



Phase I & II Geo-Environmental Assessment

Hebble Court

Dewsbury
WF12 0AY

Prepared for:

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HEBBLE COURT, DEWSBURY

NON-TECHNICAL CLIENT SUMMARY

This report presents the findings of a combined Phase I Desk Study and Phase II Intrusive Investigation undertaken to determine ground conditions, and establish if there are any environmental risks associated with the site and its development. Pertinent findings and conclusions may be summarised as follows:

- The site was industrialised from the 1850's, with 'Hebble Mill' pictured within the site boundary until the early 2000's. The surrounding site use was also industrial from the 1850's with a gas works, glass works and chemical works within 1km of the site. Calder and Hebble Navigation Canal is also situated within close proximity of the site. The site is currently disused, and surrounding land use is predominantly residential.
- The main risks identified from the Desk Study were posed to future site users and those involved with the development works, through interaction with potentially contaminated soils, and through ground gas generation from made ground fill and potential coal mine workings.
- Phase II Intrusive Investigation comprised the drilling of 5 shallow windowless sampler boreholes to a maximum depth of 5.25m, and installation of gas monitoring wells at each location. The encountered ground conditions are highlighted in the table below;


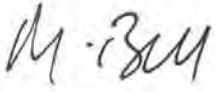
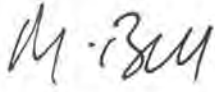
Soil Type	Depth to Base	Thickness
Made Ground	3.60m	2.00 – 3.60m
Stiff Friable Sandy Clay	>5.25m (not proven)	1.65 - >3.00m (not proven)

- Selected samples of made ground were tested for contamination at varying depths which revealed that the shallow soils could pose a hazard to people. Risks from ground gases including radon also appear low but there is enough uncertainty over several possible sources of gas to warrant protection measures within the buildings. Barrier drinking water pipes have also been recommended. The testing results dictate that a clean soil capping of at least 350mm, or effective barrier layer (such as a sufficient thickness of concrete) be used where areas of soft landscaping are due to be implemented in the proposed development.
- Detailed recommendations have been made for all of these remedial measures and what will be required to verify them in accordance with the planning process.

The above points represent a simplified summary of the findings of this assessment and must not form the basis for key decisions for the proposed development. A thorough review of the details is contained within the following report, or alternatively get in touch and we'll talk you through it.



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Where ground investigations have been conducted, these have been limited to the level of detail required for the site in order to achieve the objectives of the investigation.

The report has been written, reviewed and authorised by the persons listed above. It has also undergone EPS' quality management inspection. Should you require any further assistance regarding the information provided within the report, please do not hesitate to contact us.

The National Planning Policy Framework 2019 requires a competent person to prepare site investigation information, which is defined as a person with a recognised relevant qualification, sufficient experience in dealing with the type(s) of pollution or land instability, and membership of a relevant professional organisation. EPS considers that it fulfils these criteria and would welcome any request for staff CVs or case studies to demonstrate it.

As stated within DEFRA's Contaminated Land Statutory Guidance (2012), with any complex risk assessment it is possible that different suitably qualified people may reach slightly different conclusions when interpreting the same information. EPS recognises this and considers the conclusions presented within this report to be robust and appropriate but input from the Local Authority and their judgement in line with this guidance would still be welcomed.

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1 INTRODUCTION

In October 2021, Environmental Protection Strategies Ltd (EPS) was commissioned by Mr. Siraj Patel to complete a Phase I and II Geo-Environmental Assessment Report at Hebble Court, Dewsbury, WF12 0AY ('the site'); see Figure 1.

The work was commissioned in order to fulfil planning requirements relating to contamination for the construction of three residential dwellings at the site and the planning application reference for the proposed development is 2020/93742 (Kirklees Council).

This report presents the findings, conclusions, and recommendations of the Phase I Desk Study and subsequent Phase II Intrusive Investigation undertaken as instructed.

1.1 Objectives

The objectives of this investigation were as follows:

- a) Compile a Phase I Desk Study and Conceptual Site Model through a Preliminary Risk Assessment to evaluate the potential risks the site may pose to human and environmental receptors, both currently and in future.
- b) Investigate potential contaminant linkages identified in the CSM by means of investigating shallow soils and soil gases.
- c) Determine the potential risks posed by the site and make recommendations for further work that may be required, to ensure safe development in accordance the Environment Agency's *Land Contamination: Risk Management* guidance (LC:RM, 2020) and the *National Planning Policy Framework*.

1.2 Scope of Work

To perform an exploratory assessment of the site in accordance with the principles and requirements of DEFRA's '*Contaminated Land Statutory Guidance*' (2012), BS10175 – '*Investigation of Potentially Contaminated Sites*' and BS5930:2015 '*Code of practice for ground investigations*', the following tasks were undertaken:

Desk Study:

- Collection of site records.
- Study of existing geological, hydrogeological and historic maps of the area.
- Consultation of environmental databases, including records held by the local authority (where available).
- Review of proposed development plans.
- Development of a Conceptual Site Model (CSM) through a Preliminary Risk Assessment.

Intrusive Investigation:

- Site walkover, inspection of any visual evidence of contamination at the site, obtaining photographic records.
- Health and safety briefing / site supervision.
- Drilling of five window sample boreholes to a maximum depth of 5.0m below ground level (bgl) using a track-mounted percussive rig.
- Continual logging of ground conditions including inspection of samples for visual and olfactory contamination, and laboratory analysis of selected representative samples.
- Installation of gas and groundwater monitoring standpipes at selected locations, with a return monitoring programme conducted.

Reporting:

- Data collection
- Interpretation of data including completion of Generic Quantitative Risk Assessment

The findings and conclusions of these investigations are presented in the following sections.

1.3 Limitations and Constraints

The purpose of this report is to present the findings of a soil sampling investigation conducted at the location(s) specified. When examining the data collected from the investigations made during the assessment, Environmental Protection Strategies Ltd (EPS) makes the following statements:

No investigation method is capable of completely identifying all ground conditions that might be present in the soil or groundwater under a site. Where outlined in our report, we have examined the ground beneath a site by constructing a number of boreholes and / or trial pits to recover soil and / or groundwater samples. The locations of these excavations and sampling points are considered to be representative of the condition of the whole site subsurface however, ground conditions are naturally variable and it may be possible that the conditions encountered may differ to those found during the investigation.

No visible evidence of Japanese Knotweed was identified during the site walkover. However, this plant can be difficult to identify in the early stages of growth and therefore it is not always possible to identify its' presence at certain times of the year. For this reason, EPS cannot confirm that Japanese Knotweed rhizomes do not exist and it is recommended that if it is suspected that this species, or other similarly invasive plants are present at the site, a specialist contractor should be commissioned to make a detailed assessment.

The investigation was carried out to assess the significance of contamination resulting from the use of the site as identified in this report. Unless EPS has otherwise indicated, no assessment of potential impact of any other previous uses has been made.

Whilst it is recognised that information contained within this report may assist relevant and suitably qualified professionals, this report does not provide a geotechnical appraisal of ground conditions with respect to suitability of foundations or future structures, nor does it intend to identify a need for any associated geotechnical ground improvement works.

2 GEO-ENVIRONMENTAL SETTING

The following section provides a summary of the information collected in relation to the site location and history.

2.1 Site & Location Description

Detail	Description
Location	The site lies adjacent to Calder and Hebble Navigation Canal, approximately 1km east of Ravensthorpe Train Station, and approximately 2.20km south of Dewsbury Train Station.
National Grid Reference	424680, 419690
Topographic Elevation	Approximately 47m Above Ordnance Datum (AOD)
Description of Site	<p>The site is a rectangular shaped parcel of land, approximately 35m west to east, and approximately 15m north to south. The site is predominantly covered with hardstanding consisting of weathered concrete, with grassed cover and plants up to 3m in height located along the perimeter. The site is surrounded by a wooden fence from the entrance on Hebble Court, and by an iron fence to the rear which is bounded to the south by a supermarket.</p> <p>At the time of the investigation (October 2021) the site appeared to be used to dump for waste materials including demolition rubble and scrap metal, and to store shipping containers and disused machinery. Bricks and pre-cast concrete structures were also present including a possible soakaway ring along with an Intermediate Bulk Container (IBC) and piles of plastic ducting/guttering. Burning of unknown materials was also noted.</p>
Surrounding Land Use	The site lies within an area of predominantly residential housing. However, a supermarket lies to the immediate south of the site, and Calder and Hebble Navigation Canal lies to the immediate north of the site at a lower elevation (around 1-2m lower). An industrial estate lies around 250m north east of the site boundary.

A plan showing the site location is provided as Figure 1, the current site layout is detailed on Figure 2 and an aerial photograph is included as Figure 3. Selected site photographs are included as Appendix A, a proposed development plan is included as Appendix B and relevant extracts of a Landmark Envirocheck report are included as Appendix C.

2.2 Environmental Setting

Detail	Description	
Geology	Geological mapping shows the site is directly underlain by bedrock of the Pennine Lower Coal Measures, consisting of sandstone. No superficial deposits are recorded at the site. Information on the site's geological context is included as Appendix D.	
British Geological Survey (BGS)	An historic borehole log was acquired from the British Geological Survey (ID: SE21NW271) for a location around 260m south east at an elevation around 10m higher than the study area, and reports soft to firm sandy Clay to 1.75m, with sandstone below to 2.25m. Interbedded sandstone, siltstone and mudstone are then shown below to 6.50m where solid coal is shown to 7.25m. Mudstone is then recorded to the base of the hole at 8.25m. A copy of the historic borehole log is included within Appendix D.	
Geological Hazards	Hazard	On Site Risk
	Mining Activities	High to Moderate *
	Collapsible Ground	Very Low
	Compressible Ground	No Hazard
	Ground Dissolution	No Hazard
	Running Sand	No Hazard
	Landslide	Very low (Low within 5m)
	Shrinking / Swelling Clay	No Hazard (Very Low within 5m)
	*Review of the site records and of a Coal Mining Risk Assessment (CMRA) for the site undertaken by Geoinvestigate Ltd on 27 th November 2020 (Ref No. G20411) shows that shallow coal workings could be possible within the site boundary. Furthermore, the CMRA recommends the drilling of several boreholes to a target depth of 30m to assess the workings.	
Radon	The Envirocheck indicates the site to lie in a location where the percentage of homes above the radon action level is between 1 to 3%. It further reports that the site will not require radon protection measures in the construction of new buildings, although the BRE guidance does stipulate that radon protection should be considered at this level in new buildings.	
Hydrogeology	Groundwater vulnerability maps for the area show that the underlying bedrock geology is classified as a Secondary (A) Aquifer, and the site does not lie within a Source Protection Zone (SPZ) for local groundwater abstraction. Groundwater vulnerability maps are included as Appendix E. The Envirocheck report doesn't list any groundwater abstractions within 500m.	

Detail	Description
<p>Hydrology</p>	<p>The nearest surface water feature is Calder and Hebble Navigation Canal located approximately 15m north of the site. The canal flows approximately north west, eventually feeding into the River Calder in the east and west.</p> <p>The Envirocheck report does not list any surface water abstractions within a 500m radius. There are two discharge consents operated by British Waterways Board and Yorkshire Water Services Limited, at 365m north east and 395m east respectively. The former discharging final treated effluent into the Calder and Hebble Navigation Canal, and the latter discharging stormwater overflow into the River Calder.</p> <p>Review of the EA Flood Zone Map for the area indicates that the site lies within Flood Zone 1, which is defined as the area with a low potential risk of flooding from fluvial or tidal sources. It should be noted that the EA maps do not take into account flooding from poor drainage or groundwater. Additionally, a Flood Zone 2 & 3 area is very close to the site along Calder & Hebble Navigation Canal. A copy of the flood map for the site and surrounding area is also included within Appendix E.</p>
<p>Known Site Drainage & Utilities</p>	<p>An enquiry made to Line Search Before U Dig, dated 06/10/2021 showed the following assets on site or in close proximity to the site boundary;</p> <ul style="list-style-type: none"> • A GTC Pipelines Limited owned 63mm polyethylene pipe orientated east to west just outside of the northern site boundary. • Yorkshire Water Limited owned foul sewer, surface water sewer and water main which terminate outside the western site boundary in the carriageway of Hebble Court. • Northern PowerGrid owned LV cables which run along the western and northern site boundary, one of which enters the site from the western boundary.
<p>Landfill & Waste</p>	<p>The BGS, Local Authority, and historical records detail the presence of eight historic landfills within 1km of the site. The closest proximity of these is within 320m and listed as a railway cutting which accepted inert, industrial, and liquid sludge waste from January 1996 to December 1999. The nearest licenced waste management facility is recorded 496m east as a metal recycling site (Vehicle dismantlers).</p> <p>Twelve areas of potentially infilled land are listed within 1km of the site. The nearest is located 416m west of the site and was mapped in 1993.</p>

2.3 Industrial Land Use & Pollution

There are 40 sites licensed for industrial and commercial activity within the surrounding 500m, the details of the most pertinent are detailed below.

Land Use	Approximate Distance (Direction)	Status
Hinchliffe's (garage services)	59m (S)	Inactive
Trailer Repair Services (commercial vehicle servicing, repairs)	207 (NE)	Inactive
Shaws Services (cleaning services)	237 (SE)	Inactive
Auto Well Motor Factors Limited (car breakers)	259 (NE)	Inactive
R P Autos (garage services)	269 (NE)	Inactive
A1 Auto Dismantlers (car breakers)	275m (NE)	Inactive
Go 4 Spares (laundry & dry-cleaning supplies)	311 (SW)	Inactive
Northern Creative Metal Arts (wrought ironworks)	326 (NE)	Inactive
J Thwaites (plastics – coating services)	483 (NE)	Inactive

Three pollution incidents to controlled waters are reported within 500m of the site. The closest was within 160m to the west whereby unknown sewage was discharged into a freshwater stream/river in April 1993, and was recorded as a 'Category 3' incident. A separate incident in September 1991 whereby oils were discharged into a freshwater stream/river is also listed within 425m north east of the site, and was listed as a 'Category 2' incident.

2.4 Sensitive Land Use

There are three sensitive land uses listed within 500m of the site. The closest of which is an area of adopted green belt within 200m east of the site. The plan name is listed as Kirklees Unitary Development Plan.

2.5 Site History

A summary of historical map data from 1855 to 2021 is provided below and copies of relevant historic maps and any others examined during the investigation are included in this report as Appendix F. A map detailing historic features in the area surrounding the site is displayed below.



The history of the site and surrounding area is summarised below;

- From 1855 to 2000, Hebble Mill is shown on site, and a malthouse is shown until 1922. Calder and Hebble Navigation is shown adjacent to the site from 1855. A glass works is shown within 500m west of the site, a chemical works within 1km east, and a gas works within 500m north east of the site.
- An electrical substation is shown within 50m to the west of the site from 1954.
- Tanks are shown within 50m to the south of the site from 1955.
- A slag heap is pictured within 50m east of the site from 1960.
- The surrounding area is developed into residential dwellings from around 2016.

3 PRELIMINARY RISK ASSESSMENT & CONCEPTUAL SITE MODEL

In accordance with the Environment Agency’s Land Contamination: Risk Management, there are three stages to managing contaminated land (Risk Assessment/Remedial Options Appraisal/ Remediation and Verification). This section outlines the first tier of Stage 1, the Preliminary Risk Assessment.

The following section provides a review of the contaminant linkages that may be active at the site, whereby EPS have examined the potential sources that may be present as a result of historic and / or current site activities and where potential interaction between these sources and the identified human / environmental receptors may occur.

3.1 Background

A Desk Study comprises the first stage of any geo-environmental assessment, the purpose of which is to determine what potentially contaminative activities may have occurred at the property or the surrounding area which may pose an environmental or geological risk to site users, the surrounding environment or proposed development, either at present or in the future.

The method used in this investigation to assess the environmental risk posed is based on the concept of ‘contaminant linkage’, which considers the following three factors:

Source	The location from which an environmentally hazardous / contaminative substance is, (or was,) derived.
Pathway	A route or mechanism via which a source could come into contact with a receptor to cause significant harm.
Receptor	An environmentally sensitive object or condition e.g., person, property, controlled water, or ecological system, which may be present now or in future.

If all three factors are identified, there is the potential for a ‘contaminant linkage’ to be active, which could result in significant harm being caused to the environment or human health.

3.2 Source Characterisation

The following potential contaminant sources have been identified at the site and in the surrounding area:

Potential Source	Source Description	Principal Contaminants of Concern
Current Site Use	Waste materials including metals, demolition rubble and burnt materials.	Metals, PAH, ACM
Historic Site Use	Historic Mill & Malthouse	Metals, PAH, TPH

Historic Surrounding Land Use	Slag Heap shown within 50m of the site boundary	Metals, PAH, CH ₄ , CO ₂ , H ₂ S, CO
	Tanks shown within 50m of the site boundary	TPH (Inc BTEX), MTBE
	Electrical Substation shown within 50m of the site boundary	PCB
	Mine gas from historic workings	CH ₄ , CO ₂ /O ₂ deficient air, H ₂ S, CO

Notes:

PAH	Polycyclic Aromatic Hydrocarbons	ACM	Asbestos Containing Material
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes	MTBE	Methyl Tert Butyl Ether
VOC	Volatile Organic Compounds	PCB	Polychlorinated biphenyls
CO ₂	Carbon Dioxide	CH ₄	Methane

3.3 Potential Receptors

A framework for the assessment of risks arising from the presence of contamination in soils has been produced by the Environment Agency and the Department for the Environment, Food and Rural Affairs (DEFRA) and is presented with the report: ‘*Using Science to Create a Better Place: Updated Technical Background to the CLEA Model – Science Report SC050021/SR3*’. This guidance document defines a series of standard land-uses which have been further developed into six generic land uses in the Category 4 Screening Levels project for Land Affected by Contamination (DEFRA/Contaminated Land: Applications in Real Environments (CL:AIRE) Project Report SP1010, 2014) which form a basis for the development of the Conceptual Site Model.

Risks posed to controlled waters have been considered in line with the Environment Agency’s *approach to groundwater protection* (v1.2, 2018) and associated position statements.

The proposed development plan consists of residential dwellings with soft landscaping. Therefore, the land use has been considered as:

- Residential (with uptake), or ‘RESI_{UPTAKE}’

The above land use has been adopted as it is considered the most representative at this stage, in terms of exposure pathways and activity patterns.

In view of the environmental setting, current and potential future land use of the site and surrounding sites, the potential receptors for any contaminant impact are discussed in the table below:

Receptor	Site Specific Description
Human	Future site users, site workers involved in the site redevelopment, and those working and living in the surrounding area have the potential to be at risk from exposure to potential contaminants of concern (CoCs).
Groundwater	The underlying geology comprises Pennine Lower Coal Measures, which is classified by the EA as a Secondary (A) Aquifer. Whilst the site does not lie within a SPZ for nearby groundwater abstraction, the underlying geology is an important groundwater resource and therefore, groundwater should be considered as a potential receptor to site derived contaminants.
Surface Water	The nearest surface watercourse is Calder & Hebble Navigation Canal which comes within 15m of the boundary. Consideration should be given to the associated risk posed to nearby surface waters via lateral migration of contaminants in the subsurface. Therefore, surface waters must also be considered as a sensitive receptor within the conceptual site model.
Flora and Fauna	The proposed development includes the provision of soft landscaping. Some of the identified contaminants of concern are known to be phytotoxic and as such, the potential for this impact should be considered.
Buildings & Infrastructure	Subsurface structures are likely to be present at the site which may be adversely affected by the potential presence of the identified contaminants of concern. These include concrete used in building foundations, buried potable water supply pipes and other service lines and pipes.
Adjacent Land	Adjacent properties including private residential dwellings could also be at risk from potential contaminants found at the site.

3.4 Potential Pathways

Where contaminants may be present in soil, there are a number of potential pathways that enable human receptors to come into contact with or be exposed to them. The most direct pathways, considered under current UK legislation, can be summarised as follows:

- Direct ingestion of contaminated soil
- Ingestion of household dust
- Ingestion of contaminated vegetables
- Ingestion of soil attached to vegetables
- Dermal contact with contaminated soil
- Dermal contact with household dust
- Inhalation of fugitive soil dust
- Inhalation of fugitive household dust
- Inhalation of vapours outside
- Inhalation of vapours inside

Clearly, not all of these potential pathways apply for every standard land-use. For example, ingestion of contaminated vegetables will not apply to land uses other than residential with plant uptake and allotments.

However, in addition to direct exposure pathways, a number of physical transport mechanisms / pathways may also exist at a site that allow remote or less accessible contaminants in soil or groundwater to reach human or environmental receptors both at a site and beyond the site boundary. These include the transport mechanisms listed below.

- Downward and lateral movement of contaminants in soil either by gravity or through being ‘leached’ by percolating rainwater
- Lateral migration of contaminants dissolved in groundwater.
- Direct seepage or leaching of contaminants from soil into subsurface drains or supply pipework.
- Volatilisation of contaminants from groundwater or unsaturated soils into buildings or outdoor air.

Through examination of the standard land use and environmental setting at each site, the presence of pathways and transport mechanisms described above must be considered when assessing whether a contaminant linkage may plausibly be active, and therefore be included in the conceptual site model.

3.5 Summary of Contaminant Linkages

Considering the site use and environmental setting, and proposed land use, the following plausible contaminant linkages have been identified through this phase I assessment and require further investigation.

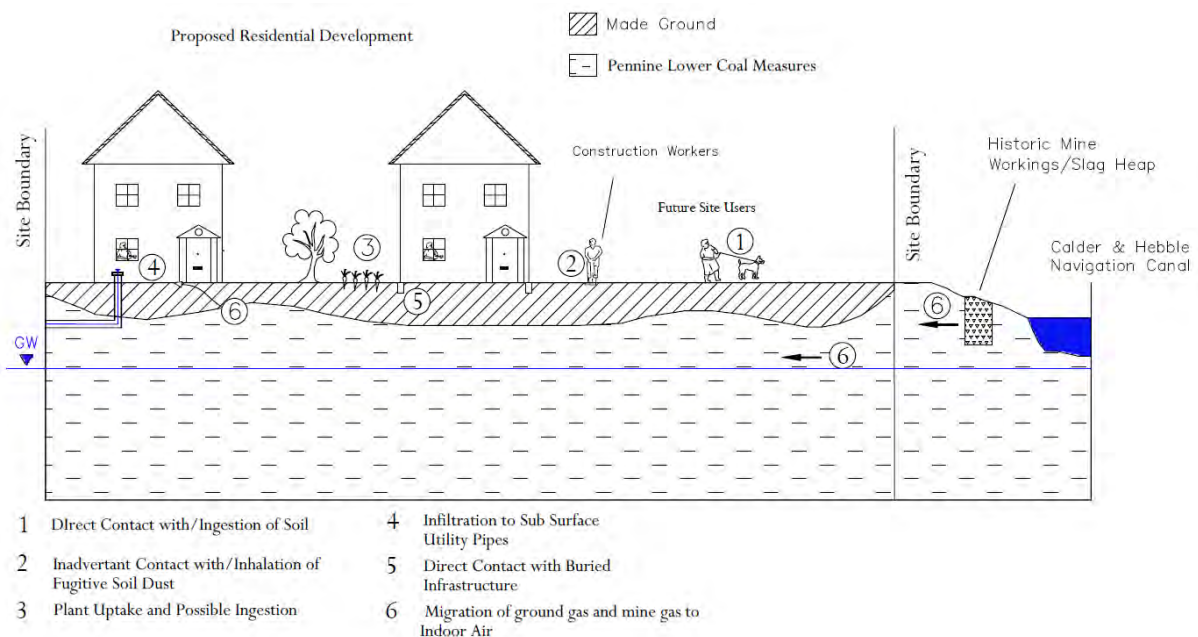
Source	Pathway	Receptor
Contaminated soil/Nearby Slag heap	Direct contact and inadvertent ingestion by eating or smoking with dirty hands	Construction workers during redevelopment & site users
	Inhalation of fugitive dusts	
	Plant uptake	Site users
	Migration of ground gases to indoor air	
	Ingress / diffusion through permeable potable water supply pipes	
Direct contact	Buried infrastructure	
Nearby Historic Mine Workings	Migration of mine gases to indoor air	Site users

The following comments are made with respect to contaminant linkages which have been considered through development of the conceptual model, but have not been concluded as ‘plausible’ – i.e., through which a significant possibility of significant harm could occur to an identified receptor:

- PAHs, weathered TPH fractions, metals and PCB’s have been identified as contaminants of concern associated with the historic on-site Mill, and nearby slag heap and electrical substation. However, these contaminants are considered to be relatively immobile in the environment by virtue of their very low solubility and volatility. On this basis, plausible pathways by which these potential contaminants could pose a significant risk to the underlying groundwater (or nearby surface watercourses) are not considered to be active. PCB’s in particular are known to be virtually immobile. The distance between the site boundary and the substation of 50m is deemed to be significant enough that there is no plausible linkage for PCBs to soils within the site boundary.
- Although several landfills have been highlighted within 1km of the site, given the distance (the nearest being 320m north) and age (and therefore likely nature of fill material) of these features, a plausible contaminant linkage is not recognised from the on-site migration of ground gas.

