ARCADIS Design & Consultancy for natural and built assets

BE FIRST REGENERATION LIMITED INNOVATIVE SITES PROGRAMME

GARAGE BLOCK AT WHEEL FARM DRIVE, DAGENHAM, RM10 7AJ

Phase 1 Desk Study and Preliminary Ground Investigation Report

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Garage Block at Wheel Farm Drive, Dagenham, RM10 7AJ

Phase 1 Desk Study and Preliminary Ground Investigation Report

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1 Introduction

1.1 Terms of Reference

Arcadis (UK) Limited (Arcadis) has been commissioned by Be First Regeneration Ltd on behalf of London Borough of Barking and Dagenham (the Client) to undertake a Geotechnical and Geo-environmental Phase 1 Desk Study and Phase 2 Ground Investigation for a plot of land at domestic garage blocks located off Wheel Farm Drive, Dagenham, RM10 7AJ (the Site).

The Client is aiming to divest a number of small sites to enable regeneration. The objective of the Innovative Sites Programme is to provide robust and pragmatic advice that sensibly de-risks each of the sites such that any unreasonable “abnormal” development costs are not incurred by developers.

The objectives of this review are to:

- Review geo-environmental information regarding the Site and its surrounding area;
- Provide information on potential geo-environmental and geotechnical constraints which may impact on the redevelopment potential for the Site;
- Identify potential development constraints due to geotechnical and geo-environmental conditions on the Site; and
- Provide a factual report following Phase 2 Ground Investigation.

The site location is shown in Figure 1 and the site plan is shown in Figure 2 below.

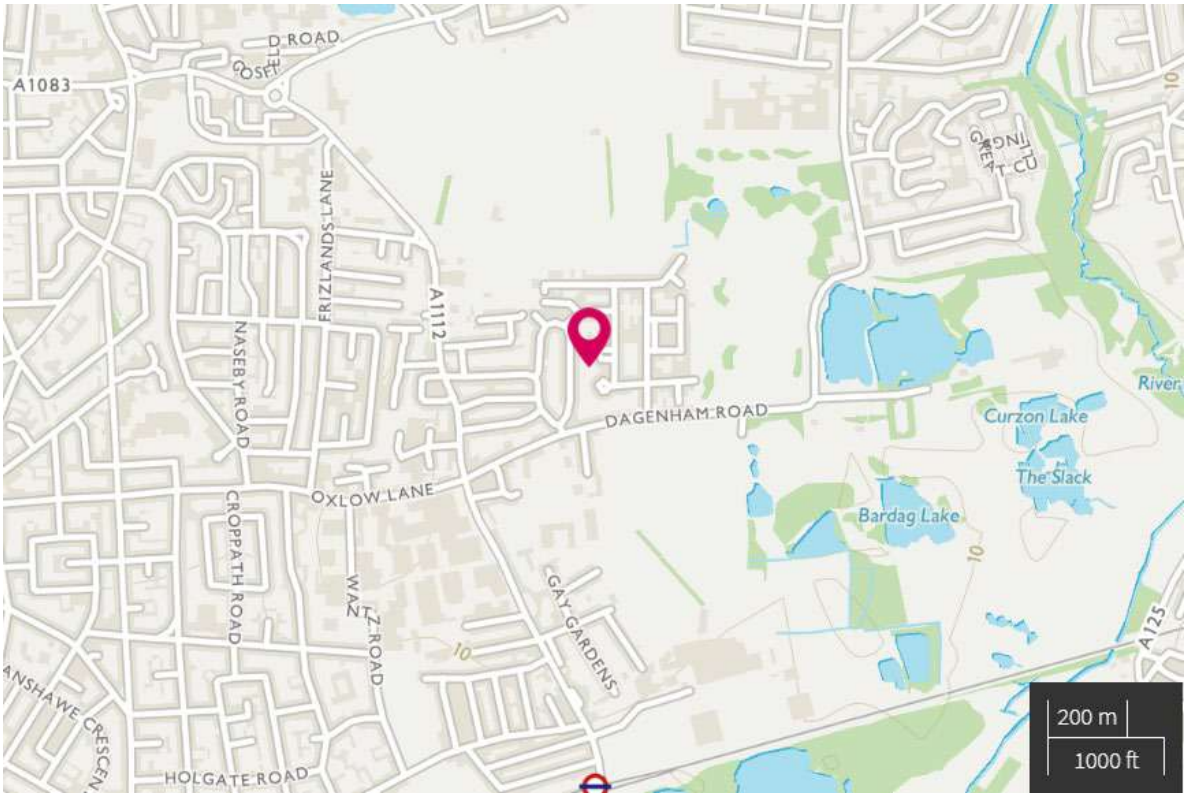


Figure 1: Wheel Farm Drive Garages Location Plan from Ordnance Survey ©



Figure 2: Wheel Farm Drive Garages Site Plan (shown in blue) provided by the Client

1.2 Sources of Information and Guidance

As part of this report various sources of information and guidance documents have been used and are detailed below:

- BGS Geological Survey of England and Wales 1:50,000 geological map series: Solid and Drift Sheet 257 Romford (Ref. 01)
- Magic Map Online Viewer, https://magic.defra.gov.uk/magicmap.aspx (Ref. 02)
- CIRIA C552, Contaminated Land Risk Assessment. A good practice, 2001 (Ref. 03)
- CDM Regulations 2015 (Ref. 04)
- BRE Special Digest 1, Concrete in Aggressive Ground, 3rd ed, 2005 (Ref. 05)
- NHBC Standards: *Vol. 1*. (Ref. 06)
- LQM / CIEH Suitable for Use Levels (S4ULs) for Human Health Risk Assessment (Ref. 07)
- LQM / CIEH Category 4 Screening Level (C4SL) for Human Health Risk Assessment (Ref. 08)

- Environment Agency (EA), 2020. Land Contamination: Risk management (LC:RM) (Ref. 09)
- Hydrogeological mapping (Ref. 10)
- Groundsure Report, Ref: GS-7642799, March 2021 (Ref. 11)
- 6Alpha Detailed Unexploded Ordnance (UXO) Threat and Risk Assessment Report, Ref: 8584_10, March 2021 (Ref. 12)

1.3 Limitations

This report has been prepared for the Client in accordance with the terms and conditions of appointment. Arcadis cannot accept any responsibility for any use of or reliance upon the contents of this report by any third party. The copyright of this document, including the electronic format, shall remain the property of Arcadis.

This report has been compiled from a number of sources, which Arcadis believes to be trustworthy. However, Arcadis is unable to guarantee the accuracy of information provided by others. The report is based on information available at the time of writing. Consequently, there is a potential for further information to become available, which may change this report's conclusion and for which Arcadis cannot be responsible.

It should be stated that the site investigation discussed in this report is a preliminary investigation and therefore a more detailed investigation would be recommended once design plans and loadings have been finalised.

Arcadis study limitations are presented in Appendix J.

2 DESK STUDY

The following information has been researched from sources of information provided within Section 1.2 including a site specific Groundsure report (Appendix B).

Table 2-1: Site Details / Environmental Setting

Item	Description
Site Location/ Address	The site is located approximately 125m north of Dagenham Road and represents an area of lock-up domestic garages and associated hard standing situated to the west of Wheel Farm Drive, Dagenham. The site is approximately centred on National Grid Reference 550247 186142, with an indicative postcode of RM10 7AJ.
Approximate Site Area	0.07 ha
Description of Site	The site walkover was undertaken on 29th March 2021. The following key points were noted. • The site is a garage block located west of Wheel Farm Drive, accessed via a single lane road with a locked gate at its entrance. • The garage blocks are arranged in a triangle formation around the boundaries of the Site. • The garages are constructed of brick. • The site is bound by private gardens associated with residential housing on all sides. • There is evidence of some fly tipping / rubbish on the site and several areas of overgrown vegetation. • The site has a surface of weathered tarmac and areas of concrete. • No other visual evidence of potential contamination was noted in addition to the fly tipping observed. **Surrounding Area** • The site is in an urban setting surrounded by residential development in all directions. Photographs taken during the site walkover are presented in Appendix A.
Anticipated Geology	The British Geological Survey (BGS) Solid and Drift Map Sheet 257 Romford (Ref.01) records the following to be present. **Superficial Deposits**: Hackney Gravel Member described by the Lexicon as "*sand and gravel, locally with lenses of silt, clay or peat.*"

	Solid Geology: London Clay described by the Lexicon as "*bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay*." **Artificial Ground**: No made ground deposits are recorded on site by the geological maps, however there may be some present derived from the historical development of the site and surrounding area. A review of the BGS website and Groundsure report shows no boreholes located within 250m of the site.
Hydrogeology	The Hydrogeological Map (Ref. 10) and Magic Map (Ref. 02) have been used to assess the anticipated hydrogeology. **Superficial Deposits**: Secondary A aquifer *Defined as: "Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers"* **Solid Geology**: Unproductive strata *Defined as: "These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow".* Based on the contours shown on the Ordnance Survey (OS) map in Magic Map (Ref. 02) it is considered likely groundwater in the area will flow towards the River Thames to the South. Groundsure report (Appendix B): shows the site to be at moderate risk from groundwater flooding. The site does not lie within a groundwater Source Protection Zone (SPZ). The Groundsure report (Appendix B) records no groundwater abstractions within 250m of the site.
Hydrology	Onsite: None recorded. Offsite: None recorded within 250m of the site. The Groundsure report indicates the site does not lie within a Flood Zone area / an area prone to flooding from rivers or seas. The site is shown to be at a 1 in 30-year risk of 0.1m – 0.3m flooding due to surface water. The above does not constitute a Flood Risk Assessment. The Groundsure report (Appendix B) records no surface water abstractions within 250m of the site.
Mining	The site does not lie within a coal mining reporting area. With reference to the historical and BGS mapping there is evidence of mining noted 176m

	south and 191m to the east of the site, both recorded as being associated with sand and gravel extraction. Based on distance none of the above are considered to present a feasible risk to land quality or stability at the study site.
Radon	The subject site is located in a lower probability radon area, where less than 1% of homes are above the recommended action level requiring radon protection measures. Radon protection measures are therefore not considered to be required.
UXO	According to the Zetica UXO map the site is within an area denoted as "High" bomb risk area. High risk areas defined are those which have seen a bombing density of 50 bombs per 1000 acres or higher. A Detailed UXO Assessment Report was completed by 6Alpha during March 2021 presented in Appendix C. The report states that the site is in an area of medium risk from UXO hazard. The report recommended the following mitigations: an operation UXO Emergency Response Plan, a UXO safety and awareness briefing before work, and an on-call UXO Engineer.
Site History Summary[1]	**On site** **1864 – 1920** Site is located within agricultural land. **1938 – 1939** Site remains undeveloped. **1950 – 2021** Garages built on site circa 1950 and still present is same layout. **Off site** **1864 – 1920** Predominantly agricultural setting with farmhouses, associated buildings and several ponds in the wider surrounding area. An engineering works is shown approximately 500m to the southwest from 1915. **1938 – 1939** Housing development built along the western boundary of site. Surrounding land use is predominantly housing to the west with agricultural to the north, south and east. **1950 - 2021** Continued residential development of surrounding area with changes to some housing areas. A large Water body (quarry pit) is shown from 1950 approximately 700m to the east at Eastbrook farm. The lakes (former pits) expand to within 500m of the site with several being backfilled.
Ecologically Sensitive site	According to information presented in the Groundsure Report (Appendix B), the site has a Local nature reserve 22m to the east and the Greenbelt is located 140m to the south. A Nitrate Vulnerable Zone is located 258m to the north of the site associated with the surface water features of the Rivers Rom and Beam.

