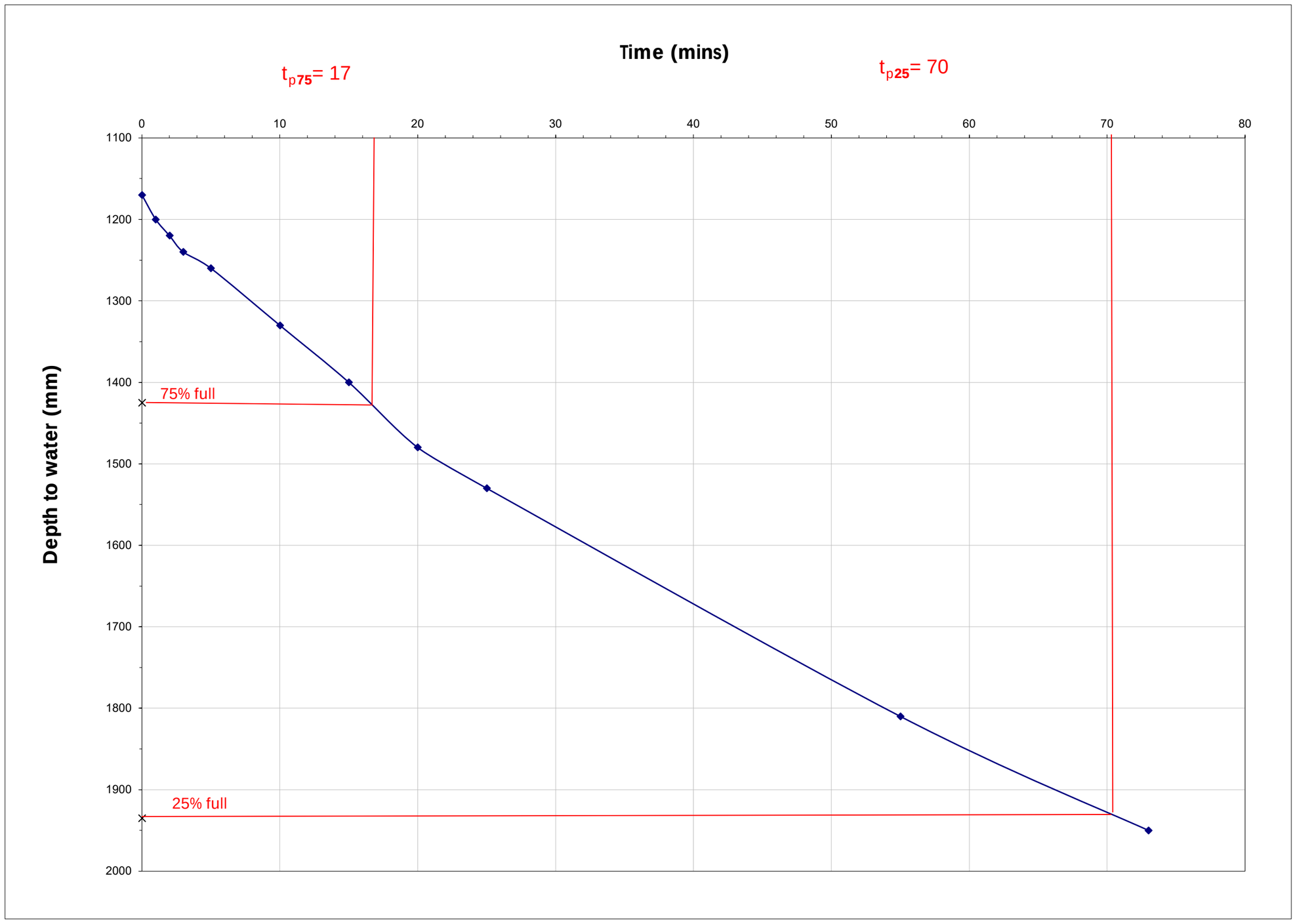
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
12:04	0	1.17	1170
12:05	1	1.20	1200
12:06	2	1.22	1220
12:07	3	1.24	1240
12:09	5	1.26	1260
12:14	10	1.33	1330
12:19	15	1.40	1400
12:24	20	1.48	1480
12:29	25	1.53	1530
12:59	55	1.81	1810
13:17	73	1.95	1950

SOAKAWAY TRIAL PIT			
Dimensions		(m)	(mm)
Length	=	3.10	3100
Width	=	0.65	650
Depth	=	2.19	2190