The following diagram provides an illustration of the plausible contaminant linkages that may be active at the site and which may need further investigation or control to ensure safe development:

Illustrative Conceptual Site Model – Hebble Court, Dewsbury



3.6 Key Potential Areas of Concern and Uncertainties

The main area of focus within the property boundary is the potential for industrial wastes including PAH and metals to be present in made ground within the property boundary. The potential for ground gases relating to made ground and possible mine workings are also of concern.

4 SUMMARY OF INTRUSIVE INVESTIGATIONS

Intrusive ground investigations were undertaken on 21st October 2021 in accordance with EPS standard operating procedures, copies of which will be made available on request. A summary of all site activities is presented in the following sections:

4.1 Exploratory Hole Locations

Exploratory hole locations were selected through consideration of the potential contaminant linkages identified through the Phase I Desk Study, the proposed development layout, the location of below ground utilities as well as operational and health & safety considerations.

Five window sample boreholes (WS01 – WS05) were formed at the site to a maximum depth of 5.25m using a track-mounted percussive drilling rig. The overall objective in terms of exploratory hole locations was to provide an appropriate lateral and vertical coverage of the soils underlying the site in order to offer information relating to their quality and nature.

Standpipes were installed within all of the positions. Groundwater sampling pipes were installed using 50mm diameter uPVC well casing and fitted with a gas tap. Slotted casing (1mm slot) was installed in WS05 and WS01 from the depth indicated on the borehole records to approximately 1.0m below the surface. In all other boreholes the slotted casing was installed to 0.50m below ground level. The installations were completed to ground surface using plain casing. A filter pack of 2-3mm of washed gravel extended from the base of the boreholes to approximately 0.1m above the slotted section with a bentonite seal to surface. All installations were finished with flush-mounted, bolt-down headworks. A borehole location plan is presented as Figure 4.

4.2 In-Situ Testing & Soil Sampling

Each borehole was logged for ground conditions encountered and inspected for any physical evidence of contamination, such as soil staining, odour and the presence of separate phase liquids on a precautionary basis. Borehole logs are presented in Appendix G.

Standard penetration tests (SPT) were carried out in boreholes WS01, WS02 and WS04 using an automatic trip hammer. The number of blows required to advance a standard split spoon over the final 300mm of a 450mm total drive was recorded, and is shown on the borehole records at the penetration resistance (“N” value).

Where potentially volatile organic compounds are suspected, EPS carries a Photoionisation Detector (PID), which can be used to measure the relative concentrations of vapour associated with soil samples collected from different depths and locations at the site. In these circumstances, soil samples will be placed into plastic bags, sealed, shaken and then allowed to rest for a few minutes to allow time for volatile vapour to accumulate in the air trapped within the bag.

The PID probe will then be used to pierce the bag and sample the air above the soil to measure the concentration of volatile compounds that have accumulated. PID readings are only used to provide EPS with a basic means to quantify areas of volatile organic compound in the field to help guide the investigation.



These readings are included within borehole logs presented as Appendix G and the results are discussed further in later sections.

4.3 Laboratory Testing

Samples obtained for analysis of identified contaminants of concern were submitted to Element Material Technologies, who hold appropriate UKAS/MCERT accreditation for the required testing. Samples were transported in laboratory supplied containers and delivered to the laboratory by approved courier. A laboratory testing schedule is included as Table 1.

5 FINDINGS OF THE INVESTIGATION

This section of the report provides a summary of the findings of the various aspects of the ground investigation.

5.1 Ground Conditions

A total of five window sample boreholes were formed at the site and the ground conditions encountered, from surface level, were found to comprise:

- Made Ground
- Stiff Friable Sandy Clay

Site specific borehole logs are included as Appendix G and give descriptions and depths of strata encountered. A summary of the general strata encountered across the site is provided in the table below, with more detailed description given in the following sub sections.

Geological Strata	Maximum Depth to Base of Strata (m bgl)	Strata Thickness (m)
Made Ground	3.60	2.00 – 3.60
Stiff Friable Sandy Clay	>5.25 (not proven)	1.65 - >3.00 (not proven)

5.1.1 Made Ground

Made ground was found in every borehole across the site and varied considerably. A firm dark brown mottled orangish brown and grey slightly sandy gravelly clay was encountered in WS01 and WS02 at ground level. Fragments of brick and coal were noted in the recovered samples.

In WS03, WS04 & WS05, very weak concrete was encountered at ground level, with a sandy gravel directly below which consisted of sandstone, quartz, limestone, brick and slag fragments. Below this layer in WS03, a firm dark brown mottled orangish brown and grey slightly sandy slightly gravelly clay was recovered with coal and brick fragments. In WS05, a dark grey mottled reddish brown silty sandy gravel of sandstone, quartz, slag and brick fragments was found below the concrete and gravel.

Below these strata, a firm to stiff orangish brown to greyish brown occasionally gravelly sandy clay was encountered with some rootlets. The gravel comprised siltstone and sandstone.

5.1.2 Stiff Friable Sandy Clay

Directly underlying the made ground material was a stiff friable silty sandy clay, which occasionally contained siltstone and sandstone gravel. This stratum is interpreted as a weathered horizon of the underlying bedrock geology (Pennine Lower Coal Measures). Given the significant thickness of the deposit, this could also be a further extension of the made ground as engineered fill. As there were no indications of made ground in the stratum, and the stratum is consistently stiff, the clay being a weathered bedrock seems more plausible.

5.2 Groundwater

Groundwater was not encountered during intrusive works. However, groundwater was encountered sporadically in boreholes at the locations and on the dates as shown below.

Monitoring Well	Depth to Groundwater		
	26/10/2021	02/11/2021	09/11/2021
WS01	-	1.63	1.74
WS02	-	-	-
WS03	-	0.39	0.48
WS04	-	0.67	0.82
WS05	-	-	-

Notes - denotes no groundwater recorded.

5.3 Physical Evidence of Contamination

The presence of slag was noted in made ground below the concrete between 0.10m and 0.70m in WS04, and in a gravelly made ground stratum between 0.50m and 0.80m in WS05. PID readings in made ground were all <0.1ppmV, and no visual or olfactory evidence of hydrocarbon staining was noted during the investigation.

5.4 Laboratory Analysis – Soil

A laboratory analysis testing schedule is presented as Table 1 and all environmental sample results obtained from the laboratory are included as Appendix H. The key results of laboratory testing on environmental soil samples are summarised below.

Contaminant	No. of Samples	No of Detections	Range of Detections (mg/kg)		Highest Location & Depth (m bgl)
			Min	Max	
Arsenic	4	4	5.7	61	WS04 (0.30-0.40)
Cadmium	4	1	0.1		WS04 (0.30-0.40)
Chromium	4	4	30.5	95.8	WS04 (0.30-0.40)
Copper	4	4	33	351	WS04 (0.30-0.40)
Lead	4	4	19	145	WS04 (0.30-0.40)
Mercury	4	0	-		-
Nickel	4	4	30	67.3	WS04 (0.30-0.40)
Selenium	4	4	1	2	WS04 (0.30-0.40)
Zinc	4	4	52	236	WS04 (0.30-0.40)
Naphthalene	4	3	0.2	2.57	WS04 (0.30-0.40)
Benzo(a)pyrene	4	3	0.45	5.25	WS04 (0.30-0.40)
Dibenzo(ah)anthracene	4	3	0.08	0.95	WS04 (0.30-0.40)
Benzo(ghi)perylene	4	3	0.33	3.14	WS04 (0.30-0.40)
PAH 16 Total	4	3	7.2	88.9	WS04 (0.30-0.40)
Benzo(b)fluoranthene	4	3	0.65	7.19	WS04 (0.30-0.40)
Benzo(k)fluoranthene	4	3	0.25	2.8	WS04 (0.30-0.40)

Contaminant	No. of Samples	No of Detections	Range of Detections (mg/kg)		Highest Location & Depth (m bgl)
			Min	Max	
<i>TPH CWG Aliphatics</i>					
>C10-C12	4	2	3.6	5.2	WS04 (0.30-0.40)
>C12-C16	4	2	8	12	WS04 (0.30-0.40)
>C16-C21	4	2	12	16	WS04 (0.30-0.40)
>C21-C35	4	2	19	19	WS04 (0.30-0.40)
Total Aliphatics C5-40	4	2	43	52	WS04 (0.30-0.40)
<i>TPH CWG Aromatics</i>					
>EC10-EC12	4	1	8.1	8.1	WS04 (0.30-0.40)
>EC12-EC16	4	2	10	42	WS04 (0.30-0.40)
>EC16-EC21	4	2	25	463	WS04 (0.30-0.40)
>EC21-EC35	4	2	58	637	WS04 (0.30-0.40)
Total aromatics C5-35	4	2	93	1195	WS04 (0.30-0.40)
Total Aliphatics and Aromatics (C5-40)	4	2	136	1247	WS04 (0.30-0.40)
Asbestos (%)	4	0	-	-	-
Soil Organic Matter	4	4	0.9	19.6	WS05 (0.60-0.70)

Notes: - Contaminant not found above laboratory detection limits PAH Polycyclic Aromatic Hydrocarbons
 TPH CWG Total Petroleum Hydrocarbons (Criteria Working Group)

- No detectable concentrations of asbestos, MTBE or BTEX were recorded in any of the tested samples.

5.5 Results of Ground Gas Monitoring

Ground gas monitoring was conducted on three occasions following the intrusive investigation. Methane was not detected on any occasion, and the highest concentrations of CO₂ were recorded in WS04 and WS05 at 0.8%v/v. Additionally, no positive flow readings were recorded during the monitoring programme.

Organic vapours were also recorded at low levels (<1.5ppmV) in every borehole during several monitoring visits. The table below summarises the recorded concentrations of methane, carbon dioxide, oxygen, and VOC. The full results of gas monitoring are presented in tables 2-4.

Borehole	CH ₄ Range of Detections (% v/v)	CO ₂ Range of Detections (% v/v)	O ₂ Range of Detections (% v/v)	VOC Range of Detections (ppmV)
WS01	<0.1	<0.1-0.2	20.0-20.5	0.2-0.3
WS02	<0.1	0.2	16.4-20.6	0.3-0.5
WS03	<0.1	0.2	20.1-20.4	0.2
WS04	<0.1	0.8	19.5-19.8	0.2
WS05	<0.1	0.5-0.8	19.6-19.9	0.2

6 ENVIRONMENTAL APPRAISAL

The following section outlines the approach applied to assessing the risks posed to human health, then identifies any sample results found by this investigation which warrant further consideration. In accordance with the Environment Agency's Land Contamination: Risk Management, this section represents the second tier of Stage 1, the Generic Quantitative Risk Assessment.

6.1 Human Health

6.1.1 Land Use Setting

It is understood that development proposals for the site include the construction of multiple residential dwellings with provision for soft landscaping.

In order to screen laboratory data for concentrations of contaminants in soil with potential to cause harm to human health in soft landscaped areas, relevant generic screening values most applicable to this land use have been utilised. A land use setting of Residential (with uptake), abbreviated to 'RESI_{UPTAKE}', has been adopted as it is considered the most representative.

The technical framework used to derive DEFRA's Category 4 Screening Levels (Policy Companion Document '*SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination*') outlines the relevant factors for determining land use selection in the application of the screening levels and the following key considerations have been taken into account.

The proposed land use is considered to be most relevant to a RESI_{UPTAKE} because Soft landscaped areas have the potential to be placed within the boundaries of each residential development.

6.1.2 Generic Screening – Soils

The technical framework used to derive the assessment criteria and the documents in which they are published are summarised as follows:

- *EA Science Reports* (SC050021/SR2, SC050021/SR3, and SC050021/SR7)
- *EA Soil Guideline Value Science Reports*
- *Suitable For Use Levels (S4ULs) for Human Health Risk Assessment* – LQM and CIEH (2015)
- *Soil Generic Assessment Criteria for Human Health Risk Assessment* - EIC/AGS/CL:AIRE (2010)

Category 4 Screening Levels (C4SLs) provide generic suitable for use screening values for common contaminants in a variety of land uses and are also utilised as appropriate generic screening criteria.

Where assessment of the risk to human health from asbestos in soil is concerned there is no nationally recognised suitable for use /generic screening value commonly referred to through the planning system. Due to this, it is necessary to take a more qualitative approach to the risks posed to future site users from asbestos on a site-specific basis.

A summary of the screening criteria and the methodology used to derive them is included in Appendix I.

6.1.3 Assessment of Results- Human Health

The results of the screening process for on-site human receptors showed that generic screening criteria representative of risks to future site users have been exceeded at two locations. As shown in the table below;

Contaminant	Screening Criteria (mg/kg)	No. of Exceedances	Highest Exceedance (mg/kg) & Sampling Location (m bgl)
Arsenic	37	2	61, WS04 (0.30-0.40)
Naphthalene	2.3	1	2.57, WS04 (0.30-0.40)
Benzo(a)pyrene	5	1	5.25, WS04 (0.30-0.40)
Dibenzo(ah)anthracene	0.24	1	0.95, WS04 (0.30-0.40)
Benzo(b)fluoranthene	2.6	1	7.19, WS04 (0.30-0.40)
TPH Aromatic C16-C21	260	1	463, WS04 (0.30-0.40)

For the distribution of PAHs, it is considered reasonable to utilise recorded concentrations of Benzo(a)pyrene (BaP) as a risk driver, or marker, representative of genotoxic PAHs (including Dibenzo(ah)anthracene but not naphthalene) to further assess the data set. One exceedance of BaP has been recorded at 0.25mg/kg above the screening criteria for RES_{UPTAKE}. Therefore, although there is a risk to human health from soils within the property boundary, it is considered to be relatively low. However, concentrations of arsenic as well as specific fractions of petroleum hydrocarbons are also shown to be above the screening criteria protective of human health. All of the exceedances of relevant screening criteria are recorded the same sample from WS04.

6.2 Ground Gas and Organic Vapour Monitoring

Significant concentrations of organic vapours were not recorded from monitoring wells although detectable concentrations were recorded in all of the wells on occasions. Additionally, none of the selected soils samples which were tested with the PID gave positive readings. Risks from organic vapour ingress into future dwellings have therefore not been identified.

In terms of ground gases (and mine gases), the monitoring visits have shown that no methane or positive flow readings were recorded in any well and low levels of CO₂ (<0.8%v/v) were present in each well. Furthermore, no H₂S or CO was recorded during any monitoring visit. However, as stated in Section 2.2, it is possible that mine workings and openings are present in close proximity, possibly within the site boundary. The site also lies within a radon affected area.

The gas screening values (GSV) that are calculated in tables 2 to 4 represent the value for each reading on each visit, calculated in accordance with the Modified Card & Wilson approach outlined in Ciria C665 *Assessing Risks Posed by Hazardous Ground Gases to Buildings*. The highest calculated GSV for the site is <0.0008L/h, which falls well below the GSV for a Characteristic Situation 1 (CS1), which is <0.07L/h. Sites which fall under a CS1 designation typically require no gas protection measures in accordance with *BS 8485:2015 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*.

In terms of risks from coal mine gas at the site, it is likely to be low risk due to the lack of any recorded concentrations of positive flow, CO, H₂S, or significant amounts of CO₂. This may be influenced by the cohesive nature of the shallow soils which act as a barrier layer to prevent migration of gas, as outlined in *CL:AIRE's Good Practice for Risk Assessment for Coal Mine Gas Emissions* (October 2021), or indeed because of the lack of any coal workings within the proximity of the site.

Although all potential sources of ground gases appear broadly low risk, there are several sources and a degree of uncertainty in the dataset to account for. In terms of mine gas, there is a possible mine opening within the site boundary (see Section 2.2). In terms of ground gases, there is a substantial thickness of made ground beneath the site which sporadically contains high organic matter, likely associated with the observed coal fragments. A slag heap is also recorded in the vicinity. Finally, the site is in a radon gas affected areas (1-3% of homes are at or above the action level). Whilst none of these individual sources mandate the need for gas protection, collectively EPS are of the view that there is a sufficient risk coupled with enough uncertainty to warrant the elective installation of gas protection measures to the equivalent of Characteristic Situation 2. A recommendation outlining these measures is included in Section 6.4.

6.3 Summary of Findings

Laboratory analysis of shallow soils sampled from the proposed soft landscaped areas across the site has identified that the adopted screening criteria protective of future site users (including residents) have been exceeded by contaminants of concern. Therefore, a remedial control measure is warranted to ensure future garden areas are safe and suitable for use (see Section 6.4). Risks to controlled waters have not been identified.

Gas monitoring of the site shows no consistently elevated levels of carbon dioxide, VOCs, methane or carbon monoxide. However, there is a possible risk of mine gas as well as radon and the made ground on site is deep with high organic content. Therefore, gas protection measures have been recommended to ensure the site is developed safely.

In the context of potentially unacceptable or acceptable risks as outlined within the Environment Agency's *Land Contamination: Risk Management* guidance (LC:RM, 2020), the risks identified by this work can be addressed through implementation of the following recommendations.

6.4 Recommendations & Remedial Strategy

The risks identified by this work can be addressed as follows, which represents the Remedial Strategy for the site.

- 1) **SOFT LANDSCAPING:** The most appropriate form of remedial action / control measure that will mitigate risks associated with the identified contamination in shallow soils to acceptable levels is considered to be the implementation of a clean topsoil cover system in all areas of proposed domestic gardens and soft landscaping within the redline planning boundary, as per the *BRE publication: Cover Systems for Land Regeneration: Thickness Design of Cover Systems for Contaminated Land* (BRE, Mar 2004). The minimum recommended thickness under this guidance has been calculated as **350mm** based on the worst-case laboratory data and designed

to ensure a practical thickness of soil can be implemented. Cover system calculations are included in Appendix J.

It should be noted that this recommendation is made only for areas of gardens and soft landscaping, and there is no such requirement for areas beneath any hard standing or building footprints. It is recognised that some shallow soils may need to be removed to achieve this cover thickness. Following the sufficient removal of shallow soils (to allow for the recommended cover system thickness), the excavations should then be made up with clean imported soils accompanied by appropriate laboratory analysis to demonstrate its chemical suitability for use. A Cover Soils Checklist which details these requirements further is presented as Appendix K.

These remedial works must be verified and EPS can assist in this process. All waste transfer documentation must be retained including for the removal of surface debris, with photographs of the excavations including any exposed clean natural soils and the information outlined in the Cover Soils Checklist.

- 2) GAS PROTECTION: EPS have identified the need for gas protection measures to be installed within the proposed dwellings on the site with a need to achieve 3.5 points under BS8485:2015 '*Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*' (given the sites classification as either a Type A or B building in Characteristic Situation 2).

A suitable geomembrane specification is included in Appendix L and this geomembrane should be included within the floor build-up. In a suspended floor, the geomembrane would typically be installed between the blocks and floor screed.

To achieve the 2 points outlined under the British Standard, this geomembrane must be installed in accordance with manufacturer's instructions by suitably qualified and experienced personnel and the installation must be verified by a third-party with integrity testing, in accordance with CIRIA 735 '*Good practice on the testing and verification of protection systems for buildings against hazardous ground gases*'.

To achieve the necessary remaining 1.5 points necessary, ventilation measures in the form of a 150mm passive sub-floor void could be incorporated within the proposed buildings beneath a suspended beam and block floor, allowing basic passive ventilation through air bricks. If alternative floor structures are proposed, such as a pre-cast floor slab, then the points will need to be reviewed by EPS to ensure it is adequate.

- 3) BARRIER PIPES: To reduce any risk associated with the ingestion of potable water which may have been affected by the diffusion of contaminants in soil into buried water supply pipes, barrier drinking water pipework should be used for all water supply pipes in the development. This will include all pipes (private supplies, mains and any communication pipes). Water Industry Standard 4-32-19 and associated fittings should be used subject to agreement with the local water company. Reference should be made to UK Water Industry Research (UKWIR) - Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites and any relevant local water company guidance.

Precautionary measures are also recommended to ensure safe development, as follows:

- a) All construction workers operating at the site should be advised of the potential for contact with made ground material within shallow soils, particularly beneath the existing buildings and hardstanding. Appropriate health and safety precautions should be adopted during any excavation works to avoid exposure to infilled soils. Reference should be made to relevant health & safety guidance including the following CIRIA document: *R132 Guide to Safe Working on Contaminated Sites*.
- b) Although the findings of the investigation would suggest that significant quantities of asbestos are unlikely to be encountered, the possibility of discrete pockets of this material existing within the made ground remains. If any evidence of visually identifiable ACM is suspected and is to be disturbed during the site development it is recommended that all works are postponed until suitable assessment and control measures (including a Working Method Statement (WMS)) are created. This WMS should be in accordance with guidance from CIRIA as well as the CL:AIRE /Joint Industry Working Group industry guidance on Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials (2016).
- c) Should any palpable evidence of unexpected contamination be encountered during the redevelopment work, it should be reported to EPS so that an inspection can be made and appropriate sampling and assessment work carried out, a method statement for this is provided as Appendix M.

It is recommended that a copy of this report be provided to the Environmental Health Department of Kirklees Council so that the information may be incorporated into their land quality records and used to support the current planning application. This report should satisfy the pre-commencement requirements of the planning process relating to contamination. A Verification Report will be required documenting the implementation of the remediation prior to completion.

It should also be noted that deep boreholes are recommended in the Geoinvestigate Ltd Coal Mining Risk Assessment for this site. EPS are not aware of whether these boreholes have been implemented or are still required.

6.5 Additional Considerations

6.5.1 Land Reclamation Relief (Tax)

It is likely the client would be eligible for land reclamation relief on all activities associated with the remediation of the site at the rate of x1.5 the original expenditure. Areas where this relief could be applied would include but not necessarily be limited to the following, although a detailed review of the issue should be undertaken by a suitably qualified accountant.

Relief is likely to apply to:

- EPS' fees in developing the remedial strategy and the verification works.
- The disposal costs of waste soils/liquids.
- The costs of importing any clean soils for use in the cover system.
- Soil gas protection measures and barrier pipework.

6.5.2 Waste Management

Depending on the requirements of the final scheme and any associated earthworks balance, it is possible that the site will be subject to a materials management exercise to ensure all potential waste soils are handled and re-used in a legally correct sustainable fashion.