	The site lies within a SSSI impact zone but no sensitive sites are recorded within 2km of the site
Environmental Public Registers[2]	
Potential sources	On site use as Garage and parking with associated fuels, lubricants and spills.

1 - A review of the available historical Ordnance Survey maps as presented in Appendix B has been undertaken to assess the historical development of the site and surrounding areas. It is not the intention of this report to provide a full history, but to identify those past uses on and within the vicinity of the Site that could have introduced sources of contamination to the soils and/or waters.

2 - The Groundsure report as presented in Appendix B, of public register information for the site and surrounding area (within 250m radius) has been summarised in the table above. It is not the purpose of this section to provide a comprehensive account of the environmental data but only to detail those factors that are or could impact the Site and are present within 250m of the site boundary.

2.1 Summary of Public Register Information

With regards to the environmental public register information identified in Table 2.1, the only identified potential source of contamination likely to present a risk to human health and controlled waters receptors is the use of the site as lock-up garages.

The other potential off-site sources of contamination have been reviewed, such as historic and current industrial uses and infilled land, are not considered to pose a significant risk due to either their distance from the Site or the anticipated hydraulic flow direction to the south. As such they are not considered further.

3 PRELIMINARY CONCEPTUAL SITE MODEL

Geo-environmental assessments are required in accordance with current regulatory guidance (Environment Agency (EA), 2020. Land Contamination: Risk Management (LC:RM) – (Ref. 09) to consider the significance of potential contamination in terms of plausible source-pathway-receptor pollutant linkages. As part of this process, it is necessary to develop a conceptual model of these potential pollutant linkages by identifying the potential contamination sources, sensitive receptors and any potential exposure pathways. A risk assessment is then undertaken to determine the likelihood that these potential pollutant linkages are complete.

3.1 Potential Contaminant Sources

Based on the information obtained from the historical and environmental research, the following potential sources of contamination have been identified on site and within the surrounding area (Table 3.1).

It should be noted that it is considered unlikely that all these substances would be present at significant concentrations within the Site.

Table 3.1: Potential on-site and off-site sources of contamination

Source	Potential Contaminants
On Site	
Made Ground present on site derived from historic development works.	Asbestos, metals, inorganics, Polycyclic Aromatic Hydrocarbons (PAH), hydrocarbons, ground gas
Car parking garage use	Hydrocarbons, lubricants and solvents from potential spills/leaks from vehicle maintenance activities. Asbestos
London Clay bedrock underlying the site	Sulphates
Off Site	
Made Ground associated with offsite developments	Polycyclic Aromatic Hydrocarbons (PAH), hydrocarbons, leachate and ground gas

3.2 Potential Receptors

The proposed end use of the site is considered likely to be as residential dwellings. As a precautionary approach the potential receptors detailed below take into consideration the most conservative end use as residential properties with private gardens and landscaped areas. It is considered possible that any potential contamination within the soils may be disturbed during the construction phase, or during gardening or landscaping undertaken by any future site users.

3.2.1 Human Health

- Future site users (residents, visitors, maintenance workers and contractors)

Contamination risks to construction workers are not appraised by chronic (long term) exposure human health risk assessments. There are no appropriate published criteria applicable to the assessment of potential risks to construction workers. The potential risks should be addressed by a site-specific construction workers risk assessment and implementation of appropriate health and safety measures, to adequately mitigate any potential risks. All works should be conducted in accordance with the CDM Regulations 2015 (Ref. 04) or any other relevant guidance.

3.2.2 Controlled Waters

- Secondary A Aquifer

3.2.3 Buildings

- Foundations & underground services

3.3 Potential Pathways

Potential pathways are the routes that link the receptor to the contamination. The potential pathways for this site are summarised in Table 3.2 below.

Table 3.2: Potential Pathways

Receptor	Pathway
Human health (future site users/residents, visitors, maintenance workers and contractors)	Ingestion of contaminants within soil, water and dust. Inhalation of dust, vapours and ground gases. Dermal contact with contaminants within soil, water and dust. Ingestion of contaminated vegetables and soil attached to vegetables.
Controlled waters (Secondary A Aquifer)	Leaching of contaminants from unsaturated zone into underlying groundwater. Vertical migration of soluble contaminants through the unsaturated zone into groundwater beneath the site. Lateral migration of contaminants onto the Site from offsite sources and subsequent leaching to the ground water beneath. Creation of preferential pathways i.e. services, piles, etc.
Buildings and structures including water supply pipes	Direct contact of building services or foundations with contaminants in the soil and Made Ground. Accumulation of ground gases in confined and poorly ventilated spaces. Potential for build-up of explosive gases or vapours.

4 FIELDWORK

4.1 General

Ground investigation works were carried out by Arcadis on the 8th June 2021.The scope of the ground investigation, including the location, scheduled depth and type of exploratory hole undertaken was determined by Arcadis Consulting (UK) Ltd and is summarised in Table 4-1.

The ground investigation methods were undertaken in general accordance with the principles set out in BS EN 1997-2:2007 and with the general practice described in BS5930:2020. The geo-environmental aspects of the ground investigation complied with the general requirements of BS 10175+A2:2017.

Table 4-1: Initial ground investigation scope

Location ID	Hole Type	Scheduled Depth (m)	Requirements
WS1101	IP + DS	5.0	Determine thickness of engineering soils; determine soil contamination; collect representative samples of strata and undertake in situ tests. To allow triangulation of groundwater flow direction.
WS1102	IP + DS	5.0	Determine thickness of engineering soils; determine soil contamination; collect representative samples of strata and undertake in situ tests. To allow triangulation of groundwater flow direction.
WS1103	IP + DS	5.0	Determine thickness of engineering soils; determine soil contamination; collect representative samples of strata and undertake in situ tests. To allow triangulation of groundwater flow direction.
WS1104	IP + DS	5.0	Determine thickness of engineering soils; determine soil contamination; collect representative samples of strata and undertake in situ tests. To allow triangulation of groundwater flow direction.
WS1105	IP + DS	5.0	Determine thickness of engineering soils; determine soil contamination; collect representative samples of strata and undertake in situ tests. To allow triangulation of groundwater flow direction.
WS1106	IP + DS	5.0	Determine thickness of engineering soils; determine soil contamination; collect representative samples of strata and undertake in situ tests. To allow triangulation of groundwater flow direction.

Notes
DS = dynamic sampling, IP = Inspection Pit

4.2 Exploratory Holes

4.2.1 Exploratory Hole Locations

The co-ordinates and elevations of the exploratory hole locations were obtained by Arcadis using a Leticia GPRS system, allowing an accuracy of +/-50 mm. All locations were cleared of services by a third party prior to the advancement of hand dug inspection pits. An exploratory hole location plan is present in Appendix D.

4.2.2 Investigation Methodology

The following methods and techniques were undertaken to construct the exploratory holes at the Site. The exploratory hole records are presented in Appendix E. Details of the methods of investigation and associated standards adopted and a key to the notation and symbols used on the logs are presented in Appendix F.

4.2.3 Dynamic Sampling

Dynamic sampling was completed using a track-mounted sampling rig (Dando Terrier) capable of driving windowless sampling tubes using a mechanical hammer dropped repeatedly from a self-governed height/hydraulic hammer drive head to advance window sample tubes into the ground.

The number of blows for the mechanical hammer was recorded together with a description of the recovered materials by the supervising engineer or the lead driller.

Due to the method of investigation, the materials recovered within the sampler apparatus were generally disturbed and were assessed as complying with Class 3 to Class 5 of BS EN 22475-2. Sub-samples of the material recovered in the liners were taken to enable representative laboratory testing. Generally small, disturbed samples were taken at each change in stratum and at 0.5 m intervals thereafter in clay soils; and small bulk samples were taken at 1 m intervals where the sand and gravel content of the soil was significant.

4.2.4 Completed Works

The exploratory hole locations plan as presented in Appendix D, the co-ordinates and elevation of the ground surface at each exploratory hole location are given on the individual logs Appendix E. The completed scope of investigation is summarised in Table 4-2.

WS1101, WS1102 and WS1105 were not completed due to the cleared locations not being accessible during the site works.

Table 4-2: Summary of completed exploratory holes

Location ID	Hole Type	Date	Final depth (m)	Termination Reason	Comment
WS1103	IP + DS	27 Jun 2021	1.70	Refusal	Rig unable to progress through granular superficial deposits.
WS1104	IP + DS	27 Jun 2021	2.40	Refusal	Rig unable to progress through granular superficial deposits
WS1106	IP + DS	27 Jun 2021	4.00	Refusal	Rig unable to progress through granular superficial deposits

Notes

DS = dynamic sampling, IP = Inspection Pit

4.3 In situ Testing

4.3.1 General

In situ testing was carried out within the relevant exploratory holes. Where tests were undertaken within or associated with a specific borehole, the test data is presented on the relevant exploratory hole log or as additional sheets to that log. As such, the location details will be the same as the associated hole and its position will be the same as the exploratory hole with which it is associated.

4.3.2 Penetration Testing

4.3.2.1 Standard Penetration Tests

Standard penetration tests (SPT) were carried out as required in the investigation scope and in accordance with the methods given in the standard procedures presented within Appendix F.

The N-values as determined in the field are presented on the borehole logs as uncorrected values that do not take into account the energy losses or efficiency of the automatic trip hammer used to drive the test tool into the ground.

4.3.3 VOC Head Space Screening

The presence of Volatile Organic Compounds (VOC) within the ground and groundwater was determined using a photoionization detector (PID) to detect the ‘headspace’ vapours emitted by the compounds. The method is applicable to a wide range of compounds that have sufficiently high volatility to be effectively liberated from the soil or water matrix in normal temperature and pressure ranges.

The headspace tests were undertaken on the freshly extracted soil samples at regular intervals by placing a small amount of material was placed into polythene bags which were enclosed to capture as much air as possible around the soil sample. The soil sample was gently broken up and left for

approximately 15 minutes prior to the bag being pierced and a *Photo-Ionisation Detector (PID) fitted with a 10.6eV Ultraviolet (UV) lamp inserted to test for ionisable VOCs.

4.4 Installations and Post-fieldwork Monitoring

4.4.1 Installations

To assess the long-term gas and groundwater monitoring of the Site, gas and groundwater monitoring standpipes was constructed within all three completed exploratory locations. The details are summarised in Table 4-3 and are also provided on the relevant borehole logs.

Table 4-3: Summary of exploratory hole installations

Location ID	Installation type	Response Zone Top (m bgl)	Response Zone Bottom (m bgl)	Comment
WS1103	Standpipe	0.70	1.70	Screening of the Superficial deposits
WS1104	Standpipe	1.00	2.40	Screening of the Superficial deposits
WS1106	Standpipe	1.00	2.00	Screening of the Made ground and Surficial deposits

4.4.2 Post-fieldwork Monitoring

Ground gas and groundwater monitoring has been undertaken on one occasion on the 22nd June 2021 to provide a preliminary ground gas assessment. The results of these are presented within Appendix G.

4.5 Laboratory Testing

4.5.1 General

Geotechnical and geo-environmental chemical testing was undertaken on selected samples obtained from the exploratory holes. The testing was scheduled by the geotechnical and geo-environmental engineer and the testing was undertaken by an Arcadis approved testing laboratory.