Effective Depth (% full)		(mm)	(m)
0.25	=	1935	1.94
0.50	=	1680	1.68
0.75	=	1425	1.43

Depth at start of test (mm)	=	1170
Depth at end of test (mm)	=	1950
Base area of pit	=	2.015
a_{p50} - 50% internal surface area inc. base	=	5.84
V_{p75-25} - Volume 75 - 25%	=	1.02765

Read from the graph:		
$t_{p\ 75}$ (min)	=	17
$t_{p\ 25}$ (min)	=	70



Soil infiltration rate, f, (m/s) = 5.53E-05

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	Precious Holdings (Wakefield) LTD
Engineer	Dan Williams
Job Name:	Providence Street, Earlsheaton
Job No.:	4985

Date:	**19/06/2024**
Trial Pit No.	**SA02**
Test No.	**2**

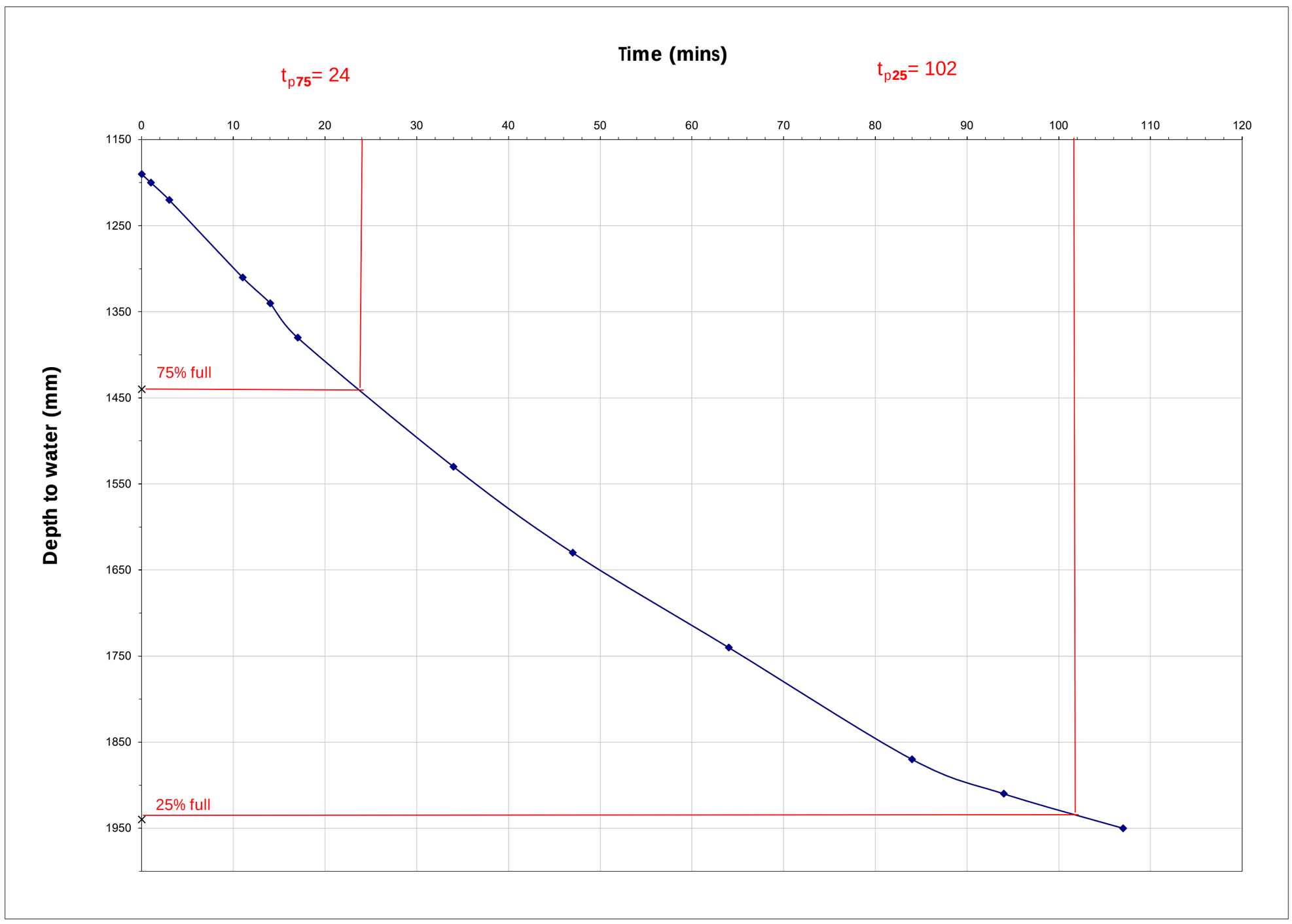
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
13:58	0	1.19	1190
13:59	1	1.20	1200
14:01	3	1.22	1220
14:09	11	1.31	1310
14:12	14	1.34	1340
14:15	17	1.38	1380
14:32	34	1.53	1530
14:45	47	1.63	1630
15:02	64	1.74	1740
15:22	84	1.87	1870
15:32	94	1.91	1910
15:45	107	1.95	1950