In those circumstances, through a risk assessment process and in accordance with CL:AIRE's *Definition of Waste: Development Industry Code of Practice*, re-use criteria can be defined for site-won soils which are suitable for use being both protective of relevant receptors and geotechnically appropriate (with input from the structural engineers as necessary). If requested, EPS can prepare a Materials Management Plan and have it formally declared by a Qualified Person prior to commencement of groundworks. EPS can also assist with similar mechanisms for re-using waste materials exempt of an environmental permit, such as a U1.

Where viable, EPS would always encourage the employment of an MMP to sustainably manage the re-use of site won soils.



FIGURES



Approximate Site Location

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Title: Site Location Plan

Project: Hebble Court, Dewsbury

Fig No: 1

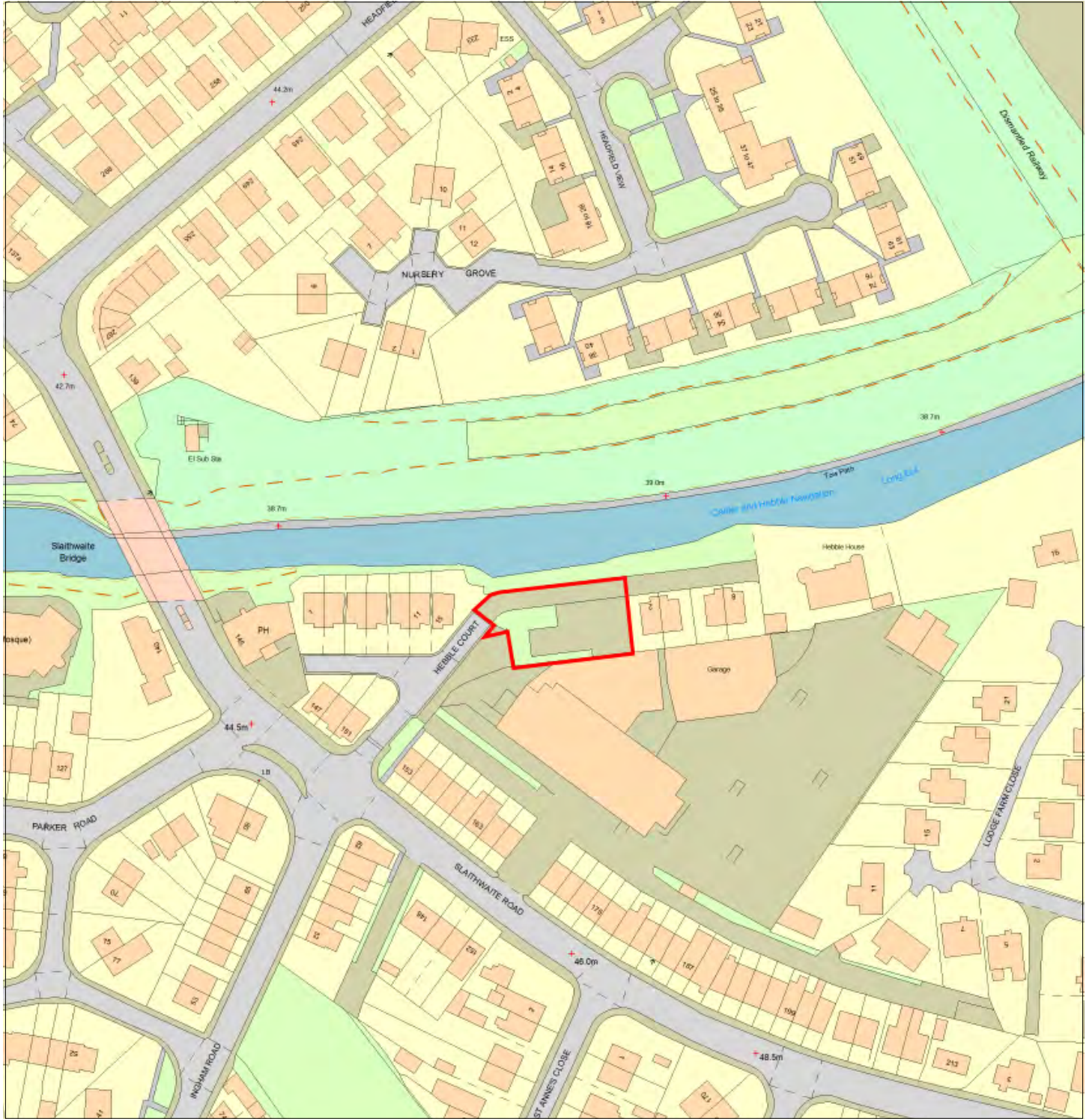
Scale: NTS

Drawn By: JJ **Approved By:**

Job No: UK21.5618

Dwg No: Hebble/1121/Fig1

Date: November 2021



Key:
Approximate Site Boundary ———

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Title: Current Site Layout	Scale: NTS
Project: Hebble Court, Dewsby	Drawn By: JJ Approved By:
Fig No: 2	Job No: UK21.5618
	Dwg No: Hebble/1121/Fig2
	Date: November 2021

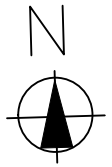


— Approximate Site Boundary

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Title: Aerial Plan	Scale: NTS	
Project: Hebble Court, Dewsbury	Drawn By: JJ	Approved By:
Fig No: 3	Job No: UK21.5618	Dwg No: Hebble/1121/Fig3
	Date: November 2021	



KEY:


- / Approximate Site Boundary
-  Approximate Window Sample Borehole Location

Fig No: 4

Title: Exploratory Hole Location Plan

Project: Hebble Court, Dewsbury

Scale: NTS - For Illustration purposes only

Drawn By: JJ

Job No: UK21.5618

Dwg No: Hebble/1121/Fig4

Date: November 2021





TABLES



Table 1 – Laboratory Testing Schedule (Environmental)

Sample ID	Sample Depth (m bgl)	EPS Mini Suite	EPS Waste Suite
WS01 ES1	0.30-0.40	X	X
WS01 ES2	1.80-1.90		
WS01 ES3	2.80-2.90		
WS02 ES1	0.80-1.00		
WS03 ES1	1.20-1.40		
WS04 ES1	0.30-0.40	X	X
WS04 ES2	1.20-1.40	X	X
WS05 ES1	0.60-0.70	X	X
WS05 ES2	3.80-4.00		

Notes:

mbgl

X

-

EPS Mini Suite

EPS TPH Suite

meters below ground level

Sample Analysed

Sample Not Analysed

Organic Matter, Cyanide, Metals, PAH's, Phenols, Asbestos
 TPH, BTEX, MTBE



Table 2 – Gas Monitoring Well Analysis (26/10/2021)

BH ID	Flow (1/hr)	CH ₄ (%v/v)		CO ₂ (%v/v)		O ₂ (%v/v)		H ₂ S (ppm)	CO	HEX (%v/v)	VOC (ppmV)	Gas Screening Value (1/hr) (CH ₄)	Gas Screening Value (1/hr) (CO ₂)
		Peak	Steady	Peak	Steady	Peak	Steady	Peak	Peak	Peak			
WS01	<0.1	<0.1	<0.1	<0.1	<0.1	20.6	20.0	<0.1	<0.1	0.000	-	<0.0001	<0.0001
WS02	<0.1	<0.1	<0.1	0.2	0.2	19.8	16.4	<0.1	<0.1	0.000	-	<0.0001	<0.0002
WS03	<0.1	<0.1	<0.1	0.2	0.2	20.4	20.4	<0.1	<0.1	0.000	-	<0.0001	<0.0002
WS04	<0.1	<0.1	<0.1	0.8	0.8	19.5	19.5	<0.1	<0.1	0.000	-	<0.0001	<0.0008
WS05	<0.1	<0.1	<0.1	0.5	0.5	19.6	19.6	<0.1	<0.1	0.000	-	<0.0001	<0.0005

Readings collected on 26/10/2021 at an atmospheric pressure of 1006mbar falling to 1004mbar on a dry, windy, overcast day at around 12°C. '-' denotes reading not undertaken.

Table 3 – Gas Monitoring Well Analysis (02/11/2021)

BH ID	Flow (1/hr)	CH ₄ (%v/v)		CO ₂ (%v/v)		O ₂ (%v/v)		H ₂ S (ppm)	CO	HEX (%v/v)	VOC (ppmV)	Gas Screening Value (1/hr) (CH ₄)	Gas Screening Value (1/hr) (CO ₂)
		Peak	Steady	Peak	Steady	Peak	Steady	Peak	Peak	Peak			
WS01	<0.1	<0.1	<0.1	0.2	0.2	20.5	20.4	<0.1	<0.1	0.000	0.3	<0.0001	<0.0002
WS02	<0.1	<0.1	<0.1	0.6	0.2	20.7	20.6	<0.1	<0.1	0.000	0.5	<0.0001	<0.0006
WS03	<0.1	<0.1	<0.1	0.2	0.2	20.1	20.1	<0.1	<0.1	0.000	0.2	<0.0001	<0.0002
WS04	<0.1	<0.1	<0.1	0.8	0.8	20.0	19.8	<0.1	<0.1	0.000	0.2	<0.0001	<0.0008
WS05	<0.1	<0.1	<0.1	0.8	0.8	20.2	19.8	<0.1	<0.1	0.000	0.3	<0.0001	<0.0008

Readings collected on 02/11/2021 at an atmospheric pressure of 991mbar falling to 989mbar on a dry, sunny day at around 6°C.

Table 4 – Gas Monitoring Well Analysis (09/11/2021)

BH ID	Flow (1/hr)	CH ₄ (%v/v)		CO ₂ (%v/v)		O ₂ (%v/v)		H ₂ S (ppm)	CO	HEX (%v/v)	VOC (ppmV)	Gas Screening Value (1/hr) (CH ₄)	Gas Screening Value (1/hr) (CO ₂)
		Peak	Steady	Peak	Steady	Peak	Steady	Peak	Peak	Peak			
WS01	<0.1	<0.1	<0.1	0.2	0.2	20.7	20.5	<0.1	<0.1	0.000	0.2	<0.0001	<0.0002
WS02	<0.1	<0.1	<0.1	0.2	0.2	20.8	20.4	<0.1	<0.1	0.000	0.3	<0.0001	<0.0002
WS03	<0.1	<0.1	<0.1	0.2	0.2	20.6	20.4	<0.1	<0.1	0.000	0.2	<0.0001	<0.0002
WS04	<0.1	<0.1	<0.1	0.8	0.8	20.5	19.6	<0.1	<0.1	0.000	0.2	<0.0001	<0.0008
WS05	<0.1	<0.1	<0.1	0.7	0.7	20.4	19.9	<0.1	<0.1	0.000	0.2	<0.0001	<0.0007

Readings collected on 09/11/2021 at an atmospheric pressure of 1013mbar falling to 1012mbar on a dry, sunny day at around 14°C.



APPENDICES





APPENDIX A

Selected Site Photographs



Key:

-  Approximate Site Boundary
-  Approximate Photo Location

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Title: Photo Location Plan

Project: Hebble Court, Dewsbury

Fig No: App. A

Scale: NTS

Drawn By: JJ Approved By:

Job No: UK21.5618

Dwg No: Hebble/1121/App.A

Date: November 2021

Photo 1: Facing west, showing the materials currently left on the surface at the site.



Photo 2: facing south west, showing possible burning of materials on the site.



Photo 3: facing south west, showing storage containers and derelict machinery on the site.



Photo 4: Showing recovered soils from WS01, between 1m to 4m.



Photo 5: Showing the stiff friable sandy clay recovered at the base of WS01.



Photo 6: Showing recovered soils from ground level to 3m in WS04.





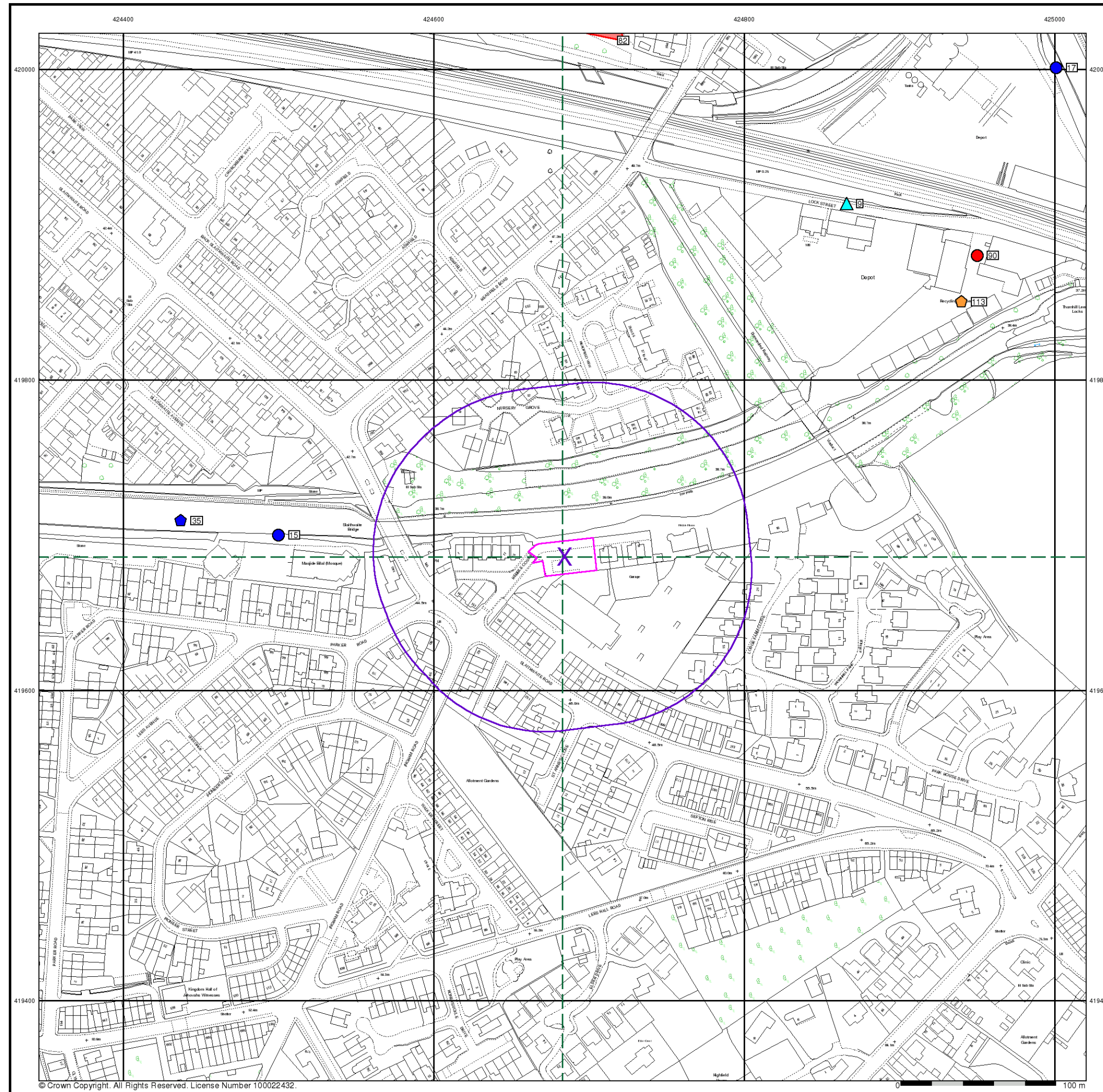
APPENDIX B

Proposed Development Plan



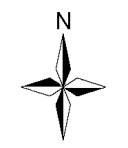
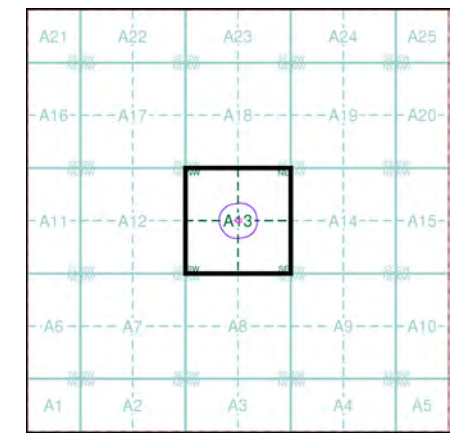
APPENDIX C

Surrounding Land Use



- General**
- Specified Site
 - Specified Buffer(s)
 - Bearing Reference Point
 - Map ID
 - Several of Type at Location
 - Pylon
 - Overhead Transmission Line
- Agency and Hydrological**
- Contaminated Land Register Entry or Notice (Location)
 - Contaminated Land Register Entry or Notice
 - Discharge Consent
 - Enforcement or Prohibition Notice
 - Integrated Pollution Control
 - Integrated Pollution Prevention Control
 - Local Authority Integrated Pollution Prevention and Control
 - Local Authority Pollution Prevention and Control 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
- 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 (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
- Hazardous Substances**
- COMAH Site
 - Explosive Site
 - NIHHS Site
 - Planning Hazardous Substance Consent
 - Planning Hazardous Substance Enforcement
- Geological**
- BGS Recorded Mineral Site

Site Sensitivity Map - Segment A13



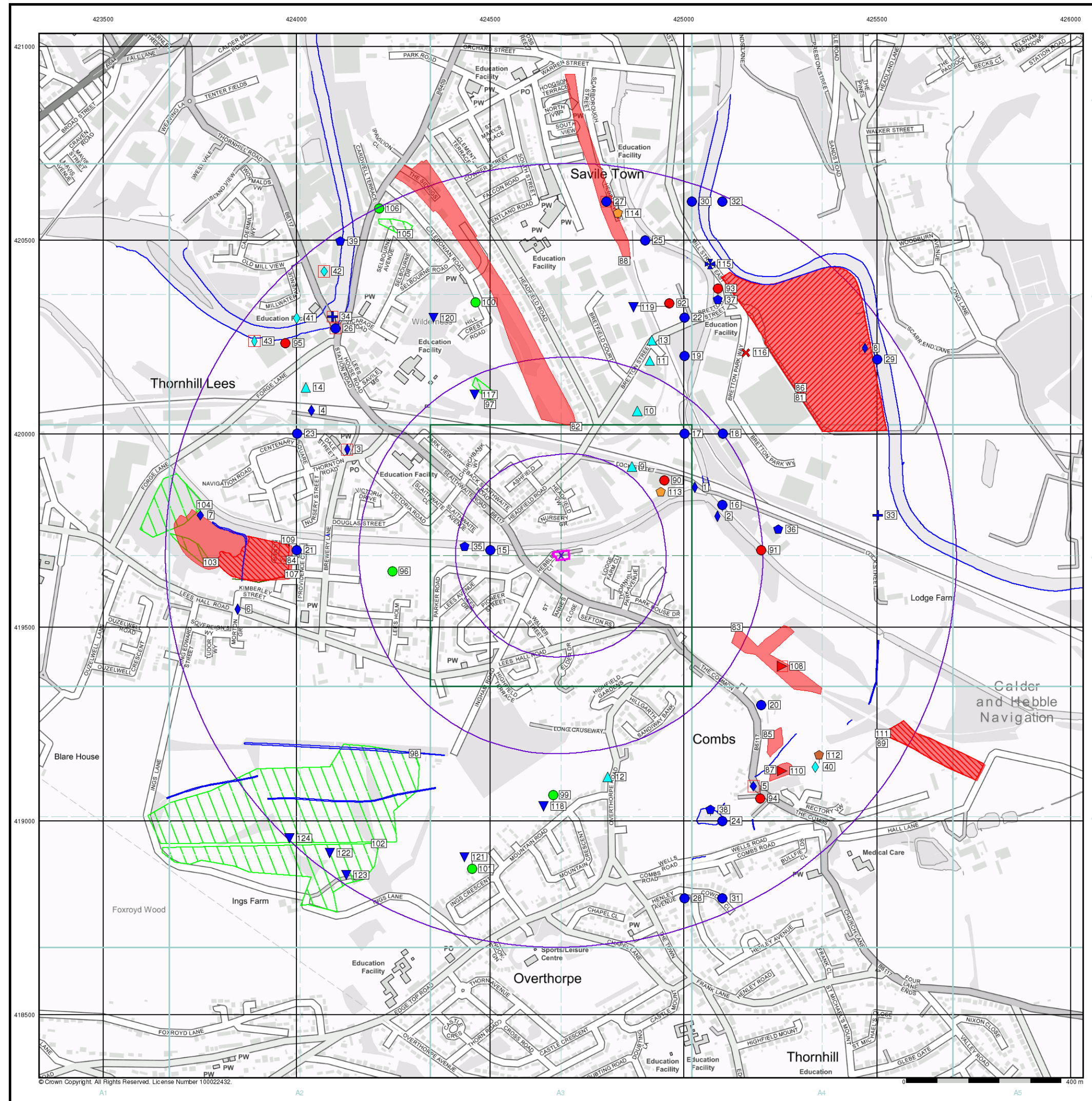
Order Details

Order Number: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Plot Buffer (m): 100

Site Details
 Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY

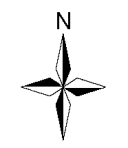
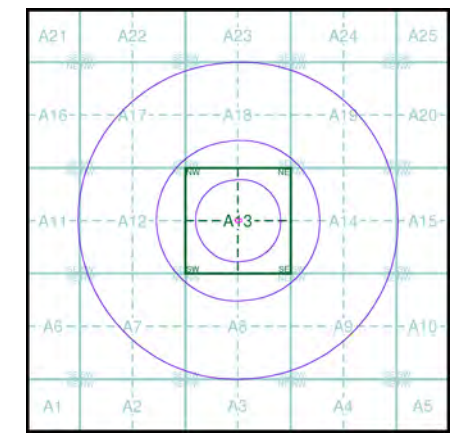
Landmark
 INFORMATION GROUP

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- 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 and Control
 - Local Authority Integrated Pollution Prevention and Control
 - Local Authority Pollution Prevention and Control Enforcement
 - Local Authority Pollution Prevention and Control Enforcement
 - Pollution Incident to Controlled Waters
 - Prosecution Relating to Authorised Processes
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 - Registered Radioactive Substance
 - River Network or Water Feature
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 - Water Abstraction
 - Water Industry Act Referral
- Hazardous Substances**
- COMAH Site
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 - 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: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

Site Details
 Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY

APPENDIX D

Geological Context

Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	MGR	Made Ground (Undivided)	Artificial Deposit	Not Supplied - Holocene
	WMGR	Infilled Ground	Artificial Deposit	Not Supplied - Holocene
	WGR	Worked Ground (Undivided)	Void	Not Supplied - Holocene
	SLIP	Landslide Deposit	Unknown/Unclassified Entry	Not Supplied - Quaternary

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Not Supplied - Holocene
	RTDU	River Terrace Deposits (Undifferentiated)	Sand and Gravel	Not Supplied - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	PMCM	Pennine Middle Coal Measures Formation	Sandstone	Not Supplied - Westphalian
	PMCM	Pennine Middle Coal Measures Formation	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	TR	Thornhill Rock	Sandstone	Not Supplied - Westphalian
	HMR	Haigh Moor Rock	Sandstone	Not Supplied - Westphalian
	PLCM	Pennine Lower Coal Measures Formation	Sandstone	Not Supplied - Westphalian
	PLCM	Pennine Lower Coal Measures Formation	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	ER	Emley Rock	Sandstone	Not Supplied - Westphalian
	BRSR	Birstall Rock	Sandstone	Not Supplied - Westphalian
	LPE	Lepton Edge Rock	Sandstone	Not Supplied - Westphalian
		Rock Segments		
		Faults		



Geology 1:50,000 Maps

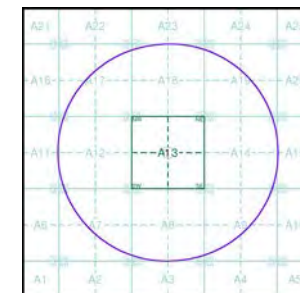
This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.