4.5.2 Geotechnical Laboratory Testing

The geotechnical tests were carried out in accordance with either BS1377:1990: Parts 1 to 8; BS EN ISO 17892; BRE SD 1:2005; or other methods as listed in Table 4.4.

The results of the geotechnical laboratory testing are presented in Appendix H.

Table 4-4: Summary of geotechnical test data

Test	Method	No of Determinations
Moisture content	BS1377 Pt 2 - 3.2	2
Atterberg Limits	BS 1377 Pt 2 -method 5	2
Particle Size Distribution - Wet sieving	BS1377 Pt 2 - 9.2 & 9.4	5
pH, water soluble sulphate;	BRE SD1 preferred methods	8

4.5.3 Geo-Environmental Laboratory Testing

Geo-environmental laboratory tests were undertaken on soil and groundwater samples collected from the Site. Testing was carried out for the contaminants detailed in Tables 4.5 and 4.6.

The results geo-environmental laboratory testing is presented in Appendix I.

Table 4-5: Summary of geo-environmental test data – soil matrix

Test type	Method	No of Determinations
Arsenic	ICP-OES	5
Boron	ICP-OES	5
Cadmium	ICP-OES	5
Chromium	ICP-OES	5
Copper	ICP-OES	5
Lead	ICP-OES	5
Nickel	ICP-OES	5
Selenium	ICP-OES	5
Zinc	ICP-OES	5
Speciated Polycyclic Aromatic Hydrocarbon compounds (PAH)	Gas Chromatography –Mass Spectrometry (GC-MS)	5
TPH CWG	Gas Chromatography –Mass Spectrometry (GC-MS)	3
Total Cyanide	Colorimetry.	5
BTEX	Determination of Volatile Organic Compounds by Headspace/ GC-MS	3

Test type	Method	No of Determinations
MTBE	Determination of Volatile Organic Compounds by Headspace/ GC-MS	3
Asbestos screen and ID	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	3
Total Organic Carbon	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	2
Phenol (total), Cresol, Chlorinated Phenols	Gas Chromatography –Mass Spectrometry (GC-MS)	5
Hexavalent Chromium	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	5

Table 4-6: Summary of geo-environmental test data – groundwater

Test type		No of Determinations
Metals (Arsenic, Boron, Cadmium, Chromium (total), Chromium (VI), Copper, Lead, Mercury, Nickel, Selenium, Zinc)	ICP-MS	3
Cyanide (complete, total, free)	Distillation followed by colorimetry.	3
TPH CWG	Gas Chromatography –Mass Spectrometry (GC-MS)	3
BTEXs	Gas Chromatography –Mass Spectrometry (GC-MS)	3
MTBE	Gas Chromatography –Mass Spectrometry (GC-MS)	
PAHs	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards.	3
Phenols	HPLC.	3
pH	Electrometric measurement.	3

5 GROUND MODEL

5.1 Ground Conditions

5.1.1 Introduction

The anticipated ground conditions identified within the Chapter 2 and the published BGS Solid and Drift Map Sheet 257 Romford (Ref.01) were expected to sands and gravels (superficial deposits) above bedrock recorded as the London Clay. There was also considered to be some potential for made ground to be present derived from historic development works in the area.

Full engineering logs are included within Appendix E while a summary of the general succession of strata encountered is presented in Table 5.1.

Due to the variable nature of the made ground and density of the superficial deposits encountered, window sample boreholes could not progress to target depth in some positions, therefore limited superficial deposits were recovered and no bedrock was encountered at the site. Further investigation may therefore be required to confirm ground conditions for detailed geotechnical design.

The laboratory report for geotechnical laboratory tests undertaken during the ground investigation are presented within Appendix H. The laboratory report for geo-environmental laboratory tests undertaken during the ground investigation are presented within Appendix I.

Table 5-1: Ground Conditions Encountered

Stratum	General Description	Depth range to top of strata (m bgl)	Thickness range (m)	Depth range to base of stratum (m)	In situ data SPT -N value
Made Ground	Asphalt was present at the surface in all locations at a thickness of 0.05m. This was found to be consistently overlying a layer of Concrete of between 0.10m and 0.15m thickness. Generally described as: MADE GROUND: silty gravelly SAND with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint. Cobbles are subrounded flint (~5%). MADE GROUND: greyish black clayey GRAVEL. Gravel is subangular medium to coarse bituminous material. Cobbles are 8 subrounded to subangular flint (~20%).	0.10 -0.15	0.30 – 0.35	0.40 -0.50	None
	MADE GROUND: Very soft to soft brownish orange slightly gravelly very sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse bituminous material. *Recovered from WS1106 only.*	0.10	1.40	1.50	7
Superficial Deposits	**Granular** Orangish or bluish brown slightly gravelly SAND. Sand is coarse. Gravel is subangular fine to coarse flint. Sometimes recovered with cobbles. Also recovered as: Loose orange medium to coarse SAND.	0.40 – 1.50	1.20-2.50	1.70-4.00 *Extent not proved*	9->50

5.2 Range of Geotechnical Parameters

Due to the density of the superficial deposits encountered, window sample boreholes did not reach target depth at any location. Therefore, only a limited amount of superficial deposits were recovered in places. Bedrock was not encountered. This therefore meant that limited in situ testing and sampling was undertaken and the material within the zone of influence beneath the anticipated foundation depth is not known at this time.

As a result, there was limited laboratory and in situ testing was undertaken within the superficial deposits, therefore further investigation will be required to determine the suitability of ground conditions for shallow foundations.

Laboratory results are provided within Appendix H.

5.2.1 Particle Size Distribution (PSD) Sieve Test Results

Five PSD tests were undertaken by wet sieving across the Site all for superficial deposits (sands and gravels).

PSD results recorded for the surficial deposits tested materials as being granular with between 70% and 96% coarse material and between 4% and 30% fines.

The test results correspond with the log descriptions attached as Appendix E. PSD results are attached as part of the Appendix H.

5.2.2 Moisture Content & Atterberg Testing

Two moisture content and Atterberg test was carried out on two samples recovered from granular superficial deposits. Atterberg limit tests indicate low to intermediate plasticity.

5.2.3 Standard Penetration Tests

One SPT was undertaken within Made Ground cohesive made ground soils. The SPT value recorded was a N value of 7. These results would typically imply low strength cohesive soils.

SPTs values undertaken within granular superficial deposits were recorded at between 9 and 50. These results would typically imply loose to dense granular deposits.

SPT test results as well as the engineer logs are attached in Appendix E.

5.3 Ground Chemistry

Chemical testing of soils for concrete classification was undertaken in accordance with BRE SD1 (Ref. 05). The results are attached as Appendix I. It should be stated that the underlying bedrock within the site is London Clay which is a potential sulphate bearing strata. Bedrock was not encountered during the investigation due the limited depths achieved. Therefore, further investigation is recommended to establish the aggressivity of the underlying clays upon the proposed foundations.

5.3.1 Olfactory/Visual contamination evidence

No visual or olfactory evidence of potential contamination was recorded during the ground investigation.

5.3.2 Groundwater

No groundwater strikes were recorded during the ground investigation. Ground water was recorded during the monitoring visit between 0.90m and 1.20m bgl.

6 GEOTECHNICAL ASSESSMENT

6.1 Proposed Development

Arcadis understands that the proposed development will be to divest a number of small sites to enable regeneration. At the time of writing no proposed end use was provided to Arcadis. Therefore, for the purposes of this assessment it has been assumed that the new proposed structure will be a 2 -3 storey structure and be relatively lightly loaded structures in the order of 80 kPa.

The existing garage block has been in place since at least 1950 (based on historical mapping) and are currently still in operation within the active site. Details of any structural survey carried out (if any) have not be passed to Arcadis for review.

Due to the difficulties in reaching target depth during the ground investigation and limited testing undertaken the following foundation recommendations are preliminary only, and further investigation would be required to confirm the depth and strength of the underlying superficial deposits and to establish that no soft compressible deposits underlie the proposed foundation depth.

6.2 Foundations

6.2.1 Floor Slabs

The thickest amount of Made Ground was recorded as 1.50m bgl within WS1106. It should be stated that in the remaining holes made ground was recovered less than 0.60m thick. In accordance with NHBC Chapter 5 (Ref. 06), a ground bearing slab may be suitable for the proposed development however, any areas where variable made ground or soft cohesive deposits are present greater than 0.60m will need to be removed and replaced with suitable type 1 granular material and proof rolled. Otherwise, a suspended floor slab would need to be used.

6.2.2 Shallow Foundations & Excavations

Ground conditions were found to comprise made ground above granular superficial deposits. However, only a maximum thickness of 2.50 m was recovered for superficial deposits. Bedrock was not found during the works.

Shallow strip footings or pad foundations are likely to be the most appropriate foundation types for the proposed development, founding within the loose to medium dense granular material at a depth between 1.0m bgl and 1.50m bgl. This should provide a presumed allowable net bearing capacity appropriate for the proposed development in the order of 175 kPa. This is based upon a 1m pad founded at 1.5mbgl, the worst case SPT N value recorded of 8 and with high groundwater. However, due to limited progress in some exploratory holes it is not clear whether soft compressible deposits lie beneath this material lie within the foundation zone of influence. Therefore, further investigation would be required to confirm suitable ground conditions across the site for shallow foundations.

No trial pits were undertaken during the ground investigation however based upon the granular nature of the strata in the superficial deposits recorded on the engineer logs it is anticipated that these materials will likely require some temporary support such as shoring or sheet piles to stabilise excavation sides over prolonged periods.

Groundwater monitoring has identified the shallowest readings to be 0.90m bgl. Given that the typical foundation depths will be in the order of 1.00m bgl to 1.50m bgl, dewatering measures will likely be required such a sumps or pumps.

Dewatering within the granular in-situ deposits could present a ground settlement risk to the site and surrounding area, as dewatering of these likely layers could induce changes in effective stress and/ or removal of fines, which in turn can cause ground subsidence/ settlement both in the immediate area of the dewatering but also sometimes within the wider zone of influence/ drawdown that any dewatering creates. The design of all excavations which progress below the groundwater level and require dewatering should consider this potential risk to the surrounding existing and sensitive structures.

6.3 Concrete Classification

Chemical testing of soils for concrete classification was undertaken in accordance with BRE SD1 (Ref. 05). The results indicate a design sulphate class of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) class of AC-1 for below ground concrete at the proposed construction depth.

7 CONTAMINATION ASSESSMENT

7.1 Generic Quantitative Risk Assessment

Laboratory testing was undertaken on five soil samples, three samples from made ground and two samples from superficial deposits. These samples were tested for a range of geo-environmental determinants as listed within Table 4.5, targeting potential sources of contamination as detailed in Table 3.1, with the results presented in Appendix I.

7.2 Soil Screening Values (SSVs)

In accordance with current UK guidance and legislation, the analytical data has been compared to Generic Assessment Criteria (GAC) for a Tier 1 screening assessment.

Soil screening values have been taken from LQM / CIEH Suitable for Use Levels (S4ULs) for Human Health Risk Assessment (Ref. 07). In the absence of a S4UL for Lead, the Category 4 Screening Level (C4SL) has been adopted (Ref 08).

A conservative approach was taken for the Site, namely adopting screening criteria for a **Residential with Plant Uptake** end use for this initial screening process.