SOAKAWAY TRIAL PIT			
Dimensions		(m)	(mm)
Length	=	3.10	3100
Width	=	0.65	650
Depth	=	2.19	2190

Effective Depth (% full)		(mm)	(m)
0.25	=	1940	1.94
0.50	=	1690	1.69
0.75	=	1440	1.44

Depth at start of test (mm)	=	1190
Depth at end of test (mm)	=	1950
Base area of pit	=	2.015
a_{p50} - 50% internal surface area inc. base	=	5.765
V_{p75-25} - Volume 75 - 25%	=	1.0075

Read from the graph:		
$t_{p\ 75}$ (min)	=	24
$t_{p\ 25}$ (min)	=	102



Soil infiltration rate, f, (m/s) = 3.73E-05

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	Precious Holdings (Wakefield) LTD
Engineer	Dan Williams
Job Name:	Providence Street, Earlsheaton
Job No.:	4985

Date:	**19/06/2024**
Trial Pit No.	**SA03**
Test No.	**1**

Water level not rising after 2 mins of filling, filling halted and test begun

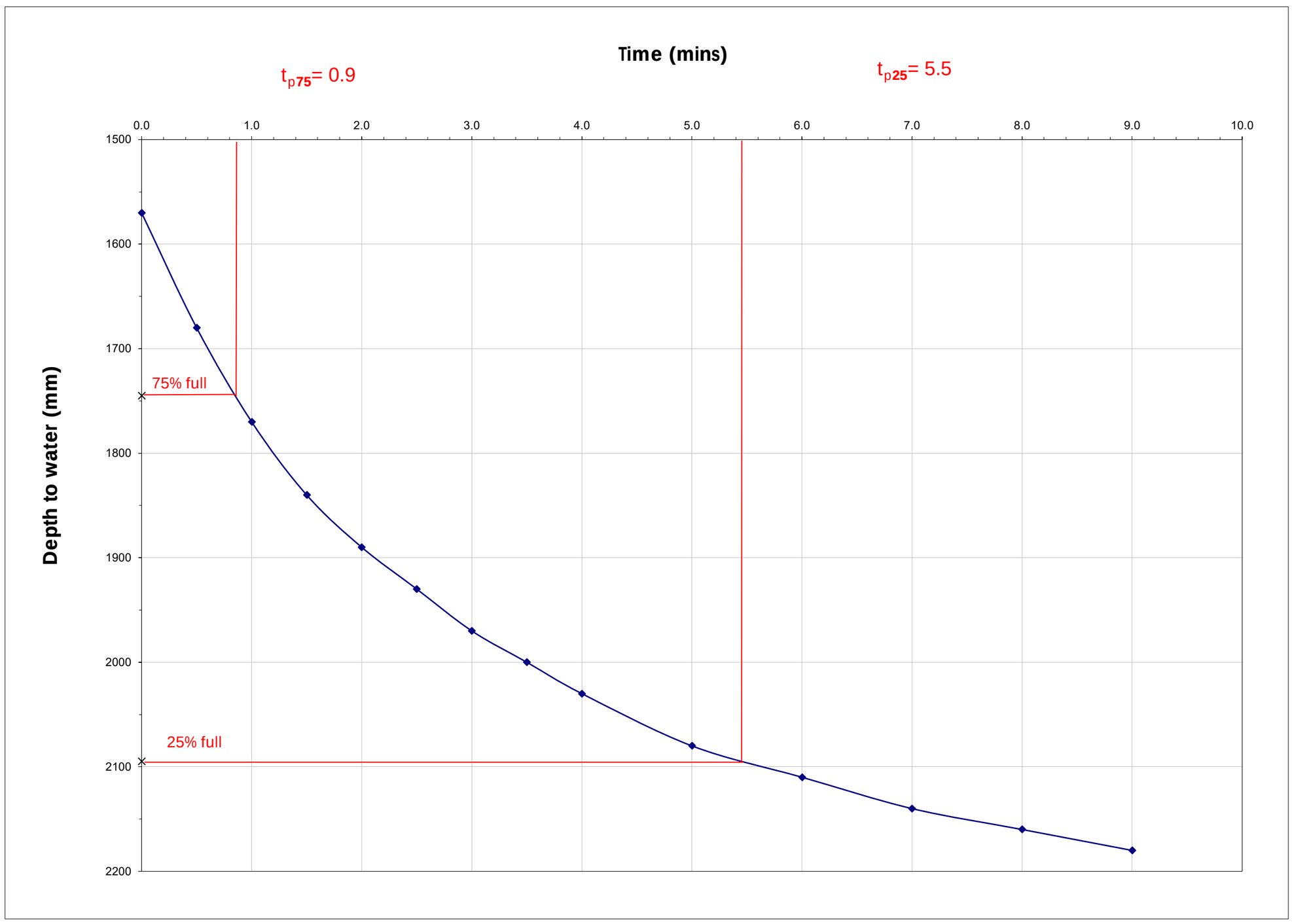
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
11:16	0.0	1.57	1570
11:16	0.5	1.68	1680
11:17	1.0	1.77	1770
11:17	1.5	1.84	1840
11:18	2.0	1.89	1890
11:18	2.5	1.93	1930
11:19	3.0	1.97	1970
11:19	3.5	2.00	2000
11:20	4.0	2.03	2030
11:21	5.0	2.08	2080
11:22	6.0	2.11	2110
11:23	7.0	2.14	2140
11:24	8.0	2.16	2160
11:25	9.0	2.18	2180