The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID:	1
Map Sheet No:	077
Map Name:	Huddersfield
Map Date:	2003
Bedrock Geology:	Available
Superficial Geology:	Available
Artificial Geology:	Available
Faults:	Not Supplied
Landslip:	Available
Rock Segments:	Not Supplied

Geology 1:50,000 Maps - Slice A



Order Details:

Order Number:	286470364_1_1
Customer Reference:	UK21.5618
National Grid Reference:	424680, 419690
Slice:	A
Site Area (Ha):	0.08
Search Buffer (m):	1000

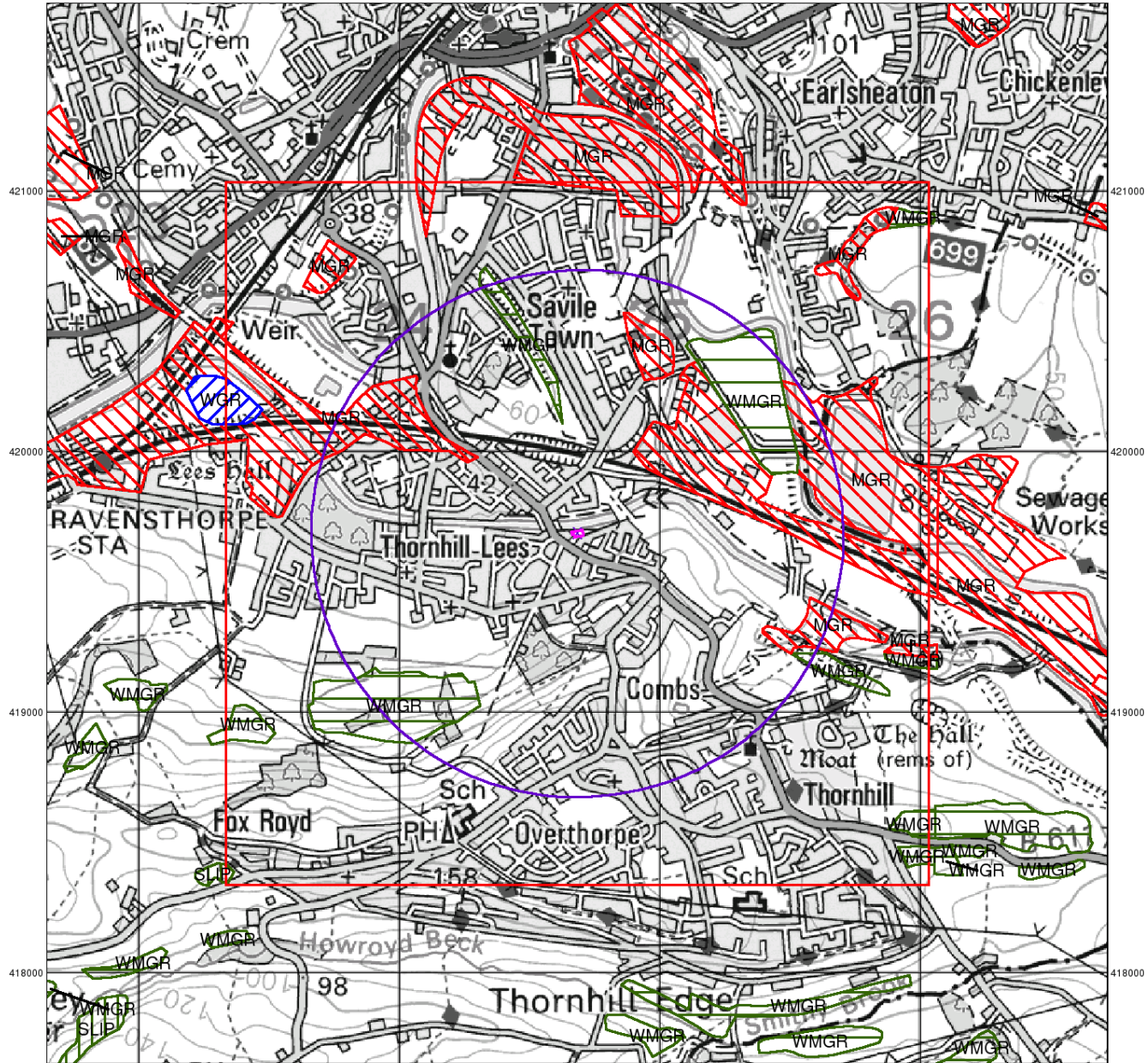
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Artificial Ground and Landslip

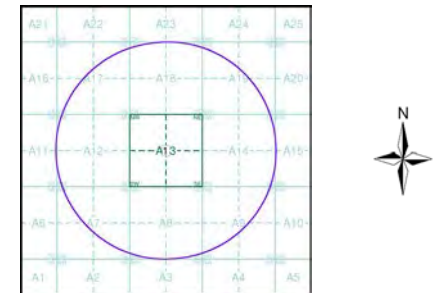
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A



Order Details:

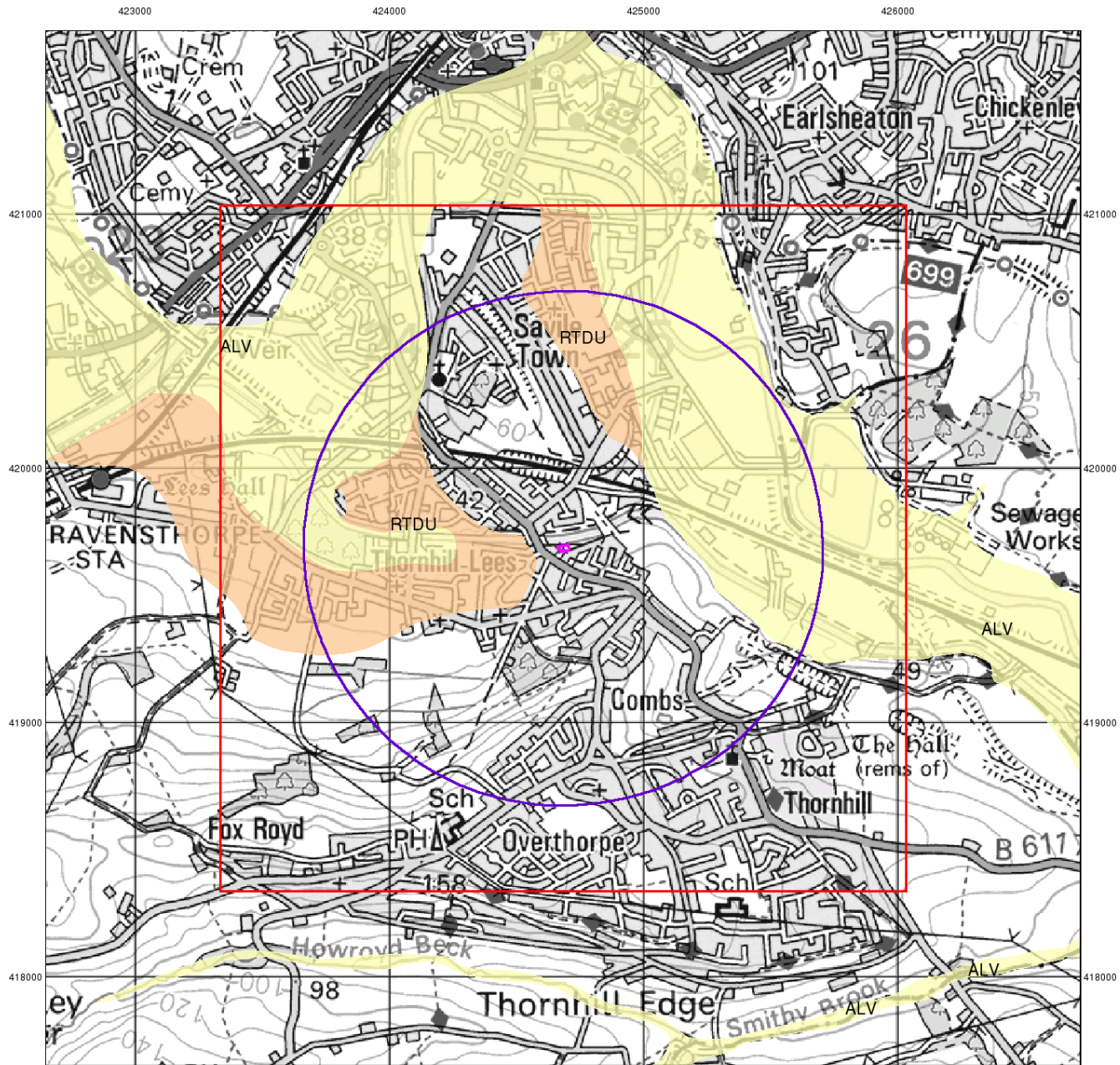
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 Customer Reference: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

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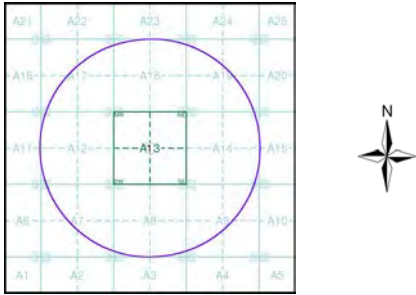
Superficial Geology

Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



Order Details:

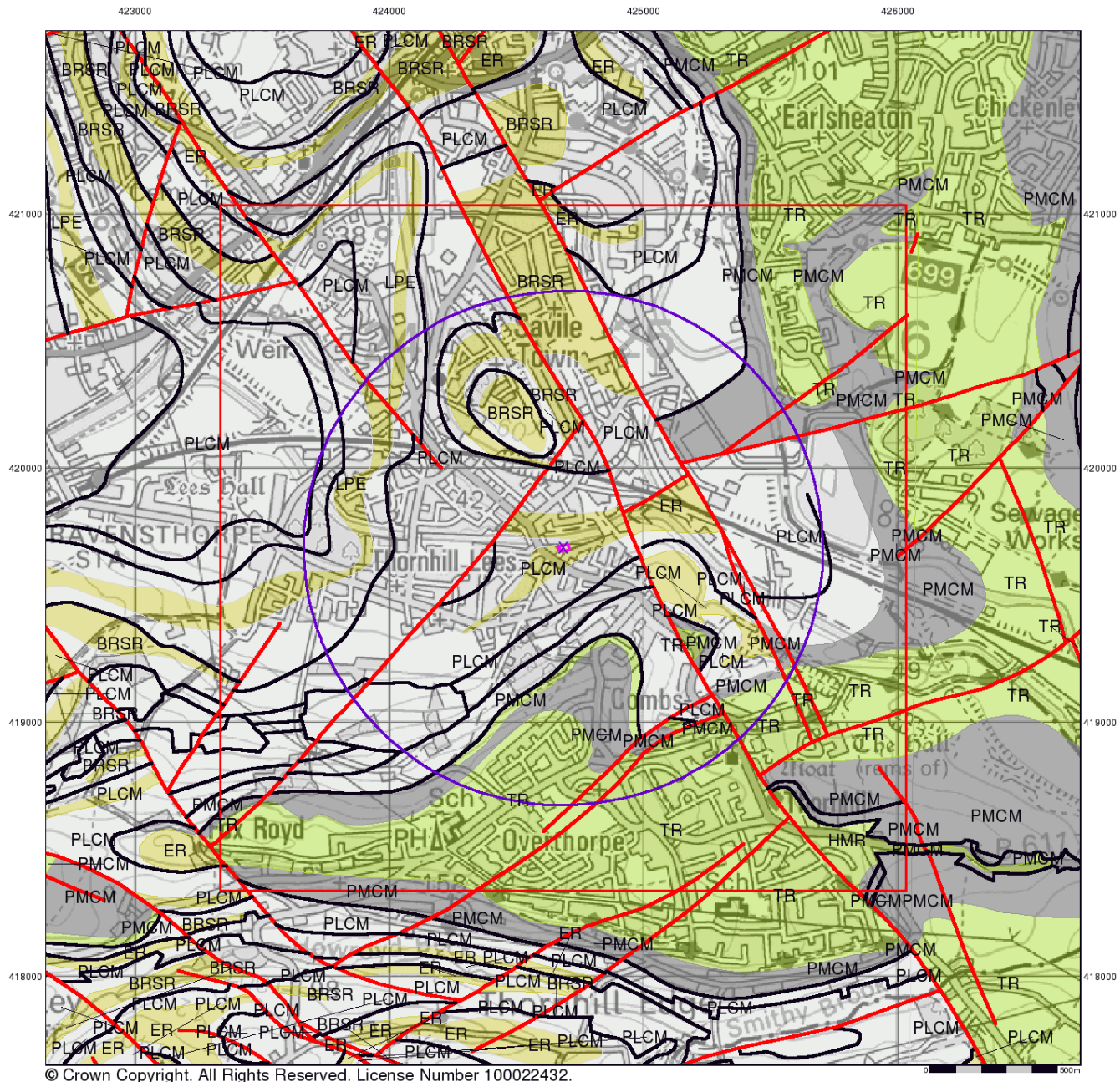
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Bedrock and Faults

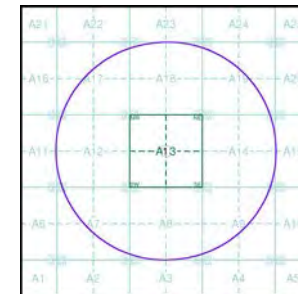
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults (e.g. normal, thrust), and thin beds mapped as lines (e.g. coal seam, gypsum bed). Some of these are linked to other particular 1:50,000 Geology datasets, for example, coal seams are part of the bedrock sequence, most faults and mineral veins primarily affect the bedrock but cut across the strata and post date its deposition.

Bedrock and Faults Map - Slice A



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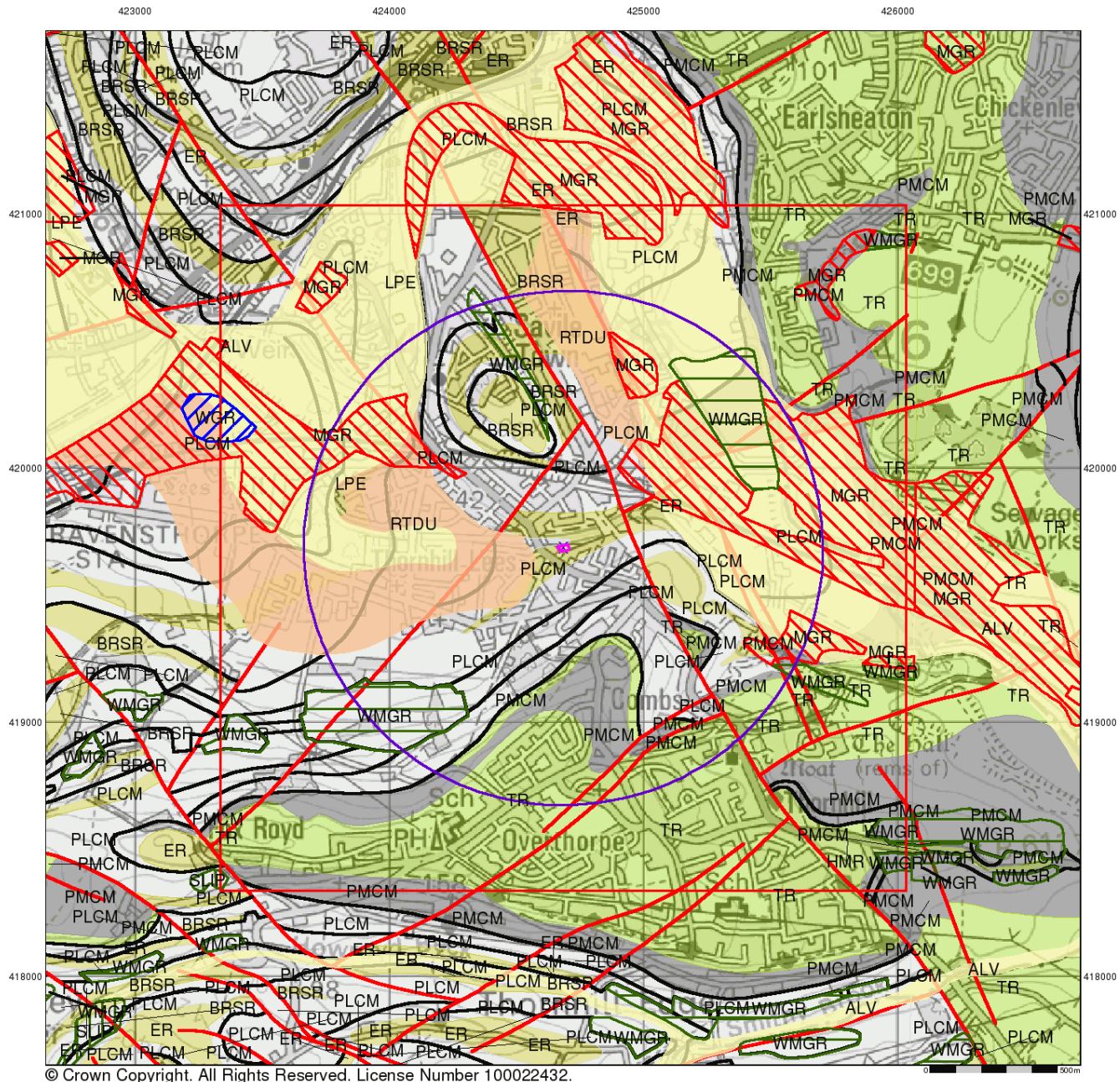
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 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

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Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

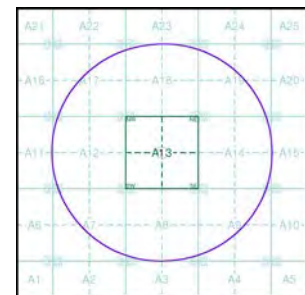
Additional Information

More information on 1:50,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

British Geological Survey
 Kingsley Dunham Centre
 Keyworth
 Nottingham
 NG12 5GG
 Telephone: 0115 936 3143
 Fax: 0115 936 3276
 email: enquiries@bgs.ac.uk
 website: www.bgs.ac.uk

Combined Geology Map - Slice A



Order Details:

Order Number: 286470364_1_1
 Customer Reference: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

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HUTTER JENNINGS & TITCHMARSH					Sheet of 1 1	Borehole No. 2	
Boring Method					Site		
ROTARY PERCUSSIVE OPEN HOLE DRILLING TECHNIQUES AT 100mm DIAMETER					THORNHILL LEES, DEWSBURY		
Drilling Commenced 14.3.88			Ground Level 58.40m A.O.D.				
Scale	Samples/Tests		Standing Water Level (m)	Reduced Level (m)	Description of Strata	Depth (m)	Legend
	Sample Type	In situ Test					
1.0					OVERBURDEN - soft to firm yellow grey brown sandy CLAY with some gravel		
2.0					Highly Weathered, brown, MUDSTONES intermixed with yellow brown SANDSTONES	1.75 2.25	
3.0					Intermixed MUDSTONES, SHALEY MUDSTONES WITH SOME SANDSTONE BANDS, generally moderately weak		
4.0							
5.0							
6.0					Solid, black COAL with some black shale at top of horizon, weak	6.50	
7.0							
8.0					Dark grey, slightly sandy/silty, MUDSTONE/SHALE moderately weak (fire clay?)	7.25	
9.0							
10.0					Boring suspended	8.25	

Remarks All comments in 'Description of Strata', regarding strength and consistency of the rock mass, are related to observations of penetration rate during drilling and in the absence of rock 'core' samples, must be regarded as indicative only.

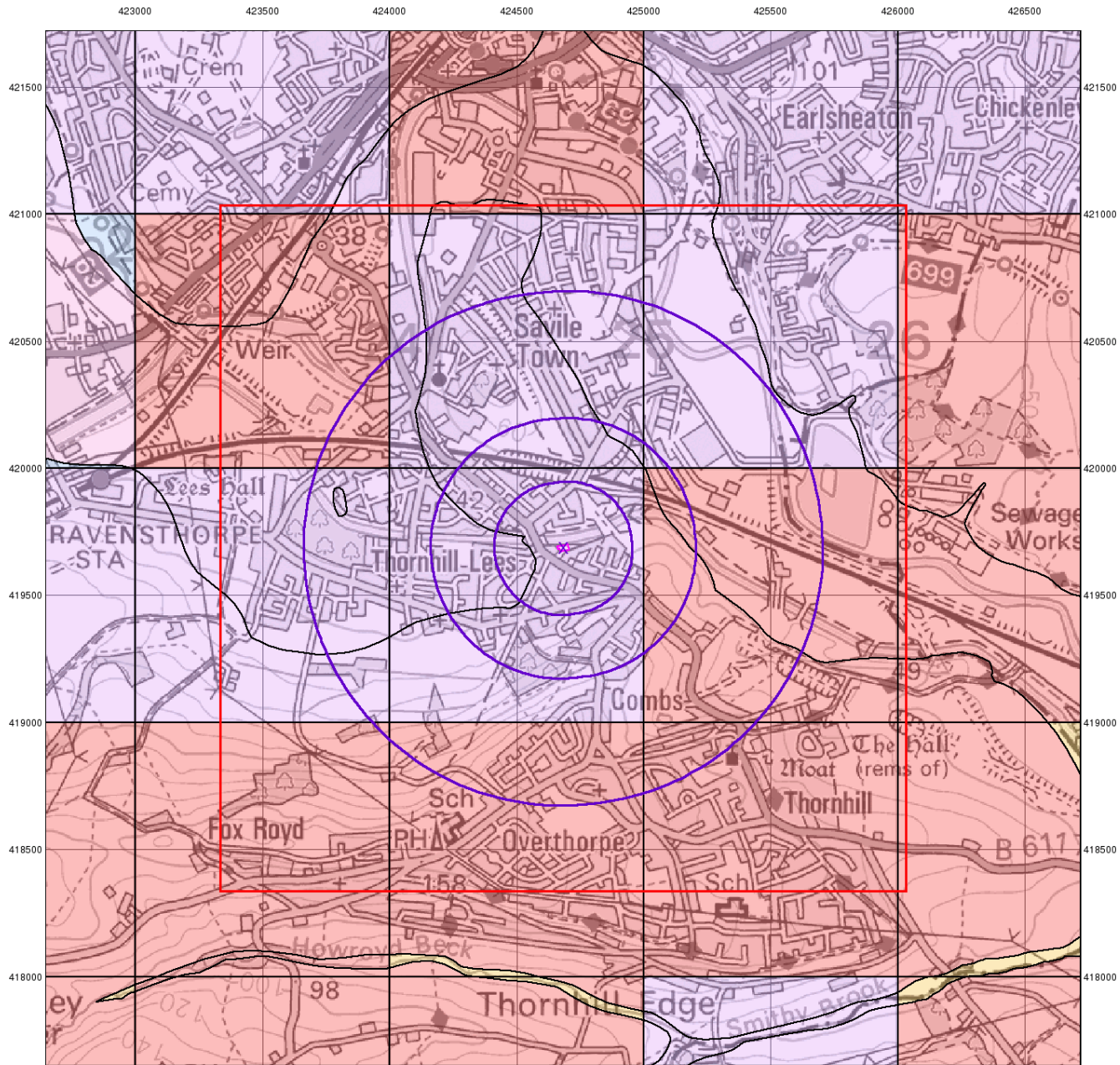
Borehole was wet from 7.0m.