Where adopted GAC values may be varied according to the organic content of the sampled soils, i.e. in relation to hydrocarbon compounds, a soil organic matter (SOM) of 1% has been assumed in line with the most conservative values provided by the C4SL/S4UL framework.

7.3 Tier 1 screening Assessment Soils – Human Health

7.3.1 Asbestos

A total of three soil samples were analysed for the potential presence of asbestos, with no positive identifications returned.

It is advised that a watching brief be maintained during future phases of intrusive works such that any potential asbestos containing materials (ACMs) be more readily identified. Damping down should also be incorporated as part of future ground works to reduce soil disturbance and the generation of dust during groundworks, including potential fugitive asbestos fibres.

Should asbestos be encountered, further laboratory analysis should be undertaken and the risk assessments presented herein revisited. Encountering such materials may also have an impact on waste costs.

All soil results are presented in Appendix I.

7.3.2 Soil Contaminants

All soil samples were screened against Residential with Plant Uptake generic assessment criteria. Eight exceedances were identified. These are summarised below in Table 7.1.

All soil results are presented in Appendix I.

Table 7-1: Exceedances against GACs

CoC	Maximum Concentration (mg/kg)	Location and Depth	Receptor (GAC)
Chrysene	23	WS1103 (0.3-0.4m) & (0.60-0.7m)	Residential with Plant Uptake (15 mg/kg)
Benzo(b)fluoranthene	24	WS1103 (0.3-0.4m) & (0.60-0.7m)	Residential with Plant Uptake (2.6 mg/kg)
Benzo(a)pyrene	20	WS1103 (0.3-0.4m) & (0.60-0.7m)	Residential with Plant Uptake (2.2 mg/kg)
Dibenz(a,h)anthracene	3.7	WS1103 (0.3-0.4m) & (0.60-0.7m)	Residential with Plant Uptake (0.24 mg/kg)

7.4 Tier 1 Screening Assessment – Controlled Waters

Three groundwater samples were taken during the monitoring visit on the 22nd June 2021. These were tested and the results screened against the appropriate Water Quality Standards (WQS) to assess the risk to controlled waters. These comprise, Drinking Water Standards (DWS) and Environmental Quality Standards for freshwater (EQS). EQS are considered protective of surface water and DWS are protective of groundwater which may be used as a potable supply.

The site is located on a Secondary A Aquifer. No groundwater or portable abstractions are identified on site. Therefore, drinking water standards (DWS) have not been considered during the assessment.

No surface water features were recorded within 250m however the presence of granular deposits and high groundwater means a potential pathway to surface waters. Therefore, the EQS has been used for the assessment.

There are no standard guideline values for TPH in groundwater in the UK. In the absence of a specific standard, 10 µg/l is considered to be a reasonable point of reference at which TPH could be of interest (former UK Drinking Water Standard).

Groundwater results are attached as part of Appendix I.

No leachate testing was carried out as part of this ground investigation.

7.4.1 Groundwaters

Three groundwater samples were taken during the monitoring period, one from each monitoring location, and were tested for a range of determinants as tabulated within Table 4.6. These were then screened against the EQS.

Exceedances identified are shown in Table 7.2 below.

Groundwater results are provided within the Appendix I.

Table 7-2: Groundwater exceedances against the EQS

Determinant	EQS Screening value (µg/L)	Concentration range (µg/L)	Number of exceedances and Location	Comment
Copper	1	2.9 – 6.2	3 WS1103, WS1104 & WS1106	Marginally elevated and are below one order of magnitude above the screening value.
Nickel	4	3.6-12	2 WS1104 & WS1106	Marginally elevated and are below one order of magnitude above the screening value.

7.5 Ground Gas Monitoring

One round of ground gas monitoring was undertaken on the 22nd June 2021 by Arcadis.

The ground gas monitoring was undertaken using an infra-red gas analyser and flow pod. Concentrations of methane (CH_4), carbon dioxide (CO_2) and oxygen (O_2) in %, Hydrogen Sulphide (H_2S) and Carbon Monoxide in ppm and ground gas flow in litres per hour (l/h) were recorded during the visit. After the monitoring was undertaken, the well was dipped to record the groundwater level.

A summary of the results is presented in Table 7.3 below.

For the purposes of the assessment a worst case of <0.1% was used where no results were recorded. Concentrations of carbon dioxide (up to 5.0% v/v) were recorded and a maximum concentration of methane of 0.00 % was recorded.

The full gas monitoring data is included in Table 1 of Appendix G.

Table 7-3: Gas Monitoring summary

Monitoring Well	Steady Flow (l/hr)	Max CH_4 (%v/v)	Max CO_2 (%v/v)
WS1103	-0.0	0.0	5.0
WS1104	0.6	0.0	1.4
WS1106	0.3	0.0	1.0

7.5.1 General

Potential risks associated with volatile compound vapours were assessed via Photo Ionisation Detection (PID) analysis of the soils during the site investigation.

Results were recorded to be very low, <2ppm, in all instances. These concentrations are not considered to be representative of a potential risk requiring further assessment or consideration at this time.

Should any visual or olfactory evidence of previously unencountered contamination (such as sheens, staining or odours) be noted during the recommended watching brief, these ground conditions should be further assessed.

7.5.2 Preliminary Hazard Gas Assessment

Current guidance for the assessment of risks associated with the presence of hazardous ground gases (principally methane and carbon dioxide) is provided in two key documents listed below, which have been used for the assessment presented herein:

- Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings. British Standard Institution (BS 8485: 2015+A1:2019); and
- Assessing Risks posed by Hazardous Ground Gases to Buildings. CIRIA (C665, 2007).

A semi-quantitative estimate of risk from hazardous ground gases can be provided, based upon the qualitative risk model and gas monitoring results.

Based on the measured flow rates and measured hazardous gas concentrations, individual “hazardous gas flow rates” (Q_{hg}) can be derived for each monitoring point, from which the “site characteristic hazardous gas flow rate” (Q_{hgs}), and then the “Characteristic Situation” can be determined.

BS8485 provides guidance on the level of required gas protection based upon the characteristic situation and the type of development.

A Gas Screening Value (GSV) is calculated using the following equation.

GSV = borehole flow rate (l/h) x gas concentration (v/v %)

Methane – 0.000 (v/v %)

Carbon Dioxide – 0.014 (v/v %)

Flow Rate – 0.6 (l/h)

GSV = 0.0000 (l/h) (methane)

GSV = 0.0084 (l/h) (carbon dioxide)

The ground conditions recorded in this location comprised Made Ground to 1.5m bgl. No organic or putrescible waste was noted in the Made Ground, and therefore a potentially significant source of ground gas generation is not present. Similarly, no such potential sources have been identified in the surrounding area.

Based on the above the site would be preliminarily classified as CIRIA Gas Characteristic Situation 1 (very low risk) whereby gas protection measures would not be required in proposed buildings.

It is however acknowledged that the above is based on a limited dataset of a single round of monitoring and additional monitoring is therefore recommended to develop levels of confidence in the understanding of the gas regime at the site.

Based on the history of the site and surrounding area, the ground conditions observed during the recent investigation works and the revised conceptual site model, ground gases are considered likely to present a very low risk.

8 Environmental Risk Assessment

8.1 Methodology

Based on the assessment of soil and groundwater data, the potential contaminant linkages identified within Section 3 have been updated in accordance with CIRIA Guidance C552 (Ref. 03), identifying the 'contaminant linkages' (contaminant source-pathway-receptor relationships) that may be present at the Site based upon the laboratory analysis and monitoring completed.

Risk assessment involves identifying hazards and determining their potential severity and likelihood of an impact occurring on identified receptors. Risks are generally managed by changing the receptor, isolating the sensitive receptor by intercepting, or interrupting the exposure pathway, or removing the source. If no pollutant linkages are formed, there is no risk.

The following risk assessment focuses on the potential contaminants identified on the Site and the proposed development of the Site.

A summary of the Risk Assessment method is presented in Appendix K.

8.2 Potential Contaminants of Concern

The laboratory analysis of soil samples has identified and refined the following potential contaminants of concern which are subsequently incorporated into risk assessment:

8.2.1 Soil

Marginal exceedances against S4UL values were identified associated with:

- **PAH compounds** (Chrysene**,** Benzo(b)fluoranthene**,** Benzo(a)pyrene, Dibenz(a,h)anthracene)

All 8 identified exceedances were in the Made Ground and superficial deposits in the location of WS1103.

8.2.2 Groundwater

Marginal exceedances of adopted EQS values were identified associated with:

- Copper; and
- Nickel.

No significant potential source of these elements has been identified at the site or in the surrounding area.

Based on the soils sampling results returned for copper and nickel being of no note, and the exceedances of the EQSs being relatively minor (within one order of magnitude), the returned groundwater sampling results are not considered to be indicative of a potential risk or impact to controlled waters requiring further assessment or consideration.

8.2.3 Sulphates

Neutral to alkaline conditions identified – appropriate concrete classification provided for mitigation as DS1 /AC1.

8.3 Contaminant Linkages – Conceptual Model

Based upon the identified potential contaminants of concern, the potential receptors and pathways identified in previous sections, and with reference to the desk study report; Table 8.2 provides an assessment of each contaminant linkage to establish the potential risk to the sensitive receptors.

The proposed development at the Wheel Farm Drive site has been considered and the risk assessment has been developed based on these specific redevelopment scenarios.

Table 8-1: Contaminant Linkages Table

PL No.	Source	Sensitive Receptor	Pathway	Hazard (Severity)	Likelihood (Probability)	Potential Risk & Mitigated Risk	Further Assessment and /or Remedial Action Required.
PL1	**Sulphates and PH in ground**	Buildings	Direct contact	**Mild**	**Low** mitigated through appropriate concrete design	**Low** **Reduced to Very Low**	Use design sulphate class DS-1 and appropriate design of concrete of AC-1.
PL2	**PAH compounds:** **Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene**	Groundwater (Secondary A Aquifer)	Leaching of contaminants into groundwater.	**Mild**	**Unlikely**	**Very low**	No significant sources of contamination have been identified and no gross contamination was found onsite. There is a lack of elevated concentrations within the soils tested on-site. Therefore, the marginally elevated concentrations found are not considered to cause a significant impact to controlled waters.
		Human	Direct contact	**Medium**	**Low** mitigated through appropriate design to reduce pathway migration	**Moderate / Low** **Reduced to Low**	Exceedances only found in one location for Made Ground and Natural soils. All but one exceedance were within one order of magnitude of the GAC. A suitable clean capping layer would be required in any development to prevent disturbance of and contact with Made Ground, especially in areas of any private gardens or proposed soft landscaping. Regulatory Consultation may be required.
PL3	**Heavy metals:** **Copper and Nickel**	Groundwater (Secondary A Aquifer & Surface waters)	Leaching of contaminants into groundwater and migration of contaminated groundwater into surface water (offsite).	**Medium**	**Unlikely**	**Low**	No potential source or gross contaminated identified onsite. Results were marginally elevated and are not considered to be high enough to cause a significant impact to controlled waters. Adopt appropriate mitigation during construction.

9 RECOMMENDATIONS AND CONCLUSIONS

Arcadis was instructed to undertake a preliminary intrusive site investigation for the proposed site regeneration. Based on the information outlined within this report, the following conclusions were made. Further site investigation will be required as the development proposals are detailed.