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	2.80	2800
Width	=	0.65	650
Depth	=	2.27	2270

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	2095	2.10
0.50	=	1920	1.92
0.75	=	1745	1.75

Depth at start of test (mm)	=	1570
Depth at end of test (mm)	=	2180
Base area of pit	=	1.82
a_{p50} - 50% internal surface area inc. base	=	4.235
V_{p75-25} - Volume 75 - 25%	=	0.637

Read from the graph:		
$t_{p\ 75}$ (min)	=	0.9
$t_{p\ 25}$ (min)	=	5.5



Soil infiltration rate, f, (m/s) = 5.45E-04

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	Precious Holdings (Wakefield) LTD
Engineer	Dan Williams
Job Name:	Providence Street, Earlsheaton
Job No.:	4985

Date:	**19/06/2024**
Trial Pit No.	**SA03**
Test No.	**2**

Water level not rising after 2 mins of filling, filling halted and test begun

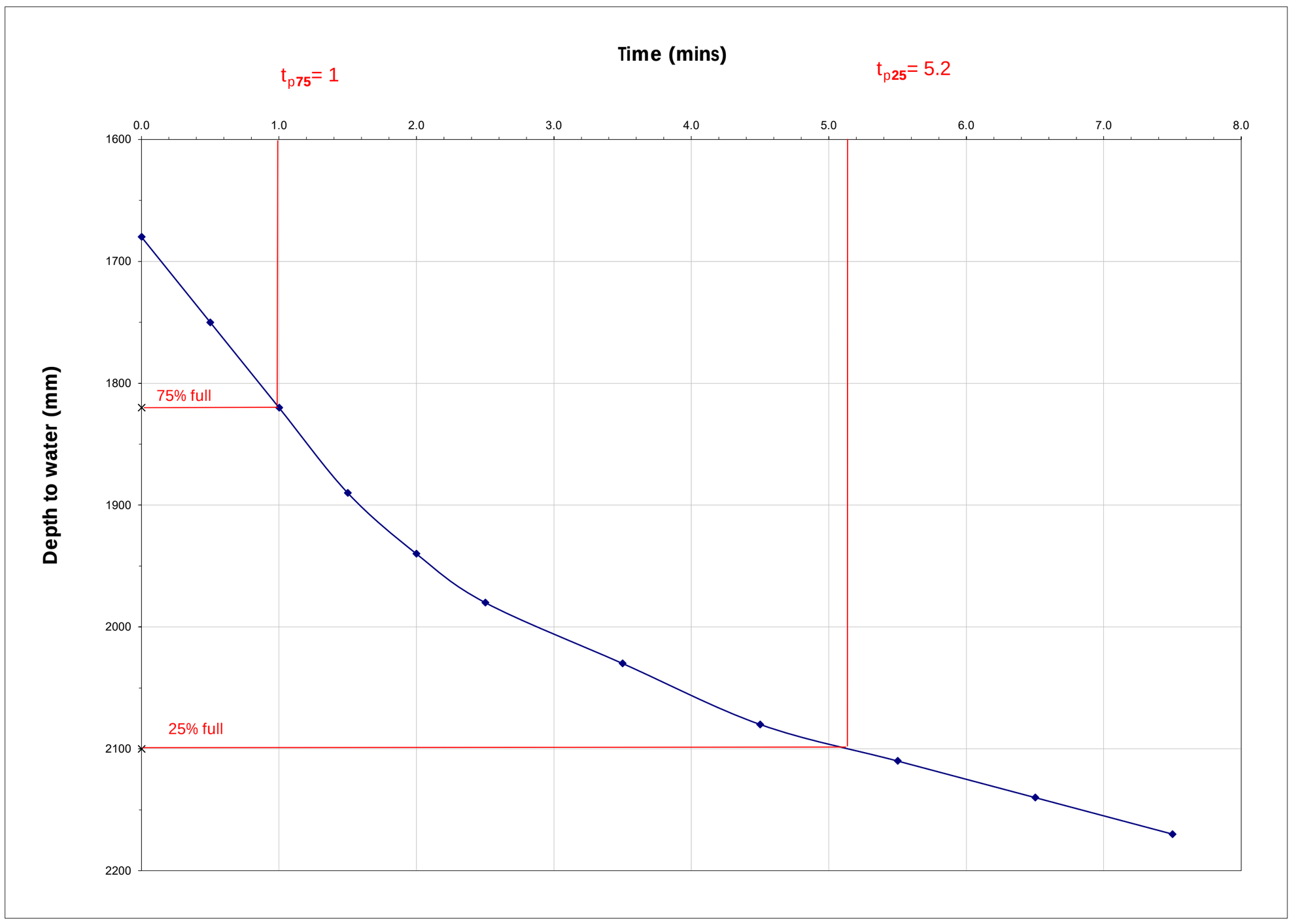
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
14:18	0.0	1.68	1680
14:19	0.5	1.75	1750
14:19	1.0	1.82	1820
14:20	1.5	1.89	1890
14:20	2.0	1.94	1940
14:21	2.5	1.98	1980
14:22	3.5	2.03	2030
14:23	4.5	2.08	2080
14:24	5.5	2.11	2110
14:25	6.5	2.14	2140
14:26	7.5	2.17	2170

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	2.80	2800
Width	=	0.65	650
Depth	=	2.24	2240

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	2100	2.10
0.50	=	1960	1.96
0.75	=	1820	1.82

Depth at start of test (mm)	=	1680
Depth at end of test (mm)	=	2170
Base area of pit	=	1.82
a_{p50} - 50% internal surface area inc. base	=	3.752
V_{p75-25} - Volume 75 - 25%	=	0.5096

Read from the graph:		
$t_{p\ 75}$ (min)	=	1
$t_{p\ 25}$ (min)	=	5.2



Soil infiltration rate, f, (m/s) = 5.39E-04

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	Precious Holdings (Wakefield) LTD
Engineer	Dan Williams
Job Name:	Providence Street, Earlsheaton
Job No.:	4985