See sheets A & B for key to symbols



APPENDIX E

Groundwater Vulnerability and Flood Risk Maps



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0 1 km



Groundwater Vulnerability

General

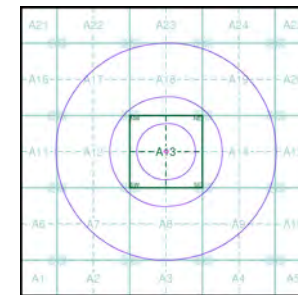
- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

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: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

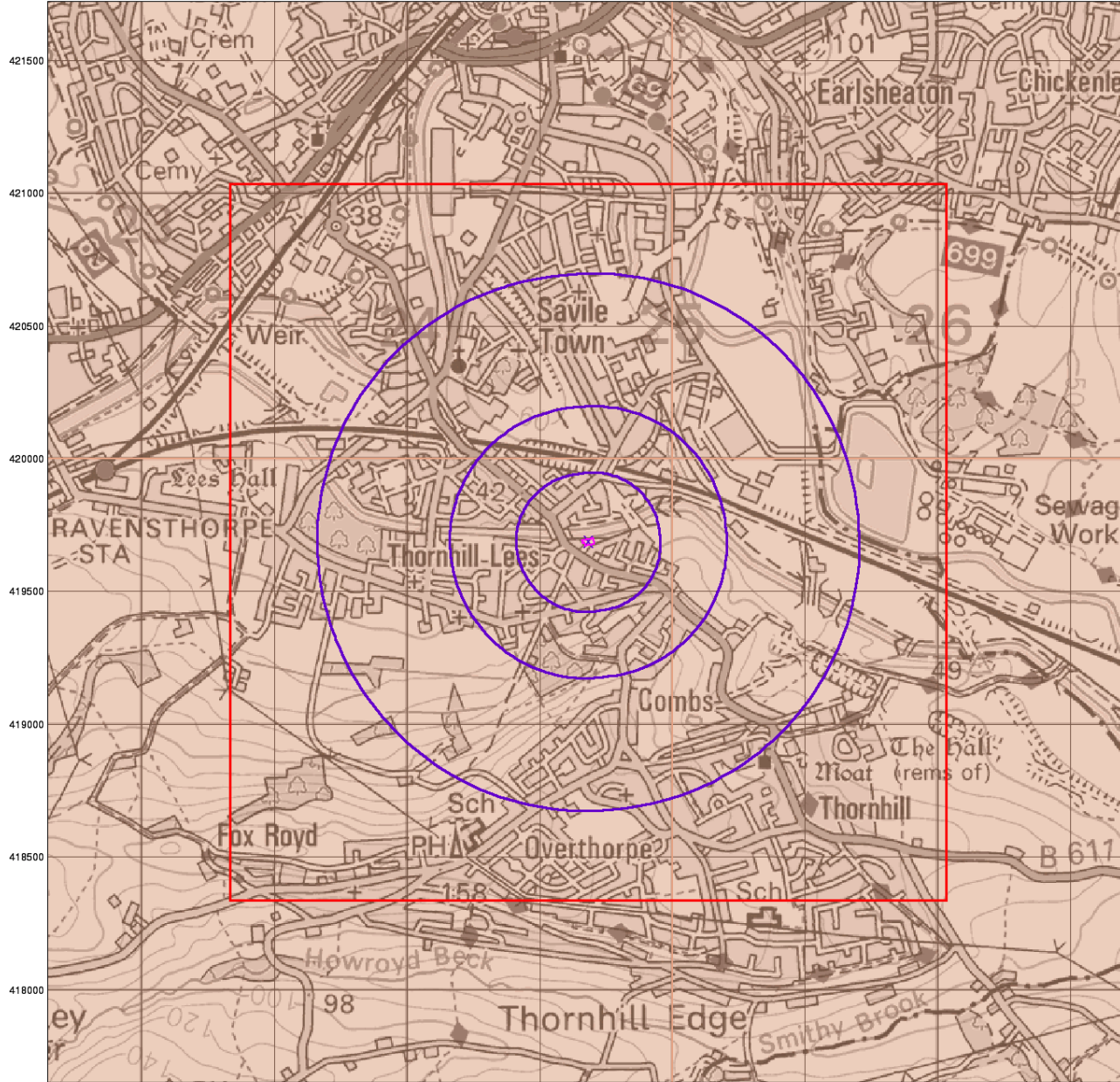
Site Details

Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY



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0 1 km



Bedrock Aquifer Designation

General

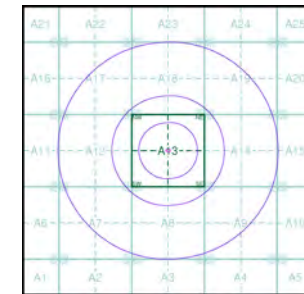
- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



Order Details

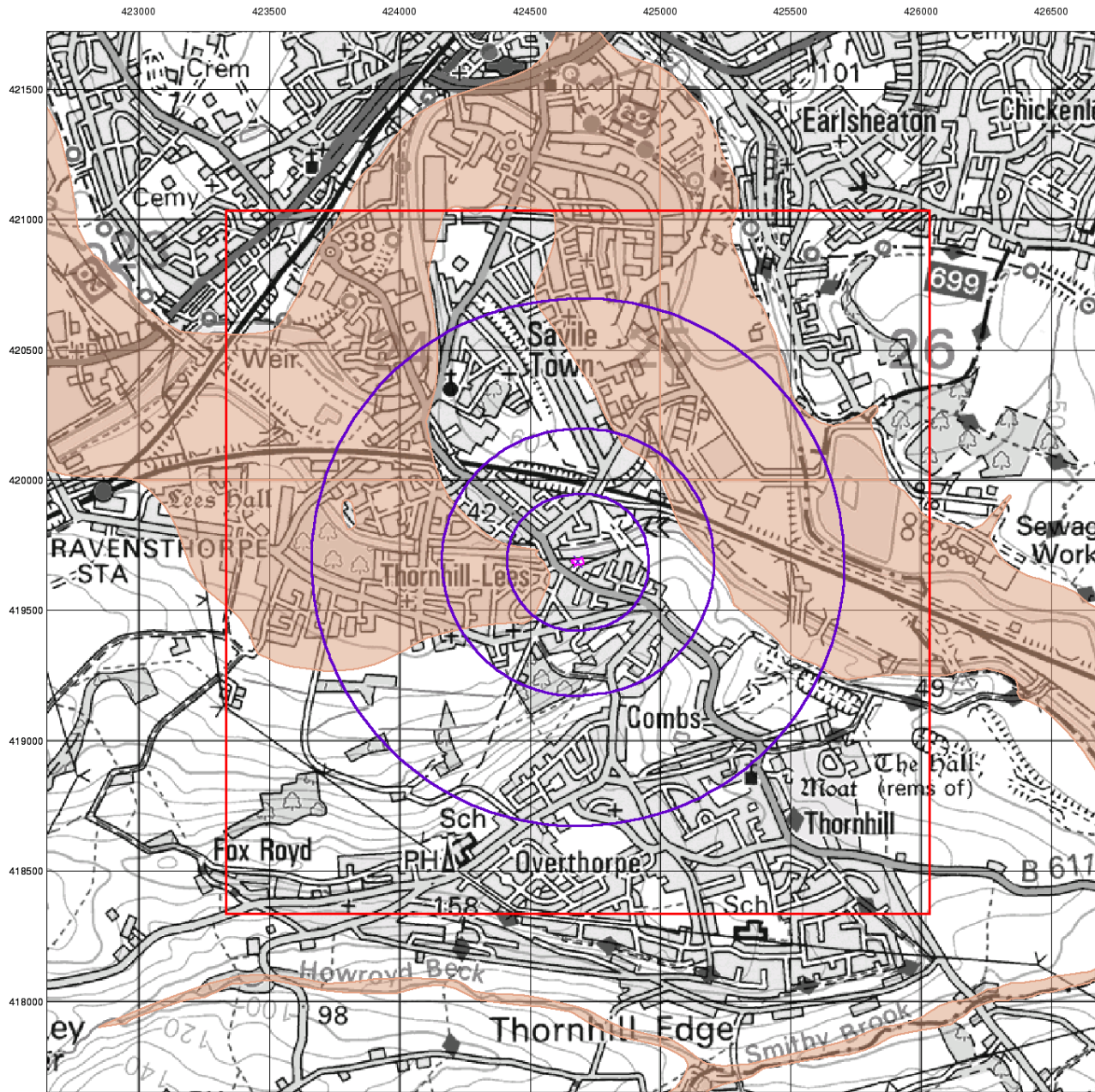
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 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
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0 1 km



Superficial Aquifer Designation

General

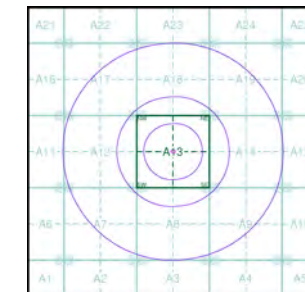
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- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



Order Details

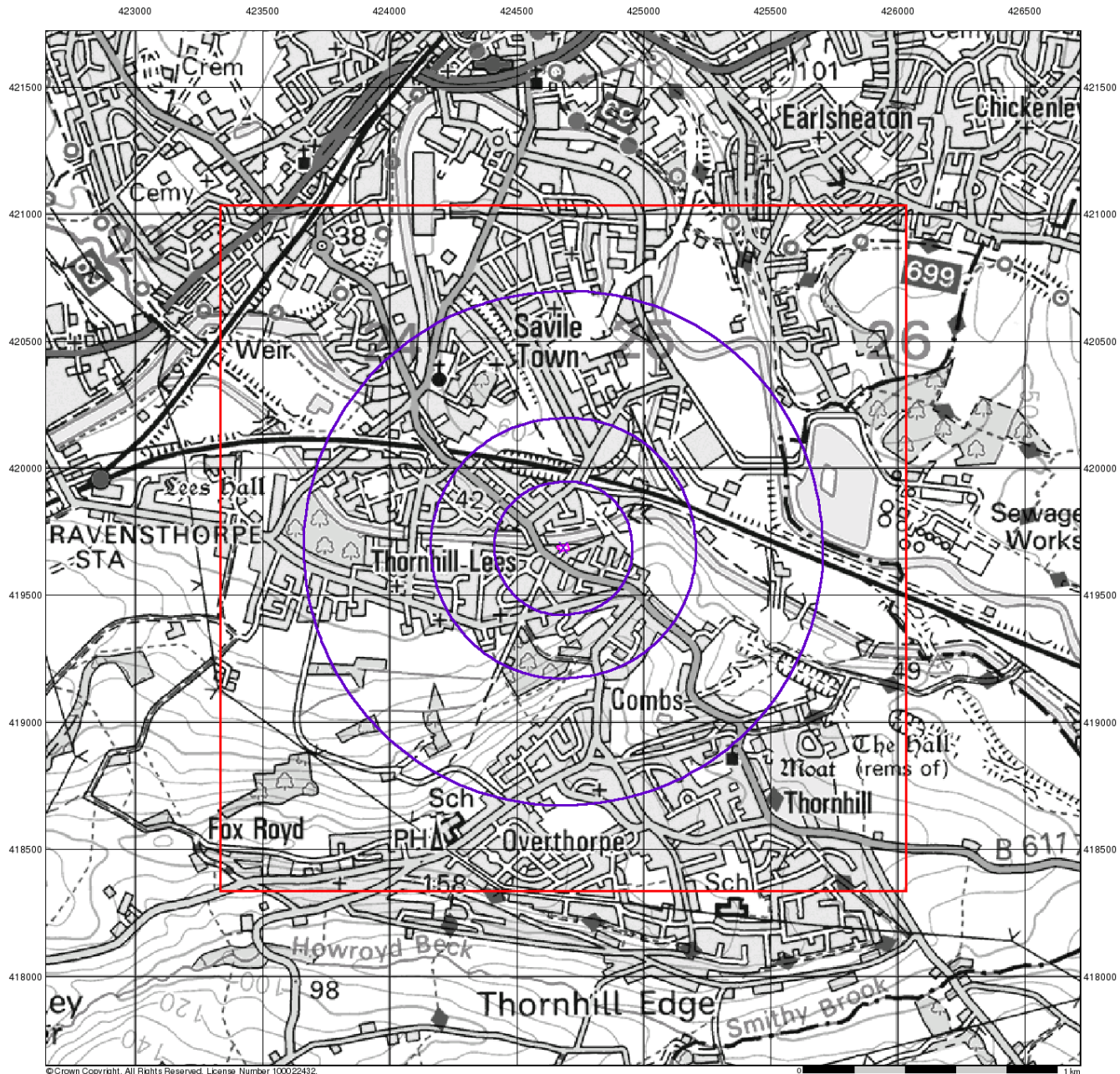
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 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
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 Site Area (Ha): 0.08
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Source Protection Zones

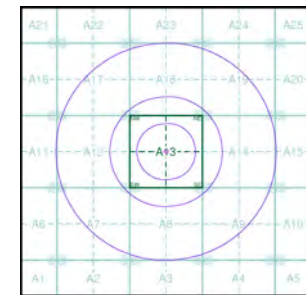
General

- ◆ Specified Site
- Specified Buffer(s)
- ✕ Bearing Reference Point
- Slice
- B Map ID

Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

Site Sensitivity Context Map - Slice A



Order Details

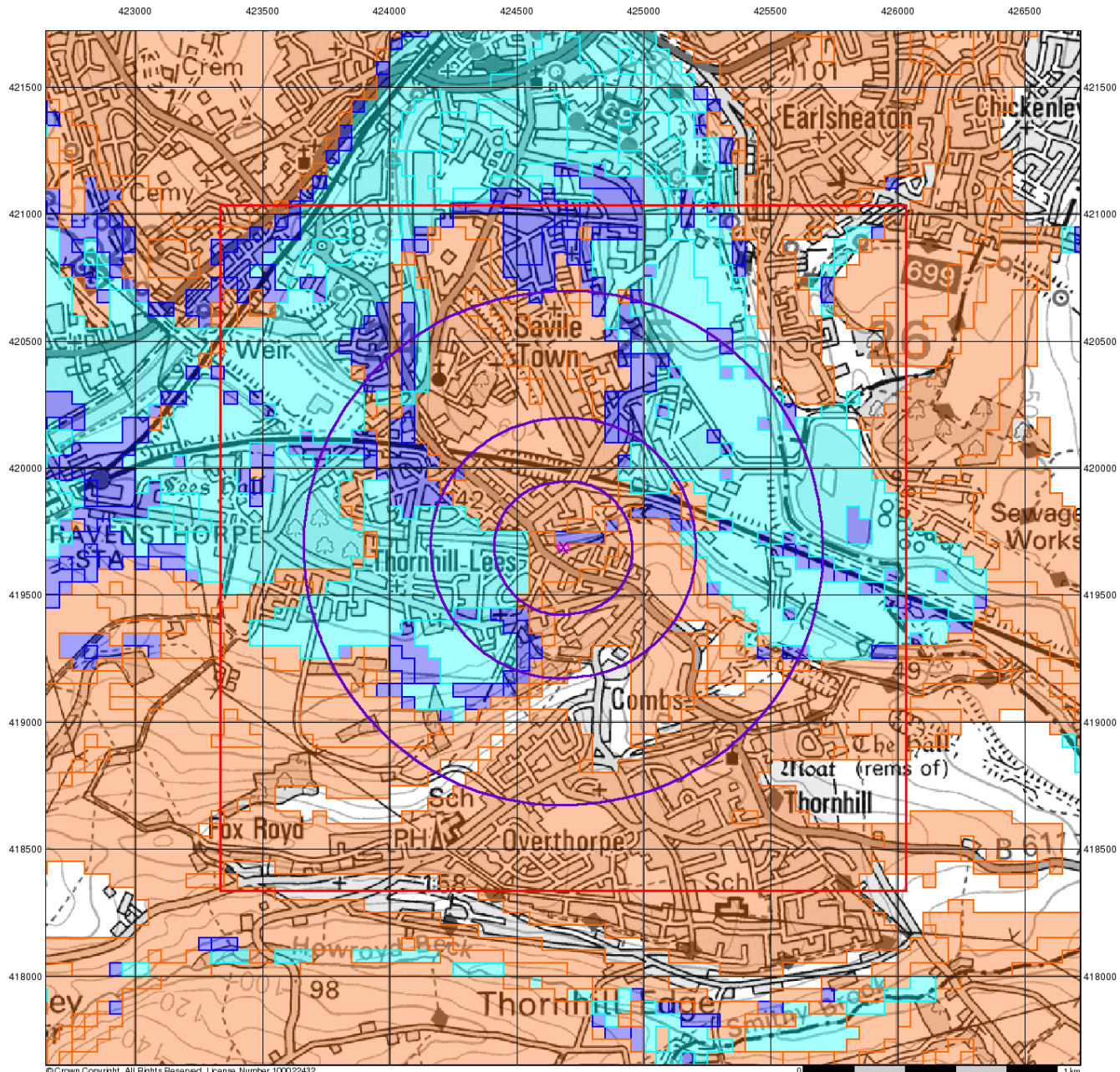
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 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
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Site Details

Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY



Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk



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BGS Flood GFS Data

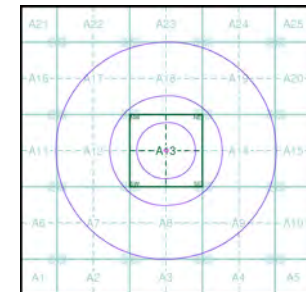
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice

Agency and Hydrological (Flood)

- Limited Potential for Groundwater Flooding to Occur
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Potential for Groundwater Flooding to Occur at Surface

Site Sensitivity Context Map - Slice A



Order Details

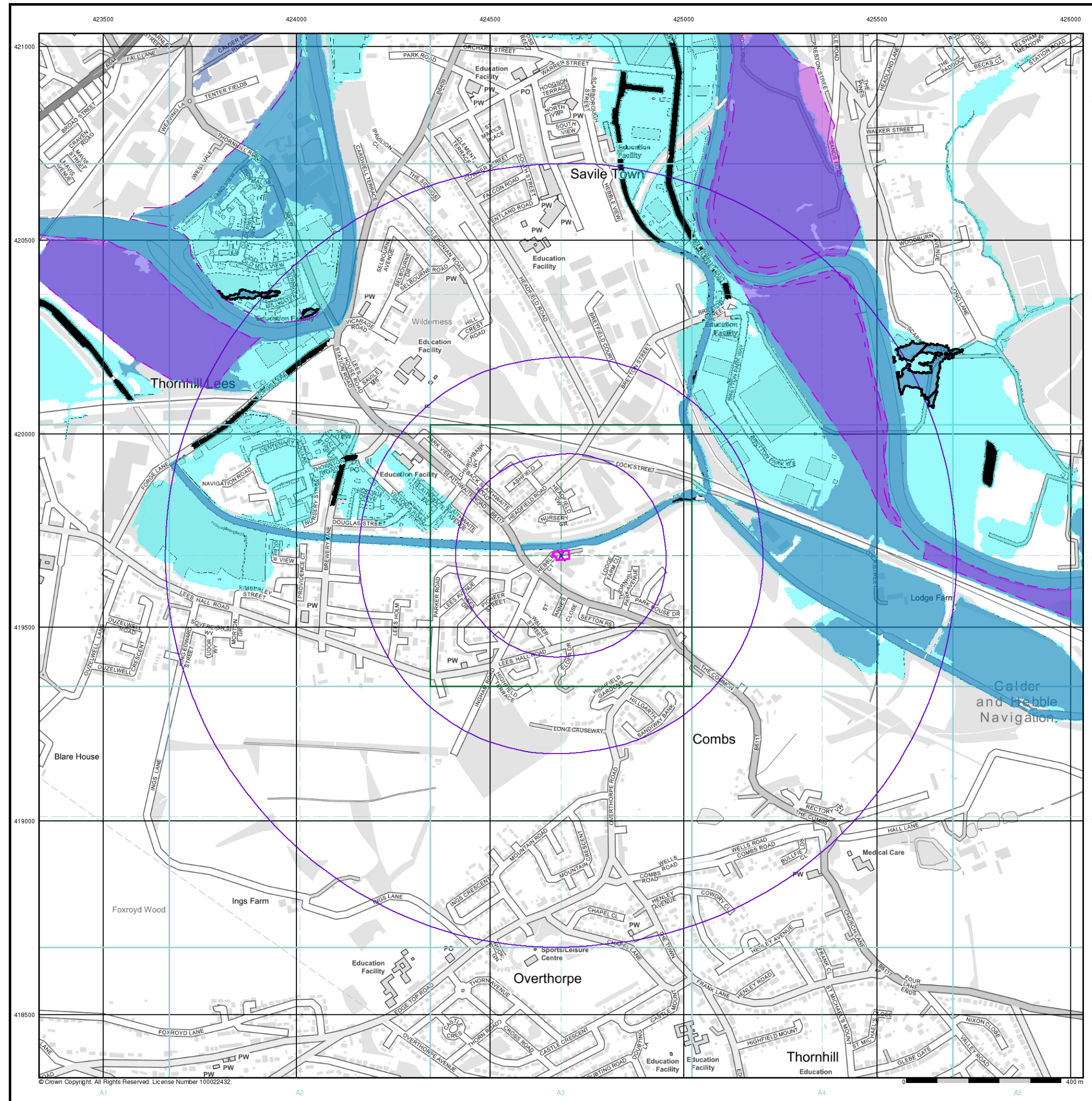
Order Number: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

Site Details

Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY



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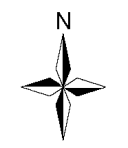
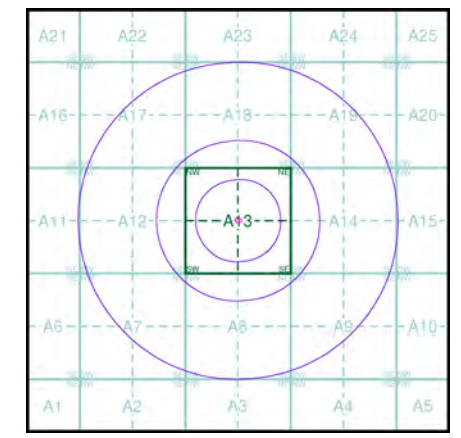
General

- Specified Site
- Specified Buffer(s)
- 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: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