9.1 Geo-environmental

No evidence of potentially significant contamination has been identified at the site. The exceedances of GAC values adopted to provide a preliminary assessment of soils and groundwater, as well as the ground gas monitoring results, are summarised below; with comments in relation to their potential significance and measures which may be required to mitigate any associated risks. Remedial actions of a capping layer above the Made ground would be recommended. This could comprise any proposed buildings / hardstanding with clean imported materials required in areas of landscaping / gardens to provide a suitable capping layer, and additionally in the absence of topsoil as a growth medium. A pre-demolition asbestos assessment should be carried out on all buildings on the site to assess materials.

- ***Soil Samples***

  Eight exceedances for four discrete PAH compounds were identified in two samples from WS1103, one from Made Ground and one of underlying natural superficial deposits. It is noted that none of the PAH compounds noted present a potential vapour risk. The potential exposure pathways are therefore considered to be ingestion of, and dermal contact with, contaminated soils; and inhalation of soil dust. These risks are considered suitable to be mitigated by the implementation of a capping system of chemically validated topsoil/subsoil in proposed gardens/soft landscaping areas (indicative thicknesses <600mm or <450mm respectively).

- ***Groundwater***

  Marginal exceedances were recorded against the EQS GACs for Copper and Nickel. The recorded results are at a level which are marginally elevated and not considered to pose a significant effect upon controlled waters. No further assessment or consideration of these is considered necessary.

- ***Ground Gas***

  A preliminary ground gas assessment indicated a characterisation of CS1 which indicates gas protection measures would not be required. However, as there is a limited data set, further monitoring may be required.

9.2 Geotechnical

Ground conditions across the Site were found to comprise of Made Ground to a maximum depth of 1.50 m bgl overlying granular superficial deposits. The extent of which was not proved. Bedrock was not found during the investigation.

The key geotechnical considerations in relation to the proposed construction development are summarised below.

- ***Floor Slabs***

  A ground floor slab should be achievable for the proposed development. However, some areas will require the removal of made ground where found to be greater than 0.60m bgl and replaced with a type 1 granular fill and compacted.

- ***Foundations***

  Based upon the ground conditions encountered shallow foundations could be achievable for the proposed structure within loose to medium dense granular superficial deposits at a depth between 1.0 m bgl of 1.5m bgl. However, this will need to be confirmed via further investigation works as the extent of superficial deposits was not proved and the potential presence of any underlying soft underlying deposits within the foundation zone of influence would need investigating as exploratory hole target depths was not reached.

- ***Excavations***

  Groundwater was encountered during the monitoring period at a depth of 0.90m bgl. Therefore, it is anticipated dewatering measures and trench support will be required during any excavations.

- ***Settlement***

  Immediate and combined settlement is anticipated to be less than 25mm based upon the ground conditions encountered within granular deposits.

- ***Concrete***

  The results indicate that for the Site, a design sulphate class of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) class of AC-1 for below ground concrete is deemed suitable.

- ***UXO***

  Potential UXO risks are considered appropriate to be addressed via toolbox talks during future phases of intrusive ground works, maintenance of a UXO Emergency Plan, and retaining a UXO engineer on call should potential UXO be identified.

APPENDIX A

Photo Log

CLIENT:	Be First Regeneration Ltd		**DATE:**	29/03/2021
REFERENCE:	10046791	**SITE NAME:**	Wheel Farm Drive	

ARCADIS Design & Consultancy for natural and built assets

Plate 1. Direction photo taken: West. Description: Narrow gated access route to site from Wheel Farm Drive	
Plate 2. Direction photo taken: North. Description: Northern section of the site with brick garages along the boundaries.	

CLIENT:	Be First Regeneration Ltd		**DATE:**	29/03/2021
REFERENCE:	10046791	**SITE NAME:**	Wheel Farm Drive	

ARCADIS Design & Consultancy for natural and built assets

Plate 3.

Direction photo taken: Northwest.

Description: Brick garages along western boundary of site.



Plate 4.

Direction photo taken: South.

Description: Southern section of site with cracked concrete and asphalt.



CLIENT:	Be First Regeneration Ltd		**DATE:**	29/03/2021
REFERENCE:	10046791	**SITE NAME:**	Wheel Farm Drive	

ARCADIS Design & Consultancy for natural and built assets

Plate 5.

Direction photo taken: South.

Description:
Fly tipping in south of site.



Plate 6.

Direction photo taken: North.

Description:
Cracked asphalt and material stored on the site.



APPENDIX B

Groundsure Report

Groundsure
LOCATION INTELLIGENCE

Enviro+Geo Insight

WHEEL FARM DRIVE, RM10 7AJ

Order Details

Date: 09/03/2021

Your ref: PO14047811_PN10046791_WHEEL_FM_DRV

Our Ref: GS-7642799

Client: Arcadis Consulting (UK) Ltd

Site Details

Location: 550247 186142

Area: 0.07 ha

Authority: London Borough of Barking and Dagenham



Summary of findings p. 2

OS MasterMap site plan p.13

Aerial image p. 8

groundsure.com/insightuserguide

Contact us with any questions at:
info@groundsure.com
08444 159 000

Summary of findings

Page	Section	Past land use	On site	0-50m	50-250m	250-500m	500-2000m
14	1.1	Historical industrial land uses	0	0	0	11	-
15	1.2	Historical tanks	0	0	0	0	-
15	1.3	Historical energy features	0	0	4	6	-
16	1.4	Historical petrol stations	0	0	0	0	-
16	1.5	Historical garages	0	0	1	3	-
17	1.6	Historical military land	0	0	0	0	-
Page	Section	Past land use - un-grouped	On site	0-50m	50-250m	250-500m	500-2000m
18	2.1	Historical industrial land uses	0	0	0	13	-
19	2.2	Historical tanks	0	0	0	0	-
19	2.3	Historical energy features	0	0	8	9	-
20	2.4	Historical petrol stations	0	0	0	0	-
20	2.5	Historical garages	0	0	2	4	-
Page	Section	Waste and landfill	On site	0-50m	50-250m	250-500m	500-2000m
22	3.1	Active or recent landfill	0	0	0	0	-
22	3.2	Historical landfill (BGS records)	0	0	0	1	-
23	3.3	Historical landfill (LA/mapping records)	0	0	0	0	-
23	3.4	Historical landfill (EA/NRW records)	0	0	2	1	-
24	3.5	Historical waste sites	0	0	0	0	-
24	3.6	Licensed waste sites	0	0	0	2	-
25	3.7	Waste exemptions	0	0	0	5	-
Page	Section	Current industrial land use	On site	0-50m	50-250m	250-500m	500-2000m
26	4.1	Recent industrial land uses	0	0	6	-	-
27	4.2	Current or recent petrol stations	0	0	1	0	-
27	4.3	Electricity cables	0	0	0	0	-
27	4.4	Gas pipelines	0	0	0	0	-
28	4.5	Sites determined as Contaminated Land	0	0	0	1	-

28	4.6	Control of Major Accident Hazards (COMAH)	0	0	0	0	-
28	4.7	Regulated explosive sites	0	0	0	0	-
28	4.8	Hazardous substance storage/usage	0	0	0	0	-
29	4.9	Historical licensed industrial activities (IPC)	0	0	0	0	-
29	4.10	Licensed industrial activities (Part A(1))	0	0	0	0	-
29	**4.11**	**Licensed pollutant release (Part A(2)/B)**	0	0	1	2	-
30	4.12	Radioactive Substance Authorisations	0	0	0	0	-
30	**4.13**	**Licensed Discharges to controlled waters**	0	0	0	1	-
30	4.14	Pollutant release to surface waters (Red List)	0	0	0	0	-
30	4.15	Pollutant release to public sewer	0	0	0	0	-
31	4.16	List 1 Dangerous Substances	0	0	0	0	-
31	4.17	List 2 Dangerous Substances	0	0	0	0	-
31	**4.18**	**Pollution Incidents (EA/NRW)**	0	0	0	1	-
31	4.19	Pollution inventory substances	0	0	0	0	-
32	4.20	Pollution inventory waste transfers	0	0	0	0	-
32	4.21	Pollution inventory radioactive waste	0	0	0	0	-

Page	Section	Hydrogeology	On site	0-50m	50-250m	250-500m	500-2000m
33	**5.1**	**Superficial aquifer**	Identified (within 500m)				
35	**5.2**	**Bedrock aquifer**	Identified (within 500m)				
36	**5.3**	**Groundwater vulnerability**	Identified (within 50m)				
37	5.4	Groundwater vulnerability- soluble rock risk	None (within 0m)				
37	5.5	Groundwater vulnerability- local information	None (within 0m)				
38	**5.6**	**Groundwater abstractions**	0	0	0	0	15
42	5.7	Surface water abstractions	0	0	0	0	0
43	**5.8**	**Potable abstractions**	0	0	0	0	2
43	5.9	Source Protection Zones	0	0	0	0	-
43	5.10	Source Protection Zones (confined aquifer)	0	0	0	0	-

Page	Section	Hydrology	On site	0-50m	50-250m	250-500m	500-2000m
44	6.1	Water Network (OS MasterMap)	0	0	0	-	-

44	6.2	Surface water features	0	0	0	-	-
45	**6.3**	**WFD Surface water body catchments**	1	-	-	-	-
45	**6.4**	**WFD Surface water bodies**	0	0	0	-	-
46	6.5	WFD Groundwater bodies	0	-	-	-	-
Page	Section	River and coastal flooding	On site	0-50m	50-250m	250-500m	500-2000m
47	7.1	Risk of Flooding from Rivers and Sea (RoFRaS)	None (within 50m)				
47	7.2	Historical Flood Events	0	0	0	-	-
47	7.3	Flood Defences	0	0	0	-	-
47	7.4	Areas Benefiting from Flood Defences	0	0	0	-	-
48	7.5	Flood Storage Areas	0	0	0	-	-
49	7.6	Flood Zone 2	None (within 50m)				
49	7.7	Flood Zone 3	None (within 50m)				
Page	Section	Surface water flooding					
50	**8.1**	**Surface water flooding**	1 in 30 year, 0.1m - 0.3m (within 50m)				
Page	Section	Groundwater flooding					
52	**9.1**	**Groundwater flooding**	Moderate (within 50m)				
Page	Section	Environmental designations	On site	0-50m	50-250m	250-500m	500-2000m
53	10.1	Sites of Special Scientific Interest (SSSI)	0	0	0	0	0
54	10.2	Conserved wetland sites (Ramsar sites)	0	0	0	0	0
54	10.3	Special Areas of Conservation (SAC)	0	0	0	0	0
54	10.4	Special Protection Areas (SPA)	0	0	0	0	0
54	10.5	National Nature Reserves (NNR)	0	0	0	0	0
55	**10.6**	**Local Nature Reserves (LNR)**	0	0	1	1	9
55	10.7	Designated Ancient Woodland	0	0	0	0	0
56	10.8	Biosphere Reserves	0	0	0	0	0
56	10.9	Forest Parks	0	0	0	0	0
56	10.10	Marine Conservation Zones	0	0	0	0	0
56	**10.11**	**Green Belt**	0	0	1	0	2
57	10.12	Proposed Ramsar sites	0	0	0	0	0