Date:	**19/06/2024**
Trial Pit No.	**SA04**
Test No.	**1**

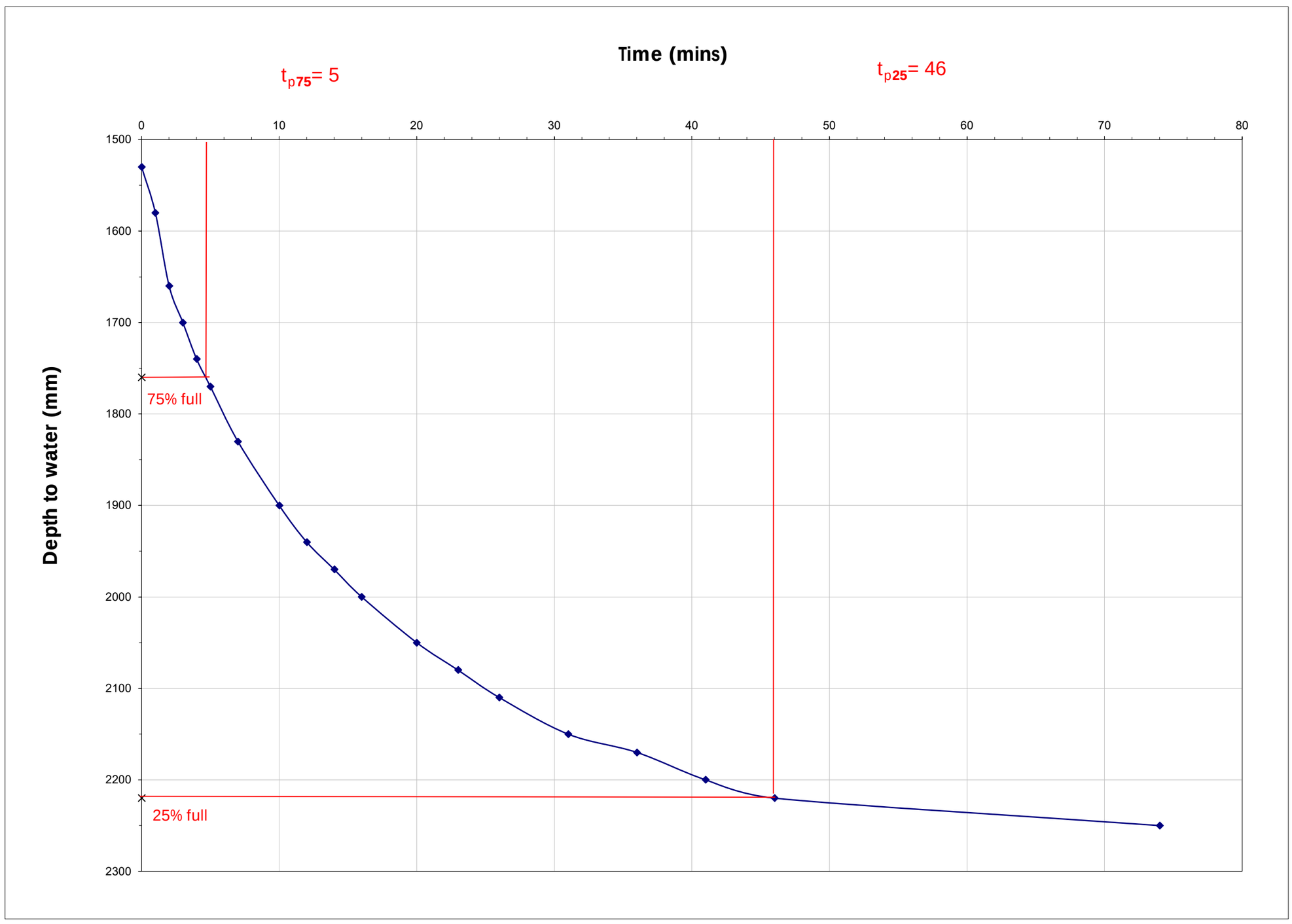
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
10:23	0	1.53	1530
10:24	1	1.58	1580
10:25	2	1.66	1660
10:26	3	1.70	1700
10:27	4	1.74	1740
10:28	5	1.77	1770
10:30	7	1.83	1830
10:33	10	1.90	1900
10:35	12	1.94	1940
10:37	14	1.97	1970
10:39	16	2.00	2000
10:43	20	2.05	2050
10:46	23	2.08	2080
10:49	26	2.11	2110
10:54	31	2.15	2150
10:59	36	2.17	2170
11:04	41	2.20	2200
11:09	46	2.22	2220
11:37	74	2.25	2250

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	3.00	3000
Width	=	0.65	650
Depth	=	2.45	2450

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	2220	2.22
0.50	=	1990	1.99
0.75	=	1760	1.76

Depth at start of test (mm)	=	1530
Depth at end of test (mm)	=	2250
Base area of pit	=	1.95
a_{p50} - 50% internal surface area inc. base	=	5.308
V_{p75-25} - Volume 75 - 25%	=	0.897