Site Details

Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY

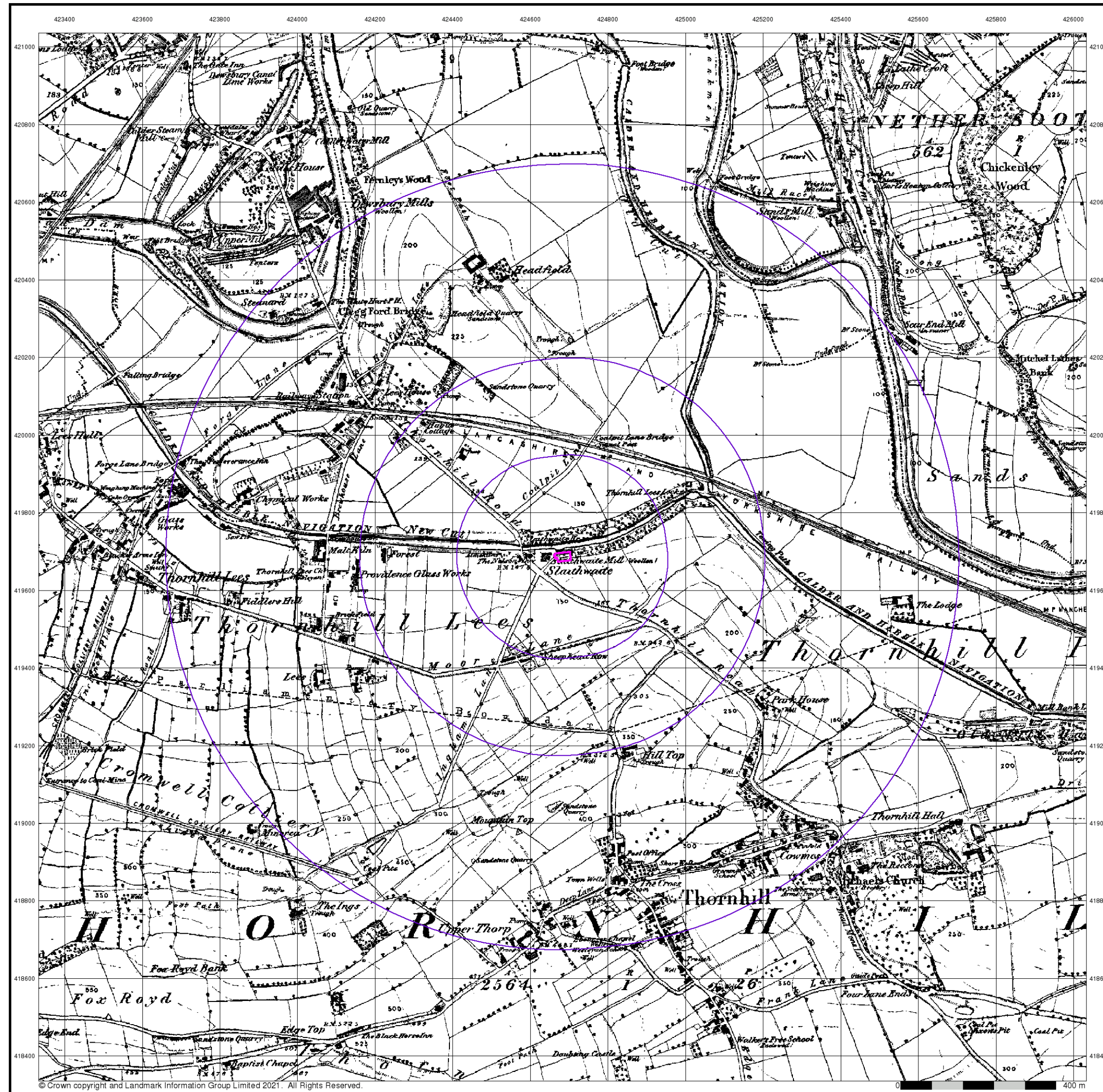


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 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk



APPENDIX F

A Selection of Historic Maps



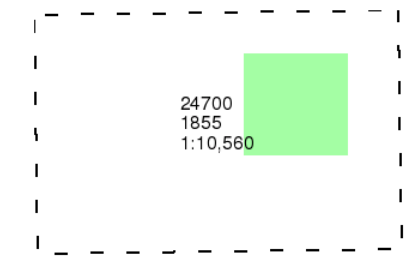
Yorkshire

Published 1855

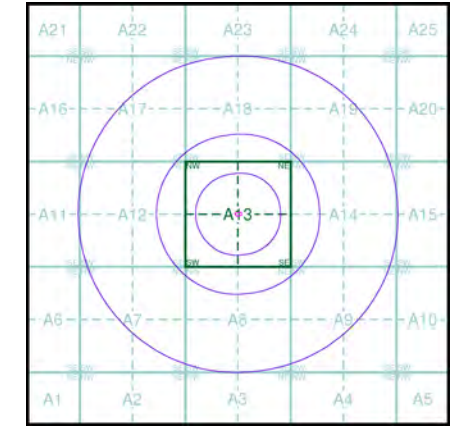
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

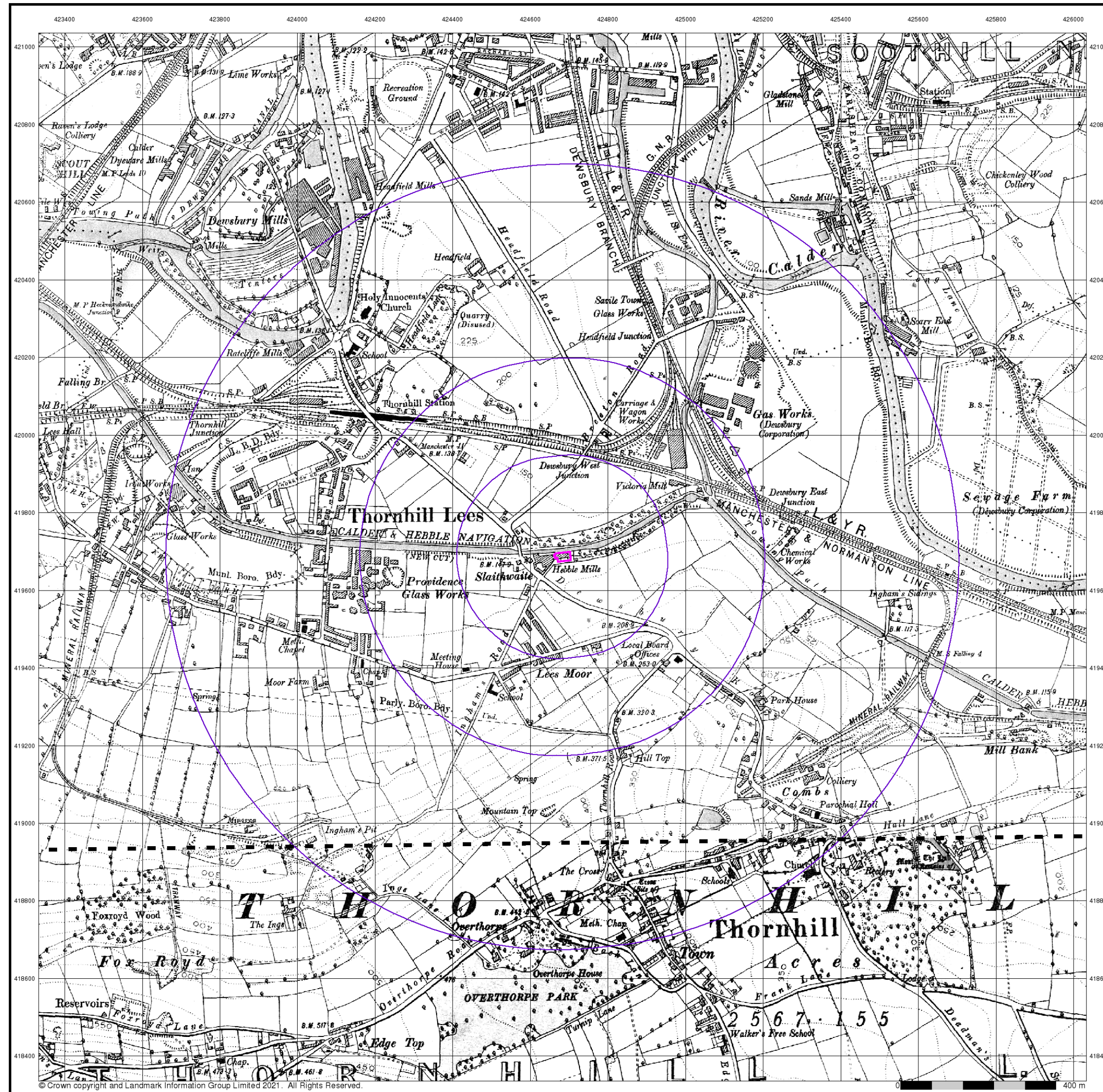
Order Number: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

Site Details

Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY



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 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk



Yorkshire

Published 1894

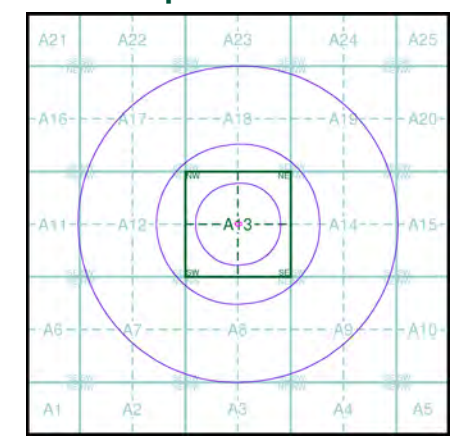
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

247NE	1894	1:10,560
247SE	1894	1:10,560

Historical Map - Slice A



Order Details

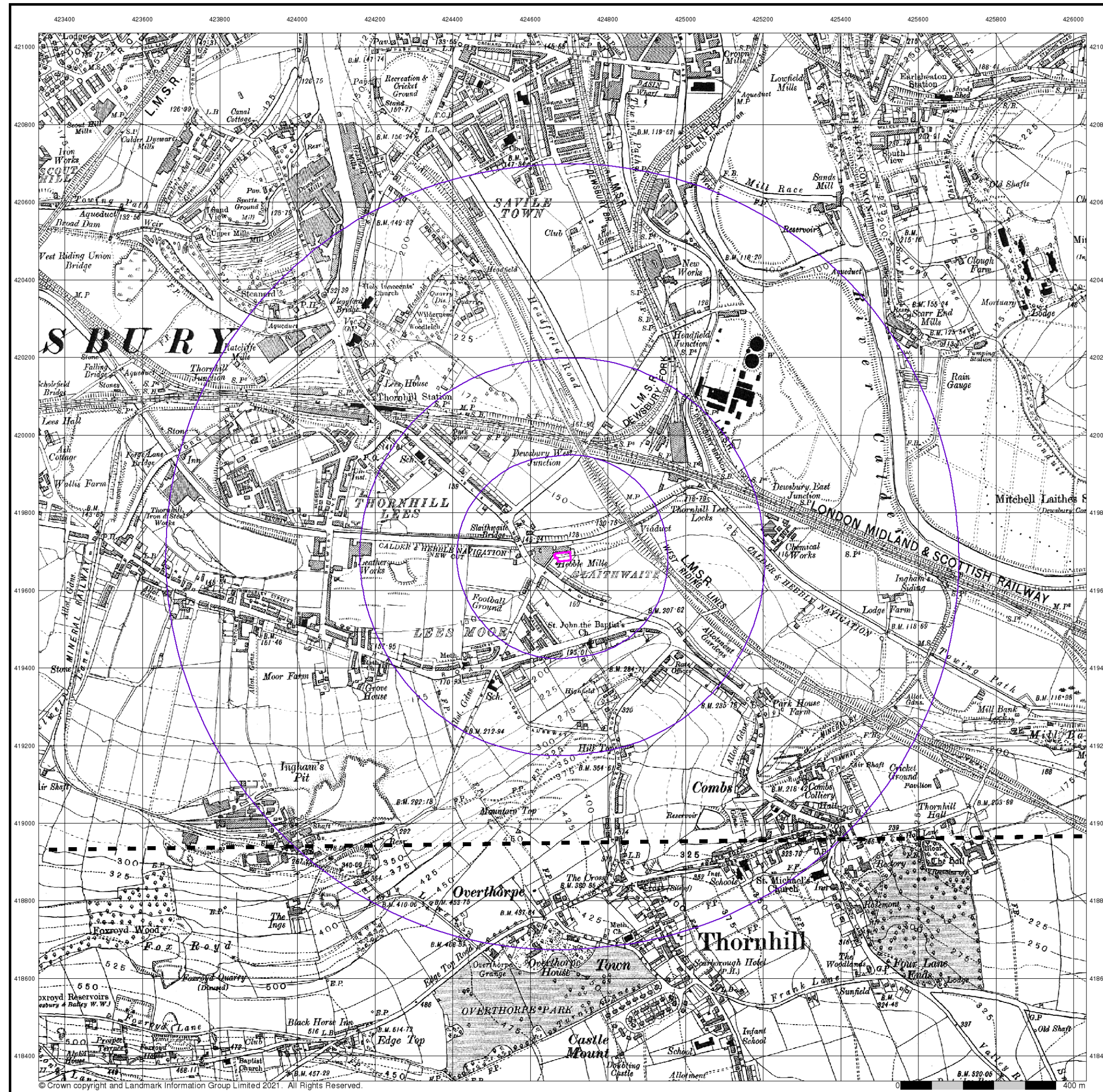
Order Number: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

Site Details

Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY



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Yorkshire

Published 1931

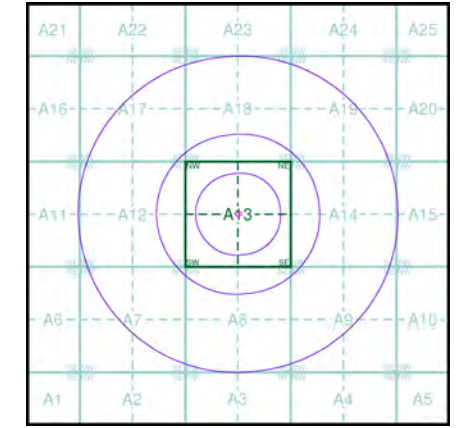
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

247NE	1931
1:10,560	
247SE	1931
1:10,560	

Historical Map - Slice A



Order Details

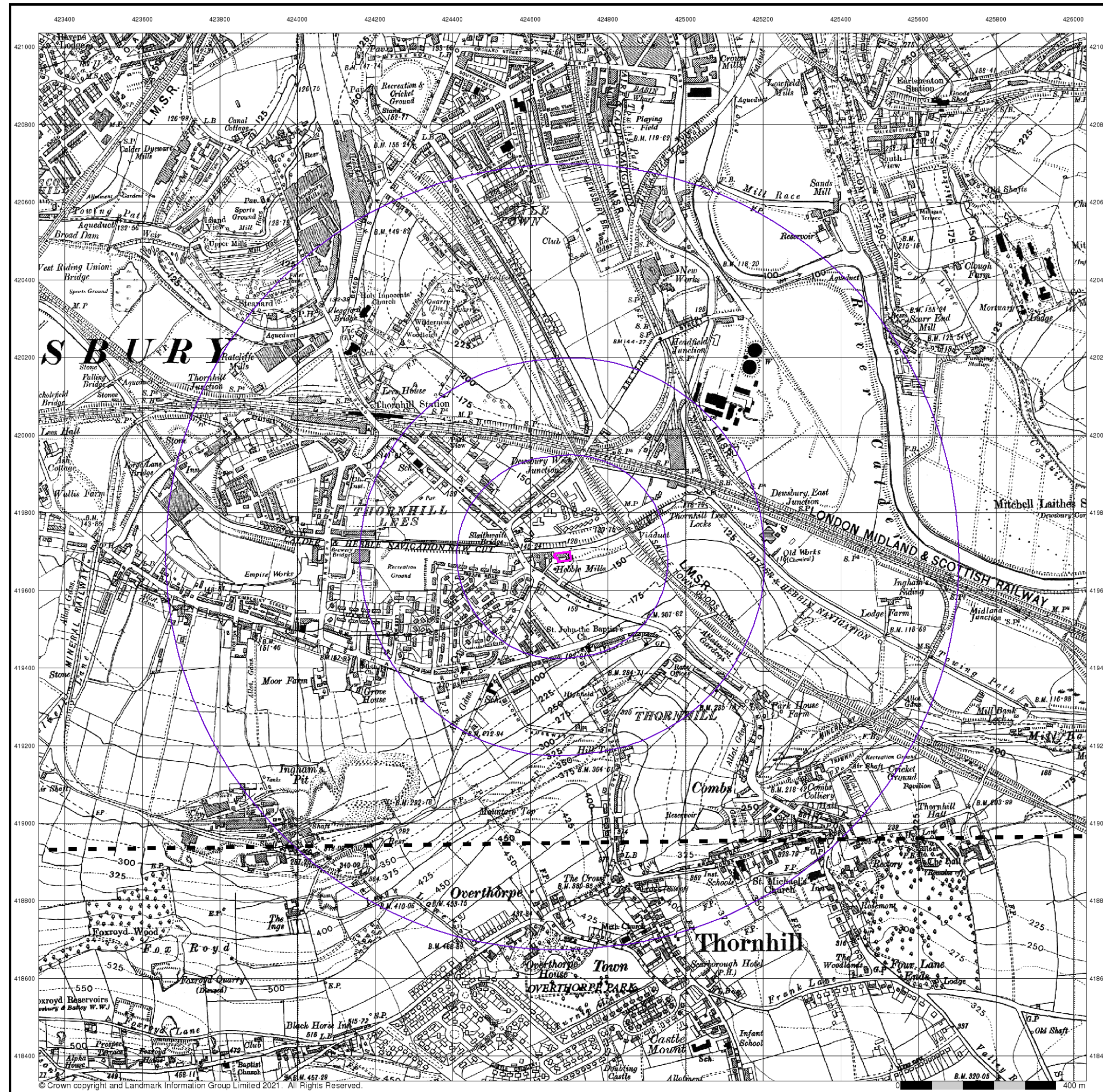
Order Number: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

Site Details

Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY



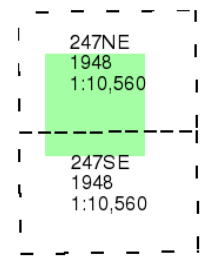
Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk



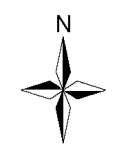
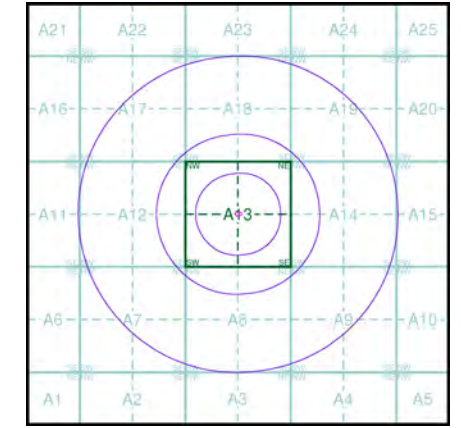
Yorkshire
Published 1948
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

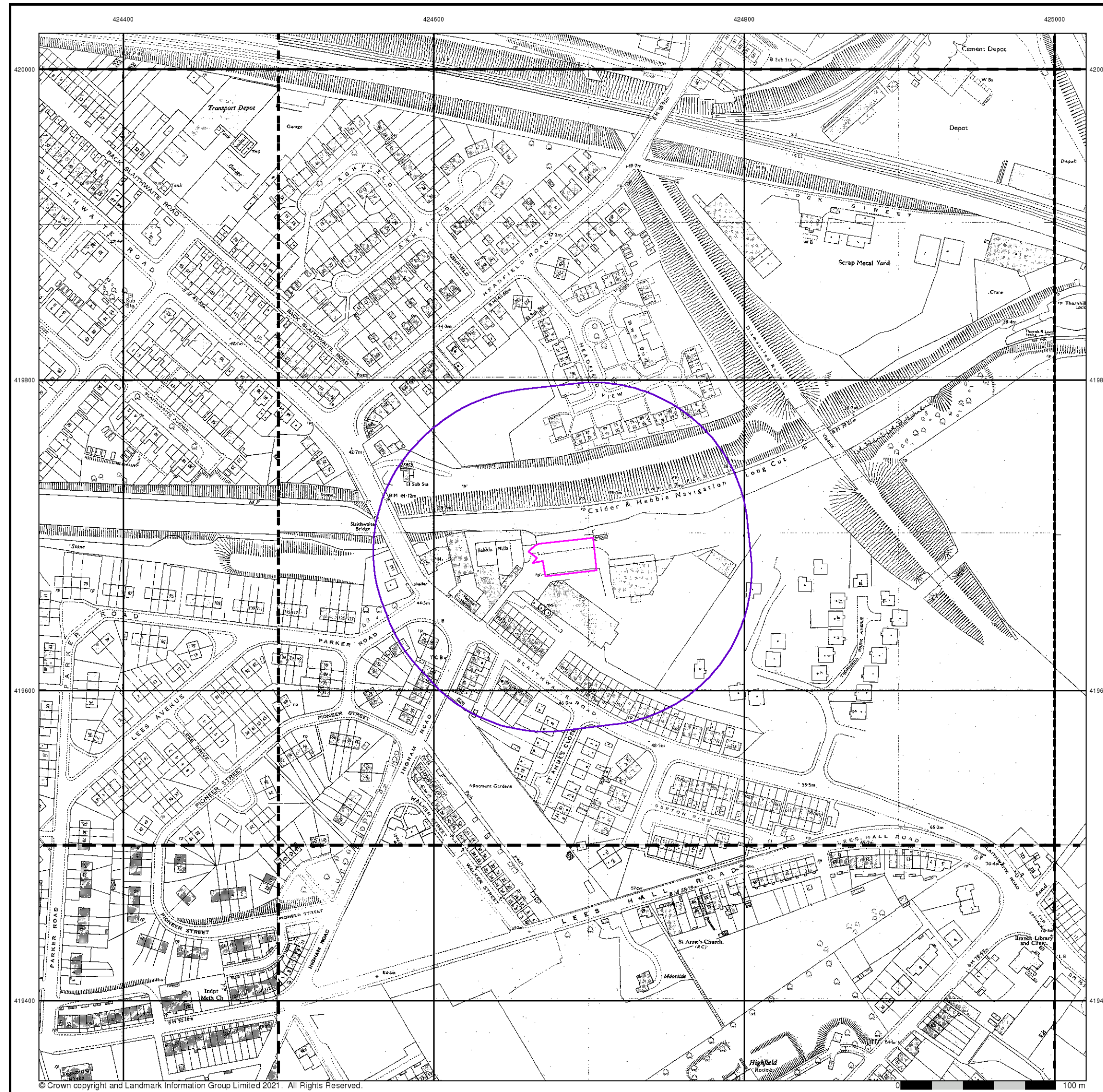
Order Number: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

Site Details

Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY



Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk



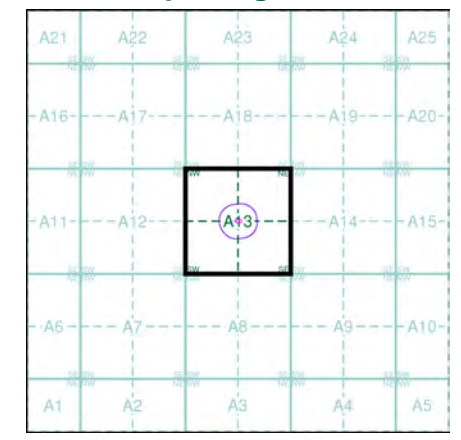
Additional SIMs
Published 1955 - 1989
Source map scale - 1:1,250

The SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

SE2420SW	SE2420SE	SE2520SW
1979	1987	1978
1:1,250	1:1,250	1:1,250
SE2419NW	SE2419NE	SE2519NW
1989	1989	1989
1:1,250	1:1,250	1:1,250
SE2419SW	SE2419SE	SE2519SW
1955	1984	1989
1:1,250	1:1,250	1:1,250

Historical Map - Segment A13



Order Details

Order Number: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 100

Site Details

Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY



Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk



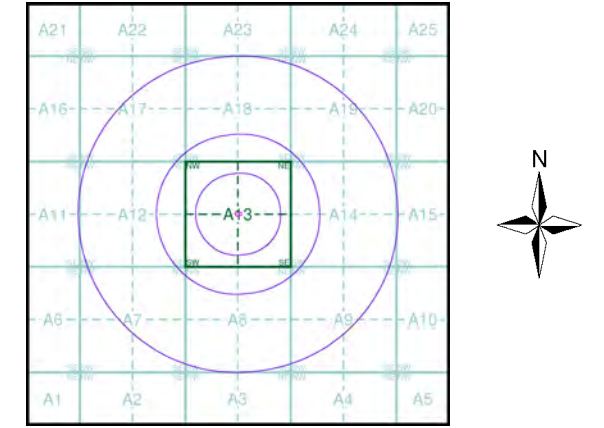
Ordnance Survey Plan
Published 1982 - 1984
Source map scale - 1:10,000

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

SE22SW	SE22SE
1983	1982
1:10,000	1:10,000
SE21NW	SE21NE
1983	1984
1:10,000	1:10,000

Historical Map - Slice A



Order Details
 Order Number: 286470364_1_1
 Customer Ref: UK21.5618
 National Grid Reference: 424680, 419690
 Slice: A
 Site Area (Ha): 0.08
 Search Buffer (m): 1000

Site Details
 Hebble Court, Thornhill Lees, Dewsbury, WF12 0AY

Landmark INFORMATION GROUP
 Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk



APPENDIX G

Site Specific Borehole Logs



Borehole Log

Borehole No.