57	10.13	Possible Special Areas of Conservation (pSAC)	0	0	0	0	0
57	10.14	Potential Special Protection Areas (pSPA)	0	0	0	0	0
57	10.15	Nitrate Sensitive Areas	0	0	0	0	0
58	**10.16**	**Nitrate Vulnerable Zones**	0	0	0	1	0
59	**10.17**	**SSSI Impact Risk Zones**	1	-	-	-	-
60	10.18	SSSI Units	0	0	0	0	0
Page	Section	Visual and cultural designations	On site	0-50m	50-250m	250-500m	500-2000m
61	11.1	World Heritage Sites	0	0	0	-	-
61	11.2	Area of Outstanding Natural Beauty	0	0	0	-	-
61	11.3	National Parks	0	0	0	-	-
61	11.4	Listed Buildings	0	0	0	-	-
62	11.5	Conservation Areas	0	0	0	-	-
62	11.6	Scheduled Ancient Monuments	0	0	0	-	-
62	11.7	Registered Parks and Gardens	0	0	0	-	-
Page	Section	Agricultural designations	On site	0-50m	50-250m	250-500m	500-2000m
63	**12.1**	**Agricultural Land Classification**	Non Agricultural (within 250m)				
64	12.2	Open Access Land	0	0	0	-	-
64	12.3	Tree Felling Licences	0	0	0	-	-
64	12.4	Environmental Stewardship Schemes	0	0	0	-	-
64	12.5	Countryside Stewardship Schemes	0	0	0	-	-
Page	Section	Habitat designations	On site	0-50m	50-250m	250-500m	500-2000m
65	13.1	Priority Habitat Inventory	0	0	0	-	-
65	13.2	Habitat Networks	0	0	0	-	-
65	13.3	Open Mosaic Habitat	0	0	0	-	-
65	13.4	Limestone Pavement Orders	0	0	0	-	-
Page	Section	Geology 1:10,000 scale	On site	0-50m	50-250m	250-500m	500-2000m
66	**14.1**	**10k Availability**	Identified (within 500m)				
67	**14.2**	**Artificial and made ground (10k)**	0	0	2	1	-
68	**14.3**	**Superficial geology (10k)**	1	0	1	1	-

69	14.4	Landslip (10k)	0	0	0	0	-
70	**14.5**	**Bedrock geology (10k)**	1	0	1	0	-
71	14.6	Bedrock faults and other linear features (10k)	0	0	0	0	-
Page	Section	Geology 1:50,000 scale	On site	0-50m	50-250m	250-500m	500-2000m
72	**15.1**	**50k Availability**	Identified (within 500m)				
73	**15.2**	**Artificial and made ground (50k)**	0	0	2	1	-
74	15.3	Artificial ground permeability (50k)	0	0	-	-	-
75	**15.4**	**Superficial geology (50k)**	1	0	0	1	-
76	**15.5**	**Superficial permeability (50k)**	Identified (within 50m)				
76	15.6	Landslip (50k)	0	0	0	0	-
76	15.7	Landslip permeability (50k)	None (within 50m)				
77	**15.8**	**Bedrock geology (50k)**	1	0	0	0	-
78	**15.9**	**Bedrock permeability (50k)**	Identified (within 50m)				
78	15.10	Bedrock faults and other linear features (50k)	0	0	0	0	-
Page	Section	Boreholes	On site	0-50m	50-250m	250-500m	500-2000m
79	16.1	BGS Boreholes	0	0	0	-	-
Page	Section	Natural ground subsidence					
80	**17.1**	**Shrink swell clays**	Moderate (within 50m)				
81	**17.2**	**Running sands**	Very low (within 50m)				
82	**17.3**	**Compressible deposits**	Negligible (within 50m)				
83	**17.4**	**Collapsible deposits**	Very low (within 50m)				
84	**17.5**	**Landslides**	Very low (within 50m)				
85	**17.6**	**Ground dissolution of soluble rocks**	Negligible (within 50m)				
Page	Section	Mining, ground workings and natural cavities	On site	0-50m	50-250m	250-500m	500-2000m
86	18.1	Natural cavities	0	0	0	0	-
87	**18.2**	**BritPits**	0	0	0	2	-
87	**18.3**	**Surface ground workings**	0	0	4	-	-
88	18.4	Underground workings	0	0	0	0	0
88	**18.5**	**Historical Mineral Planning Areas**	0	0	2	0	-

88	18.6	Non-coal mining	0	0	0	0	0
88	18.7	Mining cavities	0	0	0	0	0
89	18.8	JPB mining areas	None (within 0m)				
89	18.9	Coal mining	None (within 0m)				
89	18.10	Brine areas	None (within 0m)				
89	18.11	Gypsum areas	None (within 0m)				
89	18.12	Tin mining	None (within 0m)				
90	18.13	Clay mining	None (within 0m)				

Page	Section	Radon	
91	**19.1**	**Radon**	Less than 1% (within 0m)

Page	Section	Soil chemistry	On site	0-50m	50-250m	250-500m	500-2000m
92	**20.1**	**BGS Estimated Background Soil Chemistry**	1	0	-	-	-
92	**20.2**	**BGS Estimated Urban Soil Chemistry**	1	7	-	-	-
93	20.3	BGS Measured Urban Soil Chemistry	0	0	-	-	-

Page	Section	Railway infrastructure and projects	On site	0-50m	50-250m	250-500m	500-2000m
94	21.1	Underground railways (London)	0	0	0	-	-
94	21.2	Underground railways (Non-London)	0	0	0	-	-
94	21.3	Railway tunnels	0	0	0	-	-
94	21.4	Historical railway and tunnel features	0	0	0	-	-
94	21.5	Royal Mail tunnels	0	0	0	-	-
95	21.6	Historical railways	0	0	0	-	-
95	21.7	Railways	0	0	0	-	-
95	21.8	Crossrail 1	0	0	0	0	-
95	21.9	Crossrail 2	0	0	0	0	-
95	21.10	HS2	0	0	0	0	-

Recent aerial photograph



Capture Date: 02/08/2018

Site Area: 0.07ha

Recent site history - 2016 aerial photograph



Capture Date: 12/08/2016

Site Area: 0.07ha

Recent site history - 2010 aerial photograph



Capture Date: 24/04/2010

Site Area: 0.07ha

Recent site history - 2009 aerial photograph



Capture Date: 29/06/2009

Site Area: 0.07ha

Recent site history - 1999 aerial photograph



Capture Date: 06/09/1999

Site Area: 0.07ha

OS MasterMap site plan



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Site Area: 0.07ha

1 Past land use



Site Outline

Search buffers in metres (m)

Historical industrial land uses

Historical energy features

Historical garages

1.1 Historical industrial land uses

Records within 500m	11

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

Features are displayed on the Past land use map on **page 14**

ID	Location	Land use	Dates present	Group ID
7	259m S	Unspecified Depot	1989	2147298

ID	Location	Land use	Dates present	Group ID
9	353m NW	Nursery	1975	2161629
11	396m W	Unspecified Heap	1862	2136912
B	449m SW	Engineering Works	1915 - 1921	2281957
B	455m SW	Unspecified Works	1968	2278021
B	455m SW	Unspecified Factory	1975	2151003
C	469m S	Unspecified Depot	1975 - 1989	2224039
B	495m SW	Engineering Works	1921	2182438
B	497m SW	Unspecified Commercial/Industrial	1938	2131028
B	498m SW	Unspecified Works	1975	2271090
B	498m SW	Engineering Works	1950	2226776

This data is sourced from Ordnance Survey / Groundsure.

1.2 Historical tanks

Records within 500m	0

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

This data is sourced from Ordnance Survey / Groundsure.

1.3 Historical energy features

Records within 500m	10

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

Features are displayed on the Past land use map on **page 14**

ID	Location	Land use	Dates present	Group ID
1	106m W	Electricity Substation	1969 - 1992	268024

ID	Location	Land use	Dates present	Group ID
2	159m N	Electricity Substation	1969 - 1992	270232
3	170m N	Electricity Substation	1969 - 1992	275642
4	196m E	Electricity Substation	1969 - 1992	263887
6	252m NW	Electricity Substation	1969 - 1992	259633
8	310m SW	Electricity Substation	1999	246836
10	379m E	Electricity Substation	1977	246837
A	379m SW	Electricity Substation	1993	277051
A	383m SW	Electricity Substation	1978 - 1983	265204
12	445m SW	Electricity Substation	1993	246840

This data is sourced from Ordnance Survey / Groundsure.

1.4 Historical petrol stations

Records within 500m	0

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

This data is sourced from Ordnance Survey / Groundsure.

1.5 Historical garages

Records within 500m	4

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

Features are displayed on the Past land use map on **page 14**

ID	Location	Land use	Dates present	Group ID
5	222m SW	Garage	1961 - 1962	81920
C	466m S	Garage	1961 - 1962	82861

ID	Location	Land use	Dates present	Group ID
C	467m S	Garage	1986	75957
C	482m S	Garage	1999	76636

This data is sourced from Ordnance Survey / Groundsure.

1.6 Historical military land

Records within 500m	**0**

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

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

2 Past land use - un-grouped



Site Outline

Search buffers in metres (m)

Historical industrial land uses

Historical energy features

Historical garages

2.1 Historical industrial land uses

Records within 500m	13

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

Features are displayed on the Past land use - un-grouped map on **page 18**

ID	Location	Land Use	Date	Group ID
1	259m S	Unspecified Depot	1989	2147298
3	353m NW	Nursery	1975	2161629
5	396m W	Unspecified Heap	1862	2136912

ID	Location	Land Use	Date	Group ID
H	449m SW	Engineering Works	1921	2281957
H	455m SW	Unspecified Works	1968	2278021
H	455m SW	Unspecified Factory	1975	2151003
I	469m S	Unspecified Depot	1989	2224039
I	469m S	Unspecified Depot	1975	2224039
H	493m SW	Engineering Works	1915	2281957
H	495m SW	Engineering Works	1921	2182438
H	497m SW	Unspecified Commercial/Industrial	1938	2131028
H	498m SW	Unspecified Works	1975	2271090
H	498m SW	Engineering Works	1950	2226776

This data is sourced from Ordnance Survey / Groundsure.

2.2 Historical tanks

Records within 500m	**0**

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

This data is sourced from Ordnance Survey / Groundsure.

2.3 Historical energy features

Records within 500m	**17**

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

Features are displayed on the Past land use - un-grouped map on **page 18**

ID	Location	Land Use	Date	Group ID
A	106m W	Electricity Substation	1969	268024
A	107m W	Electricity Substation	1992	268024
B	159m N	Electricity Substation	1969	270232

ID	Location	Land Use	Date	Group ID
B	160m N	Electricity Substation	1992	270232
C	170m N	Electricity Substation	1969	275642
C	171m N	Electricity Substation	1992	275642
D	196m E	Electricity Substation	1992	263887
D	196m E	Electricity Substation	1969	263887
F	252m NW	Electricity Substation	1992	259633
F	252m NW	Electricity Substation	1969	259633
2	310m SW	Electricity Substation	1999	246836
4	379m E	Electricity Substation	1977	246837
G	379m SW	Electricity Substation	1993	277051
G	383m SW	Electricity Substation	1978	265204
G	384m SW	Electricity Substation	1983	265204
G	384m SW	Electricity Substation	1983	265204
6	445m SW	Electricity Substation	1993	246840

This data is sourced from Ordnance Survey / Groundsure.

2.4 Historical petrol stations

Records within 500m	0

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

This data is sourced from Ordnance Survey / Groundsure.