Read from the graph:		
$t_{p\ 75}$ (min)	=	5
$t_{p\ 25}$ (min)	=	46



Soil infiltration rate, f, (m/s) = 6.87E-05

Appendix L
Gas Monitoring Results

Visit 1

Job Title:	Job No:
Providence Street, Earlsheaton	4985
Client:	Sheet :
Precious Holdings	1 of 1

Date:	Arrival Time:	Depart Time:	Operator:
03/07/2024	11:00	12:15	Erin Waddilove

Gas Monitoring Results:

Ambient Concentration (% Volume):	CH_4:	ND	CO_2:	ND	O_2:	20.7

Monitoring Point	Groundwater level	Concentrations: Initial / Highest CH_4	Concentrations: Initial / Highest CO_2	Concentrations: Steady concentrations CH_4	Concentrations: Steady concentrations CO_2	Concentrations: Lowest concn O_2	Gas Flow Rates: Initial / Maximum	Gas Flow Rates: Steady	Gas Flow Rates: Time to fall from highest to steady	Bottom of well	Remarks
	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	m	
WS01	ND	ND	3.1	ND	3.1	18.1	ND	ND	30.0	1.96	
WS02	ND	ND	1.5	ND	1.5	18.3	ND	ND	30.0	1.78	
WS03	ND	ND	6.4	ND	6.4	12.2	ND	ND	30.0	1.95	
WS04	ND	ND	0.9	ND	0.9	19.6	ND	ND	30.0	1.85	
WS05	ND	ND	0.8	ND	0.8	19.8	ND	ND	30.0	1.92	
WS06	ND	ND	1.2	ND	1.2	19.5	ND	ND	30.0	2.55	

Equipment Used:	Next Calibration Date
Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	27/03/2025

Key

ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

	Site Data:			Weather Station Data (Batley Weather Station)					
	Temp (°C):	14		Barometric Pressure Trend:			Falling		
Time:	11:00	11:40	12:15	01:00	09:05	11:00	11:45	12:15	14:15
Pressure (mb):	994	993	992	1013	1006	1005	1005	1004	1003
	Weather Conditions:		Overcast, mild, cloudy, dry						
	Surface Ground Conditions:		Dry						

	CH_4	CO_2	O_2
Trigger level 1	1.0	5.0	16.0
Trigger level 2	5.0	10.0	10.0

Remarks:	Batley weather station located approximately 2 miles north from the site (Providence Street, Earlsheaton).

Visit 2

Job Title:	Job No:
Providence Street, Earlsheaton	4985
Client:	Sheet :
Precious Holdings	2 of 2

Date:	Arrival Time:	Depart Time:	Operator:
18/07/2024	11:00	12:00	Erin Waddilove

Gas Monitoring Results:

Ambient Concentration (% Volume):	CH_4:	ND	CO_2:	ND	O_2:	20.4

Monitoring Point	Groundwater level	Concentrations					Gas Flow Rates			Bottom of well	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH_4	CO_2	CH_4	CO_2	O_2					
	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	m	
WS01	ND	ND	4.8	ND	4.8	13.7	ND	ND	30.0	1.97	
WS02	ND	ND	2.6	ND	2.6	17.2	ND	ND	30.0	1.80	
WS03	ND	ND	6.3	ND	6.3	9.3	ND	ND	30.0	1.95	
WS04	ND	ND	1.2	ND	1.2	19.1	ND	ND	30.0	1.87	
WS05	ND	ND	1.4	ND	1.4	18.7	ND	ND	30.0	1.93	
WS06	ND	ND	4.8	ND	4.8	15.6	ND	ND	30.0	2.35	

Equipment Used:	Next Calibration Date
Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	27/03/2025

Key	
ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

	Site Data:			Weather Station Data (Batley Station)					
	Temp (°C):	22 to 23		Barometric Pressure Trend:			Steady / slight fall		
Time:	11:00	11:30	12:00	01:00	09:00	11:00	11:30	12:00	14:05
Pressure (mb):	1006	1007	1007	1019	1018	1018	1018	1018	1018
	Weather Conditions:		Humid, light cloud, still, warm						
	Surface Ground Conditions:		Dry						

	CH_4	CO_2	O_2
Trigger level 1	1.0	5.0	16.0
Trigger level 2	5.0	10.0	10.0

Remarks:

Batley weather station located approximately 2 miles north from the site (Providence Street, Earlsheaton).