WS01

Sheet 1 of 1

Project Name: Hebble Court, Dewsbury

Project No.
UK21.5618

Co-ords: 424702E - 419683N

Hole Type
WLS

Location: Hebble Court, Dewsbury, WF12 0AY

Level: 47.00 m AOD

Scale
1:27

Client: Mr. Siraj Patel

Dates: 21/10/2021

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	In Situ Results				
		0.30 - 0.40 0.30	ES PID	PID=0.00				MADE GROUND: Firm dark brown mottled orangish brown and grey slightly sandy gravelly clay. Gravel is angular to subangular fine to coarse of sandstone, mudstone, coal and brick fragments with some rootlets.
		1.00	SPT	N=15 (2,3/3,4,4,4)	1.50	47.00		MADE GROUND: Firm becoming stiff orangish brown mottled blueish grey slightly sandy silty clay with some rootlets.
		1.80 - 1.90	ES					
		2.00 - 2.45 2.00	D SPT	N=10 (2,2/2,2,3,3)				
		2.70 2.80 - 2.90 2.90 3.00	ES SPT	HVP=133 HVP=98 N=22 (4,4/4,6,6,6)				
	4.00	SPT	N=38 (7,10/10,9,10,9)	3.60	45.50		Stiff friable greyish brown mottled orangish brown sandy silty CLAY.	
	5.00	SPT	N=60 (9,10/60 for 255mm)					
				5.25	43.40		End of Borehole at 5.250m	

Remarks

No groundwater encountered.





Borehole Log

Borehole No.

WS02

Sheet 1 of 1

Project Name: Hebble Court, Dewsbury

Project No.
UK21.5618

Co-ords: 424689E - 419689N

Hole Type
WLS

Location: Hebble Court, Dewsbury, WF12 0AY

Level: 47.00 m AOD

Scale
1:27

Client: Mr. Siraj Patel

Dates: 21/10/2021

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	In Situ Results					
		0.80 - 1.00	ES				MADE GROUND: Firm dark brown mottled orangish brown and grey slightly sandy gravelly clay. Gravel is angular to subangular fine to coarse of sandstone, mudstone, coal, concrete and brick fragments with some rootlets. <i>Between 0.10m to 0.20m, Medium angular to subangular cobble content of concrete.</i>		
		1.00	SPT	N=28 (4,6/7,7,7,7)				1	
		2.00	SPT	N=9 (2,3/2,2,3,2)	1.90			47.00	2
		2.60		HVP=102					
		2.80		HVP=104					
	3.00	SPT	N=50 (5,8/50 for 170mm)	3.17	45.10		<i>Between 3.10m to 3.17m, Extremely weak thickly laminated sandstone recovered from SPT (Possible cobble).</i> End of Borehole at 3.170m		
							3		
							4		
							5		

Remarks

No groundwater encountered.





Borehole Log

Borehole No.

WS03

Sheet 1 of 1

Project Name: Hebble Court, Dewsbury

Project No.
UK21.5618

Co-ords: 424674E - 419686N

Hole Type
WLS

Location: Hebble Court, Dewsbury, WF12 0AY

Level: 47.00 m AOD

Scale
1:27

Client: Mr. Siraj Patel

Dates: 21/10/2021

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	In Situ Results							
		1.20 - 1.40 1.20	ES	HVP=102	0.10	47.00		MADE GROUND: Very weak concrete.			
					0.50	46.90		MADE GROUND: Greyish brown sandy angular to subangular fine to coarse gravel of sandstone, limestone and concrete fragments.			
					0.80	46.50		MADE GROUND: Firm dark brown mottled orangish brown and grey slightly sandy gravelly clay. Gravel is angular to subangular fine to coarse of sandstone, mudstone, coal and brick fragments with some rootlets.			
								MADE GROUND: Firm becoming stiff orangish brown mottled blueish grey slightly sandy silty CLAY with some rootlets.			
					1.90		HVP=98				
					2.00	46.20		Stiff friable greyish brown mottled orangish brown slightly gravelly sandy CLAY. Gravel is angular to subangular fine to medium of sandstone and siltstone.			
		2.40		HVP=104							
		2.80		HVP=91							
		3.80 - 4.00	D								
					5.00	45.00					
End of Borehole at 5.000m											

Remarks

No groundwater encountered.





Borehole Log

Borehole No.

WS04

Sheet 1 of 1

Project Name: Hebble Court, Dewsbury

Project No.
UK21.5618

Co-ords: 424677E - 419680N

Hole Type
WLS

Location: Hebble Court, Dewsbury, WF12 0AY

Level: 47.00 m AOD

Scale
1:27

Client: Mr. Siraj Patel

Dates: 21/10/2021

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	In Situ Results				
		0.10 - 0.30	ES		0.10	47.00	MADE GROUND: Very weak concrete.	
		0.30 - 0.40	ES				MADE GROUND: Dark grey mottled reddish brown silty sandy angular to subangular fine to coarse gravel of sandstone, quartz, slag and brick fragments.	
		0.90 - 1.00	D		0.70	46.90	MADE GROUND: Firm friable greyish brown mottled orangish brown slightly gravelly sandy CLAY with some rootlets. Gravel is angular to subrounded fine to medium of sandstone and siltstone.	
		1.00	SPT	N=7 (2,2/1,2,2,2)				
		1.20 - 1.40	ES					
		2.00	SPT	N=9 (2,2/2,2,2,3)	2.40	46.30	Stiff friable orangish brown mottled greyish brown sandy silty CLAY with occasional rootlets.	
		2.70		HVP=131				
		2.80		HVP=147				
		3.00	SPT	N=25 (3,4/5,5,7,8)				
		4.00	SPT	N=53 (6,6/53 for 295mm)	4.29	44.60		
							End of Borehole at 4.290m	

Remarks

No groundwater encountered.





Borehole Log

Borehole No.

WS05

Sheet 1 of 1

Project Name: Hebble Court, Dewsbury

Project No.
UK21.5618

Co-ords: 424686E - 419680N

Hole Type
WLS

Location: Hebble Court, Dewsbury, WF12 0AY

Level: 47.00 m AOD

Scale
1:27

Client: Mr. Siraj Patel

Dates: 21/10/2021

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	In Situ Results				
		0.10			0.10	47.00	MADE GROUND: Very weak concrete.	1 2 3 4 5
		0.30	PID	PID=0.00			MADE GROUND: Greyish brown sandy angular to subangular fine to coarse gravel of sandstone, limestone and concrete fragments.	
		0.60 - 0.70 0.60	ES PID	PID=0.00	0.50	46.90	MADE GROUND: Dark grey mottled reddish brown silty sandy angular to subangular fine to coarse gravel of sandstone, quartz, slag and brick fragments.	
		1.80		HVP=79	0.80	46.50	MADE GROUND: Firm friable greyish brown mottled orangish brown slightly gravelly sandy CLAY with some rootlets. Gravel is angular to subrounded fine to medium of sandstone and siltstone.	
		2.20		HVP=94				
		2.80			2.80	46.20	Stiff friable orangish brown mottled greyish brown sandy silty CLAY with occasional rootlets.	
	3.80 - 4.00	ES						
	4.40 - 4.50	D						
				4.50	44.20		End of Borehole at 4.500m	

Remarks

No groundwater encountered.





APPENDIX H

Laboratory Results – Environmental

EPS Ltd
7B Caxton House
Broad Street
Cambourne
Cambridgeshire
CB23 6JN



Attention : Jack Johnson
Date : 5th November, 2021
Your reference : UK21.5618
Our reference : Test Report 21/16766 Batch 1
Location : Hebble Court, Dewbury
Date samples received : 23rd October, 2021
Status : Final Report
Issue : 1

Ten samples were received for analysis on 23rd October, 2021 of which four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:



Bruce Leslie
Project Manager

Please include all sections of this report if it is reproduced

Client Name: EPS Ltd
Reference: UK21.5618
Location: Hebble Court, Dewbury
Contact: Jack Johnson

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Date Of Analysis	Analysis	Result
21/16766	1	WS01	0.30-0.40	3	02/11/2021	General Description (Bulk Analysis)	soil/stones
					02/11/2021	Asbestos Fibres	NAD
					02/11/2021	Asbestos ACM	NAD
					02/11/2021	Asbestos Type	NAD
					02/11/2021	Asbestos Level Screen	NAD
21/16766	1	WS04	0.30-0.40	16	02/11/2021	General Description (Bulk Analysis)	soil
					02/11/2021	Asbestos Fibres	NAD
					02/11/2021	Asbestos ACM	NAD
					02/11/2021	Asbestos Type	NAD
					02/11/2021	Asbestos Level Screen	NAD
21/16766	1	WS04	1.20-1.40	18	02/11/2021	General Description (Bulk Analysis)	soil
					02/11/2021	Asbestos Fibres	NAD
					02/11/2021	Asbestos ACM	NAD
					02/11/2021	Asbestos Type	NAD
					02/11/2021	Asbestos Level Screen	NAD
21/16766	1	WS05	0.60-0.70	20	02/11/2021	General Description (Bulk Analysis)	soil/stones
					02/11/2021	Asbestos Fibres	NAD
					02/11/2021	Asbestos ACM	NAD
					02/11/2021	Asbestos Type	NAD
					02/11/2021	Asbestos Level Screen	NAD

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 21/16766

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Please include all sections of this report if it is reproduced

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 21/16766

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes	Yes	AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes	Yes	AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
PM13	A visual examination of the solid sample is carried out to ascertain sample make up, colour and any other inclusions. This is not a geotechnical description.	PM0	No preparation is required.			AR	No

EMT Job No: 21/16766

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.			AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21B	As Received samples are extracted in Methanol: Water (60:40) by reciprocal shaker.			AR	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry); WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes	Yes	AD	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes	Yes	AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes	Yes	AD	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM50	Acid soluble sulphate (Total Sulphate) analysed by ICP-OES	PM29	A hot hydrochloric acid digest is performed on a dried and ground sample, and the resulting liquor is analysed.	Yes	Yes	AD	Yes
TM65	Asbestos Bulk Identification method based on HSG 248 First edition (2006)	PM42	Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	



APPENDIX I

Generic Screening Criteria



EPS Generic Quantitative Risk Assessment

Generic Screening Criteria (C4SLs) - All Land Uses

Contaminant	Soil Targets					
	Residential		Allotments	Commercial	Public Open Spaces	
	With Home Grown Produce	Without Home Grown Produce			Residential	Parks
Unit	mg/kg					
Arsenic	37	40	49	640	79	168
Benzene	0.87	3.3	0.18	98	140	230
Benzo(a)pyrene	5	5.3	5.7	76	10	21
Cadmium	26	149	4.9	410	220	880
Chromium (VI)	21	21	170	49	23	250
Lead	200	310	80	2330	630	1300
Chloroethene (Vinyl Chloride)	0.017	0.029	0.0058	2.2	7.8	19
Trichloroethene (TCE)	0.043	0.045	0.16	3.4	79	69
Tetrachloroethene (PCE)	1.6	1.6	11	130	3400	2500

Notes:

Targets for Human Health have been taken from the publicly available Category 4 Screening Levels (C4SLs) for assessment of land affected by contamination issued by DEFRA/CL:AIRE in December 2013 and May 2021.

Within the modelling for C4SLs, a Soil Organic Matter content of 6% has been used. Reference to site-specific data should be made where possible.

The C4SLs for the contaminant benzene along with the three chlorinated solvents are the most susceptible to changes in SOM.

EPS Generic Quantitative Risk Assessment - Residential Land Use

Contaminant	Soil Targets			Groundwater Targets	
	Human Health	Controlled Waters		Controlled Waters	
		LGWRP	HGWRP	LGWRP	HGWRP
Unit	mg/kg			ug/l	
Arsenic	See C4SL	n/c	n/c	50	10
Cadmium	See C4SL	n/c	n/c	5	5
Chromium III	910	n/c	n/c	250	50
Chromium VI	See C4SL	n/c	n/c	n/c	n/c
Copper	2400	n/c	n/c	28	28
Mercury (elemental)	1.2	n/c	n/c	1	1
Nickel	180	n/c	n/c	200	50
Lead	See C4SL	n/c	n/c	250	10
Selenium	250	n/c	n/c	10	10
Zinc	3700	n/c	n/c	500	500
Benzene	See C4SL	0.252	0.008	30	1
Toluene	130	1.17	1.17	50	50
Ethylbenzene	47	15.0	10.0	300	200
Xylene (para)	56	0.885	0.885	30	30
MTBE#	49	0.138	0.0276	75	15
Benzo(a)Pyrene	See C4SL	10	1.44	0.7	0.1
Naphthalene	2.3	0.934	0.02	10	0.1
Dibenz(ah)anthracene	0.24	n/c	n/c	n/c	n/c
Aliphatic C5-C6	42	5.27	1.05	50	10
Aliphatic C6-C8	100	23.2	4.64	50	10
Aliphatic C8-C10	27	175	35.1	50	10
Aliphatic C10-C12	130(48)*	1380	276	50	10
Aliphatic C12-C16	1100(8.48)**	27500	5490	50	10
Aliphatic C16-C35	65000 (8.48)**	3.46E+06	6.91E+05	50	10
Aromatic C8-C10	34	8.74	1.75	50	10
Aromatic C10-C12	74	13.8	2.76	50	10
Aromatic C12-C16	140	27.5	5.5	50	10
Aromatic C16-C21	260	86.9	17.4	50	10
Aromatic C21-C35	1100	690	138	50	10

Notes:

LGWRP - Low Groundwater Resource Potential

HGWRP - High Groundwater Resource Potential

f = Oral, dermal and inhalation exposure compared with oral HCV N/C = Not Calculated

* = S4UL exceeds vapour saturation limit (in brackets)

** = S4UL exceeds solubility saturation limit (in brackets)

Soil Targets

Targets for Human Health have been taken from S4ULs 'Suitable For Use Levels for Human Health Risk Assessment' – LQM and CIEH (2014) derived using standard sandy loam soil with 1% SOM, except (#) = EIC/AGS/CL:AIRE GAC 'Soil Generic Assessment Criteria' (2010). For sites where ground conditions differ significantly from sandy loam or site-specific SOM and pH are available, the generic human health targets may be revised.

Targets for Controlled waters have been derived using EA Remedial Targets Worksheet (v3.1) - using standard Sandy Loam ground conditions as described in Science Report SC050021/SR3, assuming no degradation for a 10m compliance distance with criteria of EQS or UKDWS for LGWRP and HGWRP respectively (see notes for GW targets).

Groundwater Targets

For LGWRP, targets have been taken as Freshwater EQS where available. For Ethylbenzene and BaP the WHO Health limit has been used and for MTBE and individual TPH fractions a 5 times multiplier of taste threshold and UKDWS has been taken respectively.

For HGWRP, targets have been taken as UKDWS where available, with the exception of Copper and Zinc where the EQS is lower than the DWS and therefore the EQS has been used as the groundwater target. For Ethylbenzene the upper WHO ATO limit has been used. For Toluene and Xylene, the WHO ATO limit is higher than the EQS and so the lower value has been taken. For MTBE the taste threshold has been taken.


Work carried out to calculate generic screening criteria for concentrations of contaminant in groundwater with respect of risks to Human Health has generally found that criteria far exceed (by at least 2 orders of magnitude) those listed for the protection of either LGWRP and HGWRP receptors. On this basis, the above Groundwater criteria are also considered protective of human health and further evaluation of these risks should be considered alongside any detailed quantitative risk assessments carried out for groundwater on a site specific basis.

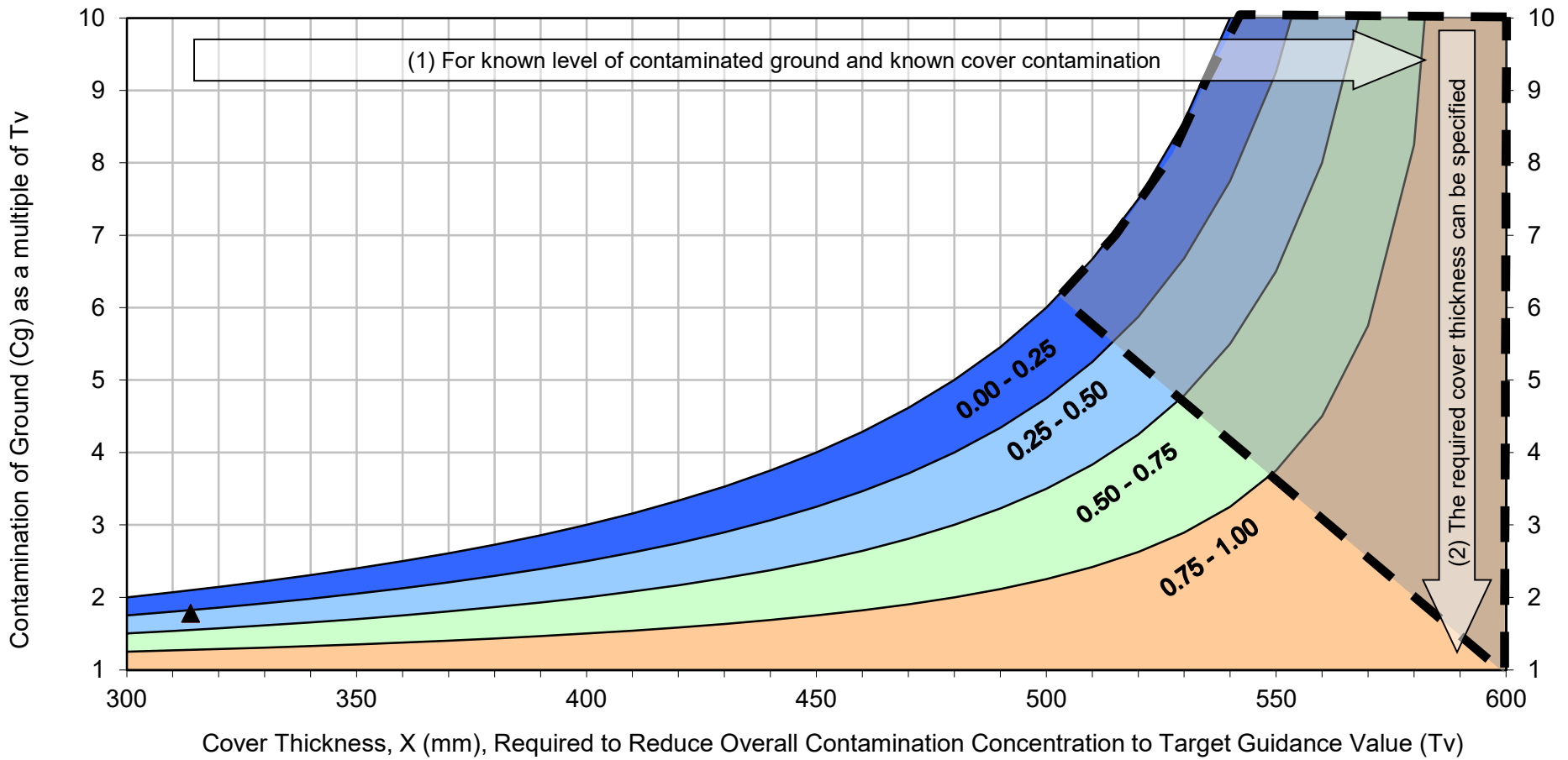


APPENDIX J

Cover Soils Calculations

Design Chart

■ Cc = 0.00 - 0.25 x Trigger levels	 If site specific data falls in shaded area consideration should be given to the applicability of using a cover system
■ Cc = 0.25 - 0.50 x Trigger levels	
■ Cc = 0.50 - 0.75 x Trigger levels	
■ Cc = 0.75 - 1.00 x Trigger levels	
▲ Target Guideline Value 2	
▲ Target Guideline Value 1	





APPENDIX K

Cover Soils Checklist



ADVISORY NOTE

SOILS FOR USE IN COVER SYSTEMS

This note applies where there is a need for a control measure in the form of a defined thickness of clean soil to be used in gardens and soft landscaped areas in order to reduce risks from underlying contamination (a 'cover system'). Where a specific thickness has been presented, it is what EPS consider sufficient provided the soil forming the cover system is good quality, as it is assumed that over time this soil will become intermixed with the underlying soils and therefore needs to have the necessary 'dilution' effect. The aim being that an acceptable reduction in exposure to contamination is achieved, rather than absolute prevention.

These simple cover systems are designed in general accordance with the BRE 2004 guidance '*Cover Systems for Land Regeneration, Thickness of Cover Systems for Contaminated Land*'. In many cases guidance from a Local Planning Authority or NHBC/Approved Inspector may also apply and need to be taken into account. In most cases, to design the cover system EPS have to assume a certain quality of cover soils in advance. In these circumstances, we utilise what we consider to represent 'good quality soil' in that the soil could never be considered 'contaminated' but is also pragmatic and does not represent an unrealistic or unsustainable objective for much of the soils in the UK. In numerical terms, this standard typically equates to soil containing contaminants at around 25% of their adopted screening values in the risk assessment.

For the cover system itself, EPS would usually carry out a verification process of your site to demonstrate the control measure has been implemented as intended to satisfy all interested parties such as planning authorities, the NHBC and the future property owner. To document this process, EPS will prepare a Verification Report. If you wish for EPS to do this, we will need the following points confirmed relating to the soils preferably before they are installed in gardens.

If there are any queries, please contact EPS before purchasing any soil.

EPS Contact Details:

Tel: 01954 710666

Email: info@epstrategies.co.uk



Pre-Verification Cover System Checklist		Yes?
Soil Source	The soil must not be a waste. Has it been confirmed that the soil is not a waste and has never been deemed as such in the past?	
	Has the source of the soil been provided?	
	Have all the delivery notes confirming the source, volume and type of soil been provided for all that is to be used? Where suppliers such as British Sugar are used, the soils should be delivered direct to site (not via an intermediary depot).	
Soil Quality	The soils are free of invasive plant species such as Japanese Knotweed, and have not been sourced from an affected area?	
	Do the soils look clean and of a high quality? I.e. the soil must not have an odour or contain any visual evidence of contamination, including oils, asbestos, glass, plastic, rubble, metal, ash, sharp objects or tarmac/bitumen?	
	Testing to 'BS 3882:2015 <i>Specification for topsoil and requirements for use</i> ' is preferable but generally not essential for public health regulation, provided you can confirm the soils comply with the above points, are suitable for their intended purpose and will provide an adequate growing medium?	
	<p>Has the soil been chemically tested prior to it arriving at site?</p> <p>Any soil test results presented to EPS by a third party must be current and clearly relate to the soil used, i.e. the testing must generally be dated within 6 weeks of delivery. The quantity of testing will be dependent on how much confidence is generated in the quality of the material, as well any specific local regulatory requirements. If the soil is clean soil from an established source such as British Sugar, the testing they provide at source may be sufficient alone without further testing (by EPS).</p> <p>For other soils, EPS can advise on the likely testing frequencies but as a rule of thumb, anticipate at least one sample per average-sized plot. The testing would usually comprise the following: Heavy Metals, Poly Aromatic Hydrocarbons, Asbestos and Total Petroleum Hydrocarbons at an accredited lab. If adequate testing has not been completed, then EPS will need to test it from stockpiles prior to installation. Installing the soils into gardens without any testing data is not advised, as it may need to all be removed later.</p>	
Cover Thickness	Are all excavations ready which will allow the necessary thickness of cover soils to be installed?	
	If yes, can you provide waste transfer documentation for any excavated soils?	