2.5 Historical garages

Records within 500m	6

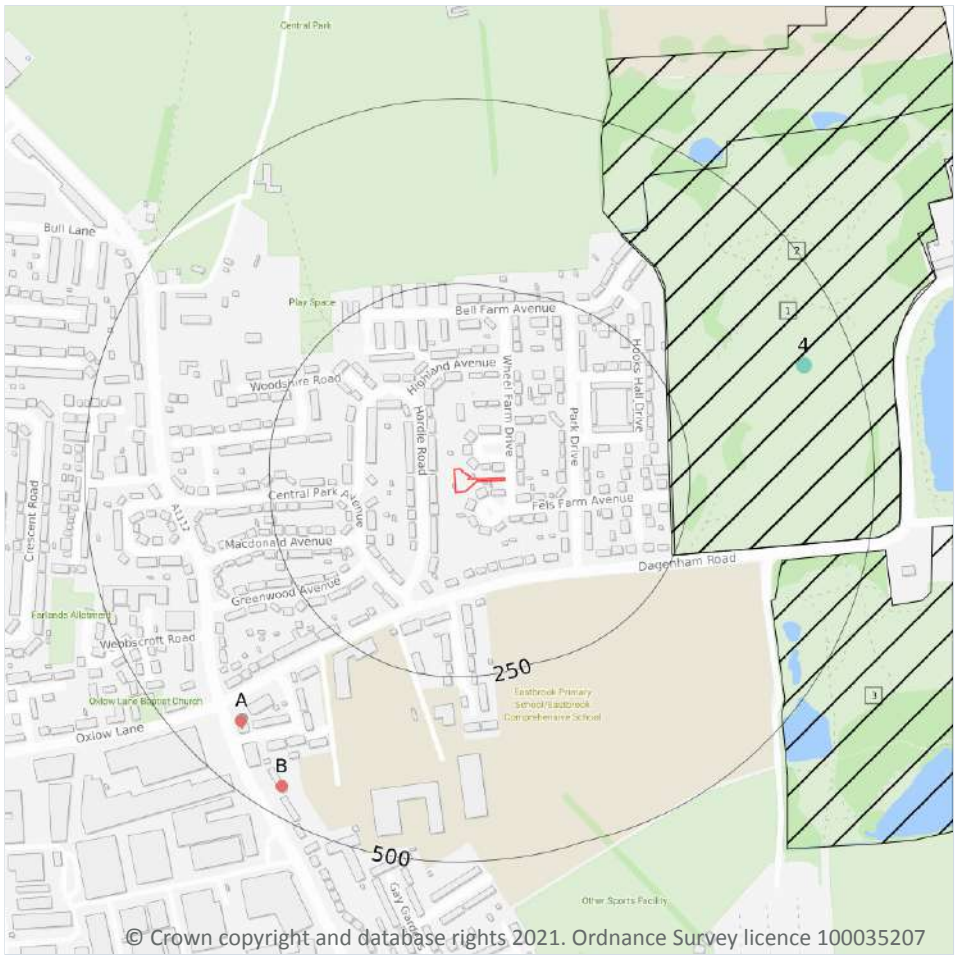
Garages digitised from historical Ordnance Survey mapping at high-detail 1:1,250 and 1:2,500 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use - un-grouped map on **page 18**

ID	Location	Land Use	Date	Group ID
E	222m SW	Garage	1962	81920
E	233m SW	Garage	1961	81920
I	466m S	Garage	1961	82861
I	467m S	Garage	1962	82861
I	467m S	Garage	1986	75957
I	482m S	Garage	1999	76636

This data is sourced from Ordnance Survey / Groundsure.

3 Waste and landfill



Site Outline

Search buffers in metres (m)

Historical landfill (EA/NRW)

Historical landfill (BGS)

Licensed waste sites

Waste exemptions

3.1 Active or recent landfill

Records within 500m	0

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

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

3.2 Historical landfill (BGS records)

Records within 500m	1

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

Features are displayed on the Waste and landfill map on **page 22**

ID	Location	Address	BGS Number	Risk	Waste Type
4	431m E	Eastbrook Farm, Dagenham Rd, Dagenham, Essex	1628	No risk to aquifer	N/A

This data is sourced from the British Geological Survey.

3.3 Historical landfill (LA/mapping records)

Records within 500m	**0**

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

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

3.4 Historical landfill (EA/NRW records)

Records within 500m	**3**

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

Features are displayed on the Waste and landfill map on **page 22**

ID	Location	Details		
1	222m E	Site Address: Eastbrook Farm, Dagenham Road, Dagenham, Essex Licence Holder Address: -	Waste Licence: - Site Reference: - Waste Type: - Environmental Permitting Regulations (Waste) Reference: - Licence Issue: - Licence Surrender: -	Operator: Ready Mixed Concrete Limited Licence Holder: - First Recorded 31/07/1969 Last Recorded: -
2	226m E	Site Address: Eastbrookend Country Park, Eastbrookend Licence Holder Address: -	Waste Licence: Yes Site Reference: 8BD006, DL362 Waste Type: Inert, Commercial, Household, Special Environmental Permitting Regulations (Waste) Reference: - Licence Issue: 05/12/1991 Licence Surrender: 04/12/1993	Operator: - Licence Holder: London Borough of Barking and Dagenham First Recorded 31/12/1991 Last Recorded: 06/04/1993

ID	Location	Details		
3	390m E	Site Address: Eastbrookend Country Park, Eastbrookend Licence Holder Address: -	Waste Licence: Yes Site Reference: DL362, 8BD006, DL369 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: - Licence Issue: 05/12/1991 Licence Surrender: 04/12/1993	Operator: - Licence Holder: London Borough of Barking and Dagenham First Recorded 31/07/1991 Last Recorded: 06/04/1993

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

3.5 Historical waste sites

Records within 500m	**0**

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

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

3.6 Licensed waste sites

Records within 500m	**2**

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

Features are displayed on the Waste and landfill map on **page 22**

ID	Location	Details		
A	423m SW	Site Name: A & J Plumbing & Heating London Ltd Site Address: 250, Rainham Road South, Dagenham, Essex, RM10 7UU Correspondence Address: -	Type of Site: Metal Recycling Site 25000 tps Size: 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: AJP009 EPR reference: EA/EPR/CB3531RF/A001 Operator: A & J Plumbing & Heating London Ltd Waste Management licence No: 103439 Annual Tonnage: 24999	Issue Date: 19/07/2012 Effective Date: - Modified:: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued

ID	Location	Details		
A	423m SW	Site Name: A & J Plumbing & Heating London Ltd Site Address: 250, Rainham Road South, Dagenham, Essex, RM10 7UU Correspondence Address: -	Type of Site: Metal Recycling Site 25000 tps Size: 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: AJP009 EPR reference: EA/EPR/CB3531RF/S002 Operator: A & J Trading (London) Ltd Waste Management licence No: 103439 Annual Tonnage: 0	Issue Date: 19/07/2012 Effective Date: - Modified:: - Surrendered Date: Jan 15 2019 12:00AM Expiry Date: - Cancelled Date: - Status: Surrendered

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

3.7 Waste exemptions

Records within 500m **5**

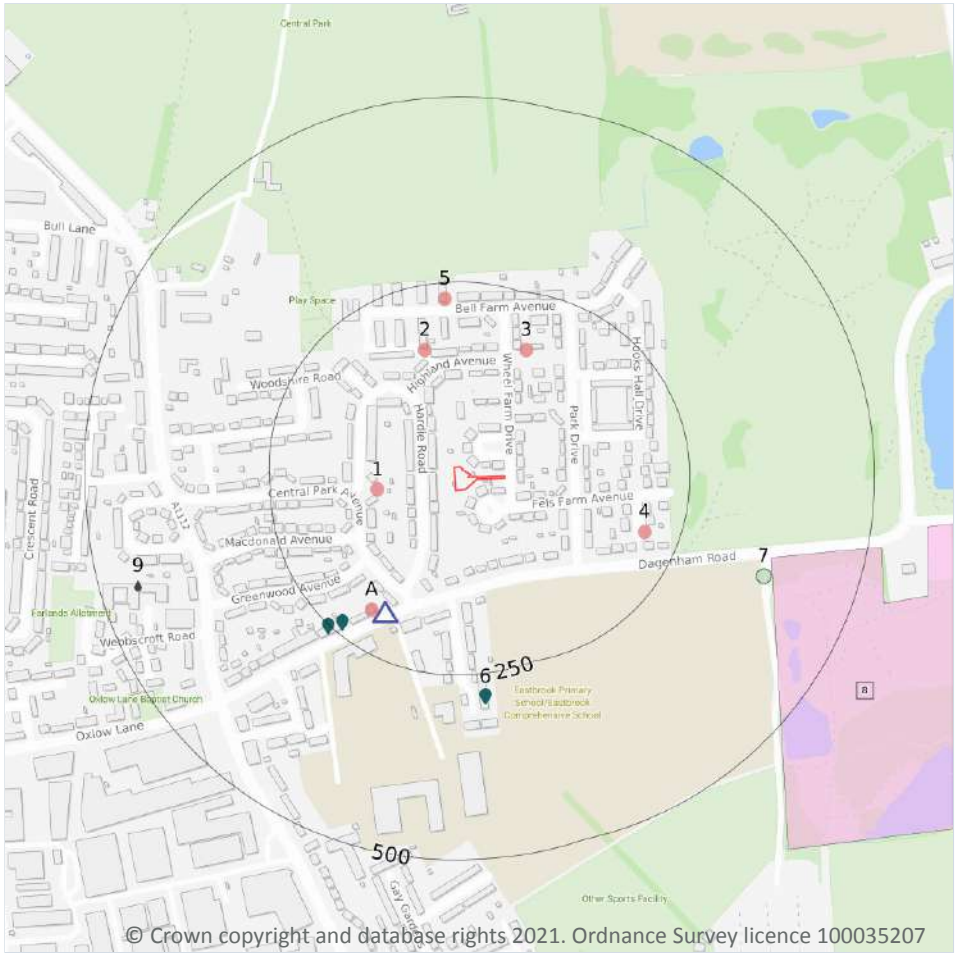
Activities involving the storage, treatment, use or disposal of waste that are exempt from needing a permit. Exemptions have specific limits and conditions that must be adhered to.

Features are displayed on the Waste and landfill map on **page 22**

ID	Location	Site	Reference	Category	Sub-Category	Description
A	425m SW	250, RAINHAM ROAD SOUTH, DAGENHAM, RM10 7UU	WEX134901	Storing waste exemption	Not on a farm	Storage of waste in secure containers
A	425m SW	250, RAINHAM ROAD SOUTH, DAGENHAM, RM10 7UU	WEX134901	Treating waste exemption	Not on a farm	Recovery of scrap metal
A	425m SW	ALEXANDER COURT CARE CENTRE, 320, RIANHAM ROAD SOUTH, ESSEX, RM10 7UU	WEX226633	Treating waste exemption	Not on a farm	Sorting and de-naturing of controlled drugs for disposal
B	463m SW	250 Rainham Road South DAGENHAM Essex RM10 7UU	EPR/PF0730QX/A001	Storing waste exemption	Non-Agricultural Waste Only	Storage of waste in secure containers
B	463m SW	250 Rainham Road South DAGENHAM Essex RM10 7UU	EPR/PF0730QX/A001	Treating waste exemption	Non-Agricultural Waste Only	Recovery of scrap metal

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

4 Current industrial land use



Site Outline

Search buffers in metres (m)

Recent industrial land uses

Current or recent petrol stations

Sites determined as Contaminated Land

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

Licensed Discharges to controlled waters

Pollution Incidents (EA/NRW)

4.1 Recent industrial land uses

Records within 250m	6

Current potentially contaminative industrial sites.