APPENDIX L

Ground Gas Geomembrane Specification

Juta (UK) Ltd
Melton Grove Works
Church Road
Lytham FY8 5PL

Tel: 01772 754177
e-mail: info@juta.co.uk
website: www.juta.co.uk



Agreement Certificate

18/5581

Product Sheet 1

GP TITANTECH WATERPROOFING, GAS AND HYDROCARBON MEMBRANES

GP TITANFLEX MEMBRANES

This Agreement Certificate Product Sheet⁽¹⁾ relates to GP⁽²⁾ TITANFLEX Membranes, a range of multilayer thermoplastic membranes with a core layer that is resistant to ground gases, hydrocarbons and volatile organic compounds (VOCs). The products are for use as damp-proof membranes and to protect the building from the ingress of water vapour, radon, methane and carbon dioxide, hydrocarbons and volatile organic compounds (VOCs).

(1) Hereinafter referred to as 'Certificate'.

(2) GP is a registered trademark.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.



KEY FACTORS ASSESSED

Resistance to water and water vapour — the products, including joints, will provide an effective barrier to the passage of moisture from the ground (see section 6).

Resistance to underground gases — the products are capable of restricting the ingress of radon, methane and carbon dioxide into the structure (see section 7).

Resistance to chemicals — the products are chemically resistant and will reduce the transmission of VOCs (see section 8).

Resistance to damage — the products have satisfactory resistance to damage (see section 9).

Durability — under normal service conditions, the products will remain effective against the ingress of water and water vapour, and will restrict the ingress of radon, methane, carbon dioxide and VOC vapours for the lifetime of the structure in which they are installed (see section 11).



The BBA has awarded this Certificate to the company named above for the products described herein. These products have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate

On behalf of the British Board of Agrément

Claire Curtis-Thomas

Date of First issue: 23 October 2018

John Albon – Head of Approvals
Construction Products

Claire Curtis-Thomas
Chief Executive

The BBA is a UKAS accredited certification body – Number 113.

The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agreement Certificate by either referring to the BBA website or contacting the BBA direct.

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

British Board of Agrément

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Watford
Herts WD25 9BA

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tel: 01923 665300
clientservices@bbacerts.co.uk
www.bbacerts.co.uk

Regulations

In the opinion of the BBA, GPTITANFLEX Membranes, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	C1(2)	Site preparation and resistance to contaminants
Comment:		The products will contribute to a construction satisfying this Requirement. See sections 7.1, 7.2 and 8 of this Certificate.
Requirement:	C2(a)	Resistance to moisture
Comment:		The products, including joints, will enable a structure to satisfy this Requirement. See section 6 of this Certificate.
Regulation:	7	Materials and workmanship
Comment:		The products are acceptable. See section 11.1 and the <i>Installation</i> part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)	Durability, workmanship and fitness of materials
Comment:		The use of the products satisfies the requirements of this Regulation. See section 11.1 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	3.1	Site preparation – harmful and dangerous substances
Standard:	3.2	Site preparation – protection from radon gas
Comment:		When properly installed in a correctly designed structure, the products will form an effective barrier to the movement of radon, methane, carbon dioxide and VOC vapours enabling compliance with these Standards, with reference to clauses 3.1.2 ⁽¹⁾⁽²⁾ , 3.1.6 ⁽¹⁾⁽²⁾ , 3.1.7 ⁽¹⁾⁽²⁾ and 3.2.2 ⁽¹⁾⁽²⁾ . See sections 7.1, 7.2 and 8 of this Certificate.
Standard:	3.4	Moisture from the ground
Comment:		The products, including joints, will enable a structure to satisfy the requirements of this Standard, with reference to clauses 3.4.2 ⁽¹⁾⁽²⁾ , 3.4.4 ⁽¹⁾⁽²⁾ 3.4.6 ⁽¹⁾⁽²⁾ . See section 6 of this Certificate.
Standard:	7.1(a)	Statement of sustainability
Comment:		The products can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	12	Building standards applicable to conversions
Comment:		Comments in relation to the products under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1 ⁽¹⁾⁽²⁾ and Schedule 6 ⁽¹⁾⁽²⁾ .

(1) Technical Handbook (Domestic).

(2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	23(a)(i)	Fitness of materials and workmanship
Comment:	(iii)(b)(i)	The products are acceptable. See section 11.1 and the <i>Installation</i> part of this Certificate.

Regulation:	26(1)(b)	Site preparation and resistance to contaminants
Comment:	26(2)	The products will contribute to a construction satisfying the requirements of this Regulation. See sections 7.1, 7.2 and 8 of this Certificate.
Regulation:	28(a)	Resistance to moisture and weather
Comment:		The products, including joints, will enable a structure to satisfy this Regulation. See section 6 of this Certificate.

Construction (Design and Management) Regulations 2015 Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See section: 3 *Delivery and site handling* of this Certificate.

Additional Information

NHBC Standards 2018

In the opinion of the BBA, GP TITANFLEX Membranes, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to *NHBC Standards*, Chapters 4.1 *Land quality – managing ground conditions* and 5.1 *Substructure and ground bearing floors*, Clause 5.1.20 *Damp-proofing concrete floors*, for use below the slab and in sandwich constructions.

CE marking

The Certificate holder has taken the responsibility of CE Marking the products in accordance with harmonised European Standard EN 13967 : 2012. An asterisk (*) appearing in this Certificate indicates that data shown are given in the manufacturer's Declaration of Performance.

Technical Specification

1 Description

1.1 GP TITANFLEX Membranes are a range of multilayer polyethylene waterproofing membranes with a gas and VOC resistant core available in three thicknesses as shown in Table 1:

Product	Thickness (mm)
GP TITANFLEX	0.50
GP TITANFLEX+	0.75
GP TITANFLEX XL	1.00

1.2 The products are available in black/silver colour as standard and have the nominal characteristics given in Table 2. Other colours are available on request.

Table 2 Nominal characteristics

Characteristic (unit)	GP TITANFLEX	GP TITANFLEX+	GP TITANFLEX XL
Roll Length (m)	50	50	50
Roll Width (m)	2.0	2.0	2.0
Mass per unit area (g·m ⁻²)	500	750	1000
Impact resistance (mm)	≥ 650	≥ 950	≥ 950
Tensile strength* (N·50 mm ⁻¹)			
MD	≥ 550	≥ 550	≥ 550
CD	≥ 400	≥ 400	≥ 400
Elongation (%)	≥ 550	≥ 550	≥ 550
Water vapour transmission (g·m ⁻² ·day ⁻¹)	0.11-0.18	0.11-0.18	0.11-0.18
Watertightness* (60 kPa)	Pass	Pass	Pass
Nail tear* (N)			
MD and CD	≥ 300	≥ 450	≥ 450
Resistance to static loading* (kg)	≥ 20	≥ 20	≥ 20

1.3 An ancillary item for use with the products and included in this assessment is GP TAPE, an extruded double-sided butyl rubber based tape used to form lap joints in the membranes when used in damp-proofing applications. A 100 mm wide version of the tape is also available marketed as GP TITANTAPE.

1.4 Other ancillary items for use with the products, but outside the scope of this Certificate, include:

- protection fleece and/or protection boards for use above and below the membranes to protect them from damage during the installation
- fleece-backed butyl sealing tape for use over joints to provide additional protection and a smooth finish
- foil-backed tape for use over lap joints above ground when not subject to hydrostatic pressure
- pre-fabricated corner units and top hats
- specialised sealants and liquid-applied membranes for sealing around penetrations and pile caps
- void-vent geocomposite membrane for use as part of a gas/VOC restrictive system.

The Certificate holder should be consulted for suitable products.

2 Manufacture

2.1 The products are manufactured by extrusion and laminating processes.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

2.3 The management system of the manufacturer have been assessed and registered as meeting the requirements of EN ISO 9001 : 2008 by TÜV Austria (Certificate 010150310/02).

3 Delivery and site handling

3.1 The products are delivered to site in 50 x 2 m rolls wrapped in polyethylene film on pallets. Other roll sizes are available on request. Pallets include a maximum of 25 rolls. Pallets are shrink-wrapped for transportation.

3.2 The 50 x 2 m rolls have nominal weights of:

GP TITANFLEX	50 kg
GP TITANFLEX+	75 kg
GP TITANFLEX XL	100 kg.

3.3 GP TAPE and GP TITANTAPE are available in rolls of 50 mm x 1.5 mm x 10 m, and 100 mm x 1.5 mm x 15 m respectively, in black. The products are packed into cardboard boxes. Each box contains 12 rolls of GP TAPE and four rolls of GP TITANTAPE. Each box has a nominal weight of 1 kg.

3.4 The Certificate holder has taken the responsibility of classifying and labelling the products under the *CLP Regulation (EC) No 1272/2008 on the classification, labelling and packaging of substances and mixtures*. Users must refer to the relevant Safety Data Sheet(s).

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on GP TITANFLEX Membranes.

Design Considerations

4 Use

4.1 GP TITANFLEX Membranes are satisfactory for use as gas-resistant barriers to restrict the ingress of radon, methane, carbon dioxide and VOCs into buildings from landfill and naturally occurring sources. The products are chemically resistant when in contact with hydrocarbons, see section 8.

4.2 Buildings in areas at risk from radon, methane or carbon dioxide should be constructed in accordance with the recommendations of BRE Report BR 211 : 2015, and following the guidance set out in BS 8485 : 2015.

4.3 When used in buildings in areas at risk from VOCs, the guidance given in CIRIA Report C748 : 2014 should be followed.

4.4 The products are also satisfactory for use as damp-proofing membranes for solid floors in accordance with the relevant clauses of CP 102 : 1973 Section 3, BS 8000-0 : 2014 and BS 8000-4 : 1989.

4.5 The products should be fully protected immediately after they are installed, in accordance with the Certificate holder's instructions.

5 Practicability of installation

The products should only be installed by installers who have been trained and approved by the Certificate holder. The Certificate holder must be consulted for suitable installers.

6 Resistance to water and water vapour



6.1 The products, including joints, when completely sealed and consolidated, will resist the passage of moisture from the ground and so satisfy the relevant requirements of the national Building Regulations.

6.2 When installed in accordance with the following documents, the membranes will comply with the minimum sheet thickness detailed in the national Building Regulations:

England and Wales — Approved document C, Requirements C2(a), Section 4.8

Scotland — Mandatory Standard 3.4, Technical Handbook⁽¹⁾⁽²⁾ (clauses 3.4.2, 3.4.4 and 3.4.6)

Northern Ireland — Technical Booklet C, Regulation 28(a), section 5.5.

(1) Technical Handbook – Domestic.

(2) Technical Handbook – Non-domestic.

7 Resistance to underground gases



7.1 The products, including hot air welded joints, will restrict the ingress of radon, methane and carbon dioxide into buildings from landfill and naturally occurring sources, and satisfy the performance for a gas-resistant membrane as defined in BS 8485 : 2015.

7.2 Measured gas permeability/diffusion values on unjointed GP TITANFLEX Membranes are given in Table 3.

Table 3 Measured gas transmission rates and radon diffusion coefficient of GP TITANFLEX Membranes

Gas	Method	Result
Methane membrane without joint ⁽¹⁾	ISO 15105-1	0.13 ml·m ⁻² ·day ⁻¹ ·atm ⁻¹
membrane with joint ⁽²⁾		≤ 1 ml·m ⁻² ·day ⁻¹ ·atm ⁻¹
Carbon dioxide (membrane without joint) ⁽¹⁾	ISO 15105-1	3.01 ml·m ⁻² ·day ⁻¹ ·atm ⁻¹
Radon	Czech University (method K124/02/95)	1.0 x 10 ⁻¹² m ² ·s ⁻¹

(1) 0.50 mm thick GP TITANFLEX membrane tested.

(2) Hot air welded joint tested.

7.3 BRE Report BR 211 : 2015 recommends a 300 µm thick polyethylene sheet as a minimum required thickness for a radon gas-resistant membrane. It is generally accepted that other materials with comparable or higher gas-resistance are suitable, provided they can withstand the construction process. In the opinion of the BBA, the products satisfy these criteria.

8 Resistance to chemicals



8.1 The products, including hot air welded joints, are resistant to the chemicals commonly found on construction sites. The results of immersion tests on a range of chemicals, including hydrocarbons, are given in Table 4. Site-specific examination and assessment should be carried out on a case by case basis to establish the suitability for any specific application and the need for additional testing.

Table 4 Resistance to chemicals of GP TITANFLEX Membranes

Test method	Exposure chemical(s)	Retained Tensile strength/elongation (%)	Result
BS EN 14414 : Method A	Sulphuric acid (10% solution)	MD 108/117 CD 118/123	Pass
BS EN 14414 : Method B	Calcium hydroxide solution (saturated)	MD 108/118 CD 107/122	Pass
BS EN 14414 : Method C	Diesel, paraffin, lubricating oil mixture	MD 86/97 CD 80/92	Pass
BS EN 14414 : Method D	Synthetic leachate comprising a mixture of organic acids, glucose, chlorides, sulfates and phosphate	MD 101/103 CD 96/101	Pass
BS EN 14414	Benzene (saturated solution in water)	MD 95/101 CD 102/104	Pass
	Toluene (saturated solution in water)	MD 94/103 CD 91/96	Pass
	Ethyl benzene (saturated solution in water)	MD 99/100 CD 97/95	Pass
	m,p,o-Xylenes (saturated solution in water)	MD 91/93 CD 106/103	Pass
	Tetrachloroethene (PCE) (saturated solution in water)	MD 93/97 CD 102/104	Pass
	Trichloroethene (TCE) (saturated solution in water)	MD 99/102 CD 93/100	Pass
	Hexane (saturated solution in water)	MD 99/100 CD 104/99	Pass
	Napthalene (saturated solution in water)	MD 101/101 CD 93/99	Pass

8.2 Measured vapour transmission rates for a range of VOCs are given in Table 5. A site-specific risk assessment should be carried out to establish the products' suitability for any specific application.

Table 5 Measured vapour transmission rates of volatile organic compounds for GP TITANFLEX Membranes⁽¹⁾

Volatile liquid	Method	Result	
		(mg·m ⁻² ·day ⁻¹)	(ml·m ⁻² ·day ⁻¹)
Benzene ⁽²⁾	ISO 15105-2 (Annex B)	3.6	1.04
Toluene ⁽²⁾	ISO 15105-2 (Annex B)	13.8	3.36
Ethyl benzene ⁽²⁾	ISO 15105-2 (annex B)	2.7	0.56
m,p,o-Xylenes ⁽²⁾	ISO 15105-2 (Annex B)	7.7	1.62
Tetrachloroethene (PCE) ⁽²⁾	ISO 15105-2 (Annex B)	26.2	3.54
Trichloroethene (TCE) ⁽²⁾	ISO 15105-2 (Annex B)	54.7	9.32
Napthalene	ISO 15105-2 (Annex B)	< 0.0006	<0.0001
Hexane ⁽²⁾	ISO 15105-2 (Annex B)	0.6	0.15
Vinyl chloride	ISO 15105-2 (Annex B)	< 0.04	0.05 ⁽³⁾
Cis-1,2,-dichloroethene ⁽²⁾	ISO 15105-2 (Annex B)	< 1.1	≤ 0.3
1,1,2,2,-tetrachloroethane ⁽²⁾	ISO 15105-2 (Annex B)	< 0.008	≤ 0.001
1,1,2-trichloroethane ⁽²⁾	ISO 15105-2 (Annex B)	< 0.006	≤ 0.001

(1) Membranes in contact with test gases at saturated vapour pressure unless otherwise noted.

(2) Membranes in contact with the liquid.

(3) 0.05 cm³·m⁻²·day⁻¹·bar⁻¹.

9 Resistance to damage

9.1 The membranes can be punctured by sharp objects; care should be taken when handling building materials and tools over the exposed surface.

9.2 Provided there are no sharp objects present either below the membrane or on the membrane's surface during installation of the membrane and protective layer, the products will not be damaged by normal foot traffic.

10 Maintenance

As the products are confined within the structure and have suitable durability (see section 11), maintenance is not required. However, any damage occurring before enclosure must be repaired (see section 15).

11 Durability



11.1 The products, when fully protected in normal circumstances, will remain effective against the ingress of water and water vapour, and will restrict the ingress of radon, methane, carbon dioxide and VOC vapours for the lifetime of the building.

11.2 The products will not be affected by short term exposure to ultraviolet light to allow for installation. Long periods of exposure may however reduce the effectiveness of the membranes and they should be protected from UV as soon as practicable after they are installed.

12 Reuse and recyclability

The products contain polyethylene, which can be recycled.

Installation

13 General

13.1 GP TITANFLEX Membranes must be installed in accordance with the Certificate holder's instructions and this Certificate, and following the relevant guidance given in BRE Report BR 211 : 2015, BS 8485 : 2015 and CIRIA Report C748 : 2014.

13.2 The membranes can be installed in all normal site conditions, provided that the air temperature is not below -5°C and the membrane is free from condensation and ice that could affect jointing.

13.3 The surface onto which the membranes are to be laid must be smooth, dry and free from sharp protrusions and debris that could damage the membranes. Brickwork or blockwork must be flush pointed or rendered to provide a smooth surface.

13.4 For chemical and gas resistance applications, it is recommended the membranes are installed with hot air welded joints in accordance with the Certificate holder's instructions.

13.5 For VOC resistance applications, the membranes must be installed with hot air welded joints.

13.6 For damp proofing applications, joints in the membranes can be formed using GP TAPE or GP TITANTAPE.

13.7 The membranes must be protected as soon as possible after they are installed to minimise direct foot trafficking. Direct trafficking by vehicles must be avoided.

14 Procedure

Hot air welded joints

14.1 The membrane is rolled out and properly aligned to the structure.

14.2 Side laps and end laps must be a minimum of 100 mm and end laps should be staggered.

14.3 All surfaces must be dry before welding.

14.4 Before welding work is carried out, trials must be completed to determine the 'operating window' for the welding equipment, materials and ambient conditions. Typically, the operating window will be between 180 to 240°C at a rate of 1.5 m/min. In case of doubt, the Certificate holder should be consulted for advice.

14.5 Weld widths must be a minimum of 50 mm and must be checked for integrity after being formed.

14.6 All service penetrations and direction changes should be properly detailed in accordance with the Certificate holder's instructions. Service ducts should be vented to prevent the possibility of gas accumulating in confined spaces.

14.7 The continuity of the gas protection must extend over the footprint of the building, and the gas membrane must be sealed to a compatible gas-resistant damp-proof course. The use of the membranes as damp-proof courses is outside the scope of this Certificate and the Certificate holder must be consulted in these instances.

14.8 The membrane must be protected from UV and mechanical damage as soon as possible after installation.

14.9 For gas and VOC resistance applications, the membrane installation should be subject to third-party independent validation, in accordance with BS 8485 : 2015 and/or CIRIA Report C748 : 2014.

Taped joints

14.10 For use in damp-proofing applications the membrane can be jointed using GP TAPE or GP TITANTAPE.

14.11 After laying the first sheet, the protective release film on one side of the tape is removed and the tape applied to the clean membrane sheet along a 100 mm guide line from the edge.

14.12 The second layer of membrane should be unrolled over the first layer, ensuring an overlap of 150 mm and rolling with a silicone roller to remove any trapped air.

14.13 The joint can then be finished with a suitable sealing tape applied over the joint to provide a smooth finish.

15 Repair

15.1 Any damage to the membranes must be repaired using a patch of the membrane, and laps welded or sealed with GP TAPE or GP TITANTAPE and secured over the edges with a suitable butyl sealing tape. All patched areas must extend a minimum of 100 mm from the damaged area. For VOC resistance applications, laps must be hot air welded.

15.2 If required, repair work should be confirmed by an independent validation report, as all gas or VOC membrane installations should be subject to third-party validation in accordance with BS 8485 : 2015 and/or CIRIA Report C748 : 2014.

Technical Investigations

16 Tests

Tests were carried out and the results assessed to determine:

- visible defects
- characterisation by thermogravimetric analysis
- width, straightness and flatness
- mass per unit area
- thickness
- foldability at low temperature
- tensile strength and elongation
- airtightness of joints
- shear strength of joints
- dimensional stability
- resistance to static loading
- effect of heat ageing

- effect of water exposure
- effect of exposure to UV.

17 Investigations

17.1 An evaluation was made of the results of independent test data to establish:

- methane gas transmission (on unjointed and jointed membranes)
- carbon dioxide gas transmission
- radon gas diffusion coefficient
- transmission of vapours from VOCs
- tensile strength and elongation
- chemical resistance
- leaching resistance
- resistance to tearing (nail shank)
- resistance to impact
- Watertightness at 196.2 kPa hydrostatic pressure (including joints made with 50 mm wide GP TAPE).

17.2 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

Bibliography

BRE Report BR 211 : 2015 Radon — *Guidance on protective measures for new buildings*

BS 8000-0 : 2014_ Workmanship on construction sites — Introduction and general principles

BS 8000-4 : 1989 Workmanship on building sites — Code of practice for waterproofing

BS 8485 : 2015 *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*

BS EN 14414 : 2004 *Geosynthetics — Screening test method for determining chemical resistance for landfill applications*

BS ISO 15105-1 : 2007 *Plastics — Film and sheeting — Determination of gas-transmission rate — Differential-pressure methods*

BS ISO 15105-2 : 2003 *Plastics — Film and sheeting — Determination of gas-transmission rate — Equal-pressure method*

CIRIA C748 : 2014 *Guidance on the use of plastic membranes as VOC vapour barriers*

CP 102 : 1973 *Code of practice for protection of buildings against water from the ground*

EN 13967 : 2012 + A1 : 2017 *Flexible sheets for waterproofing — Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet — Definitions and characteristics*

EN ISO 9001 : 2008 *Quality management systems — Requirements*

18 Conditions

18.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

18.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

18.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

18.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

18.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

18.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.



APPENDIX M

Method Statement for Encountering Unexpected Contamination



METHOD STATEMENT

ACTIONS TO BE TAKEN IN THE EVENT OF DISCOVERING UNEXPECTED CONTAMINATION DURING INTRUSIVE GROUNDWORKS

If at any point during intrusive groundworks at a site, evidence of unforeseen contamination is encountered in the form of significant noxious odours, discolouration, or instability within soils or sheen/ discolouration in groundwater, the following actions will be taken:

- Intrusive works in the immediate area of the impacted ground will be suspended and the continuation of work in other areas of the site will be considered within the context of the site specific health & safety plan.
- Environmental Protection Strategies Ltd (EPS) will be contacted and appraised of the situation so that arrangements can be made to characterise the impact and determine what action may be necessary in addition to the scheduled site works. Where possible / health & safety plan permits, digital photographs of the impacted ground will be taken and emailed to EPS at the address below to assist in the initial assessment
- It may well be necessary for EPS to attend site to undertake visual inspection and obtain samples for field and/or laboratory analysis, although the actions taken will be dependent on the nature of what is encountered
- In cases where EPS consider the unforeseen contamination likely to pose a significant risk of significant harm to adjacent site users or local environmental receptors, the local authority and the Environment Agency will be informed of the situation and the actions being taken
- Once appropriate action has been agreed and undertaken, a written summary will be produced by EPS for submission to the Local Authority, (and where relevant, the Environment Agency) in accordance with planning requirements. The submission will include details of work undertaken, analytical results of investigative and validation samples obtained and conclusions and recommendations for any further actions considered necessary
- Where regulatory bodies have been involved, site works should only recommence following their agreement and in all cases should only recommence when the site manager considers it safe to do so within the context of the site specific health & safety plan.

EPS Contact Details:

Marcus Bell	Associate Director	Tel: 0787 206 9979
Will Evans	Director	Tel: 0781 253 9655
Steve Bullock	Director	Tel: 0786 694 9221

Email: info@epstrategies.co.uk (Automatically forwarded to the above and office-based personnel)