Features are displayed on the Current industrial land use map on **page 26**

ID	Location	Company	Address	Activity	Category
1	106m W	Electricity Sub Station	Greater London, RM10	Electrical Features	Infrastructure and Facilities
2	164m N	Electricity Sub Station	Greater London, RM10	Electrical Features	Infrastructure and Facilities
3	173m N	Electricity Sub Station	Greater London, RM10	Electrical Features	Infrastructure and Facilities

ID	Location	Company	Address	Activity	Category
A	197m SW	Depot	Greater London, RM10	Container and Storage	Transport, Storage and Delivery
4	202m E	Electricity Sub Station	Greater London, RM10	Electrical Features	Infrastructure and Facilities
5	228m N	Klemca Party Delights	32, Bell Farm Avenue, Dagenham, Greater London, RM10 7BA	Baking and Confectionery	Foodstuffs

This data is sourced from Ordnance Survey.

4.2 Current or recent petrol stations

Records within 500m	**1**

Open, closed, under development and obsolete petrol stations.

Features are displayed on the Current industrial land use map on **page 26**

ID	Location	Company	Address	LPG	Status
A	190m SW	OBSOLETE	796-806, Dagenham Road, Dagenham, Outer London, RM10 7UB	Not Applicable	Obsolete

This data is sourced from Experian.

4.3 Electricity cables

Records within 500m	**0**

High voltage underground electricity transmission cables.

This data is sourced from National Grid.

4.4 Gas pipelines

Records within 500m	**0**

High pressure underground gas transmission pipelines.

This data is sourced from National Grid.

4.5 Sites determined as Contaminated Land

Records within 500m	1

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

Features are displayed on the Current industrial land use map on **page 26**

ID	Location	Description	Site name	Category	Year identified
8	376m E	Former landfill	Eastbookend Country Oark, Dagenham Road, Dagenham	Potentially Contaminated Land	Not specified

This data is sourced from Local Authority records.

4.6 Control of Major Accident Hazards (COMAH)

Records within 500m	0

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

This data is sourced from the Health and Safety Executive.

4.7 Regulated explosive sites

Records within 500m	0

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

This data is sourced from the Health and Safety Executive.

4.8 Hazardous substance storage/usage

Records within 500m	0

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

This data is sourced from Local Authority records.

4.9 Historical licensed industrial activities (IPC)

Records within 500m	0

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

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

4.10 Licensed industrial activities (Part A(1))

Records within 500m	0

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

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

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

Records within 500m	3

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

Features are displayed on the Current industrial land use map on **page 26**

ID	Location	Address	Details	
A	236m SW	796-806 Dagenham Road, Dagenham, Essex, RM10 7UB	Process: Unloading of Petrol into Storage at Service Stations Status: Historical Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of enforcement: No Enforcements Notified Comment: No Enforcements Notified
A	252m SW	Total, Dagenham Rd, RM10 7UB	Process: Petrol Vapour Recovery Status: Historical Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of enforcement: No Enforcements Notified Comment: No Enforcements Notified
6	281m S	LBBD Transport Yard, Education Department Garage, Eastbrook Avenue, Dagenham, Essex, RM10 7	Process: Respraying of Road Vehicles Status: Historical Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of enforcement: No Enforcements Notified Comment: No Enforcements Notified

This data is sourced from Local Authority records.

4.12 Radioactive Substance Authorisations

Records within 500m	0

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

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

4.13 Licensed Discharges to controlled waters

Records within 500m	1

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

Features are displayed on the Current industrial land use map on **page 26**

ID	Location	Address	Details	
9	448m W	RESIDENTIAL AREA, 210-217 RAINHAM R, RESIDENTIAL AREA 210-217 RAINHA, M ROAD NORTH DAGENHAM ESSEX	Effluent Type: MISCELLANEOUS DISCHARGES - SURFACE WATER Permit Number: CESR.0057 Permit Version: 1 Receiving Water: WANTZ STREAM	Status: REVOKED - UNSPECIFIED Issue date: 22/04/1968 Effective Date: 22/04/1968 Revocation Date: 02/08/1991

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

4.14 Pollutant release to surface waters (Red List)

Records within 500m	0

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

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

4.15 Pollutant release to public sewer

Records within 500m	0

Discharges of Special Category Effluents to the public sewer.

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

4.16 List 1 Dangerous Substances

Records within 500m	0

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

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

4.17 List 2 Dangerous Substances

Records within 500m	0

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

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

4.18 Pollution Incidents (EA/NRW)

Records within 500m	1

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

Features are displayed on the Current industrial land use map on **page 26**

ID	Location	Details	
7	374m E	Incident Date: 06/11/2003 Incident Identification: 200144 Pollutant: Inert Materials and Wastes Pollutant Description: Construction and Demolition Materials and Wastes	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)

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

4.19 Pollution inventory substances

Records within 500m	0

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

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

4.20 Pollution inventory waste transfers

Records within 500m	0

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

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

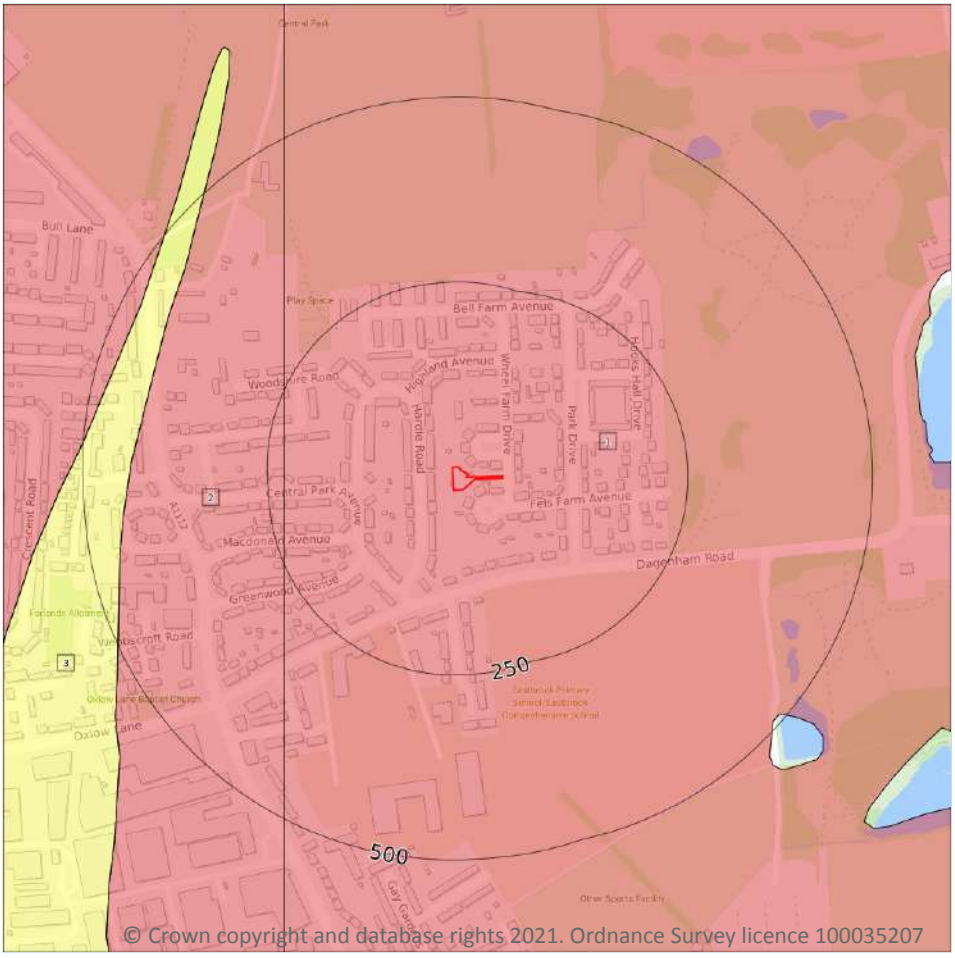
4.21 Pollution inventory radioactive waste

Records within 500m	0

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

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

5 Hydrogeology - Superficial aquifer



5.1 Superficial aquifer

Records within 500m	3

Aquifer status of groundwater held within superficial geology.

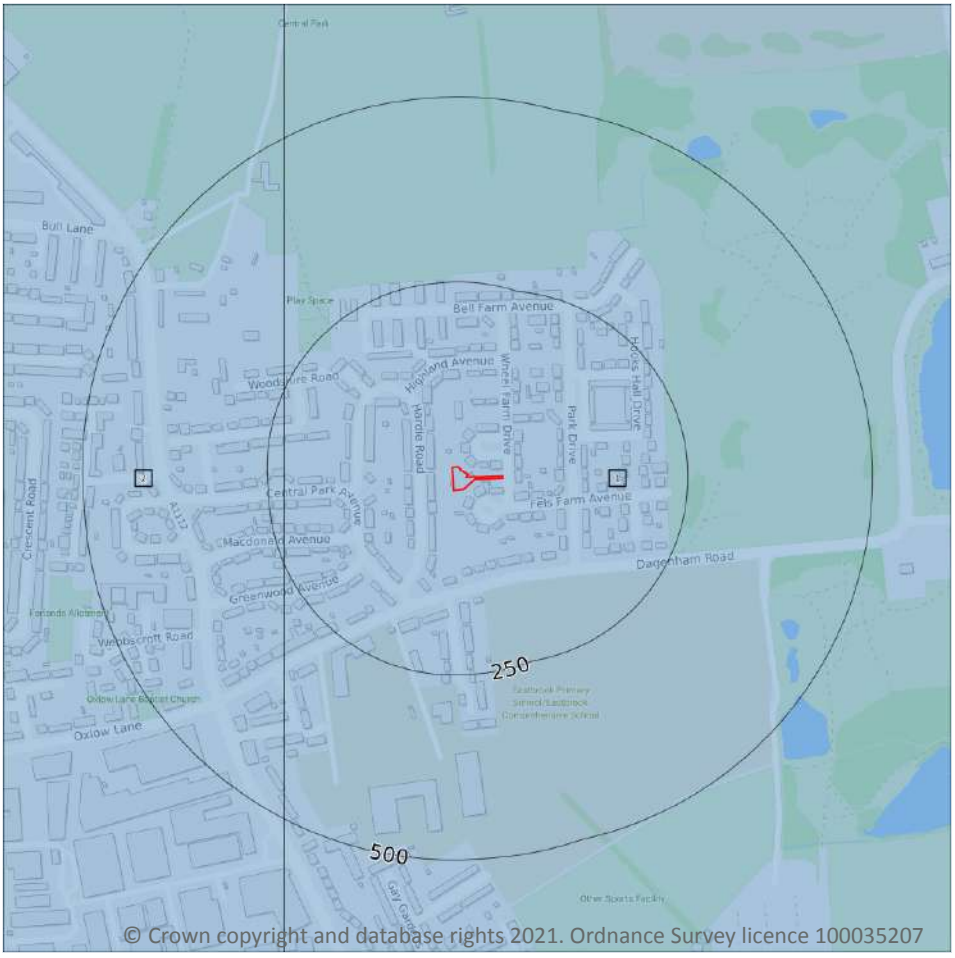
Features are displayed on the Hydrogeology map on **page 33**

ID	Location	Designation	Description
1	**On site**	**Secondary A**	**Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers**
2	228m W	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

ID	Location	Designation	Description
3	422m W	Secondary Undifferentiated	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type

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

Bedrock aquifer



5.2 Bedrock aquifer

Records within 500m	2

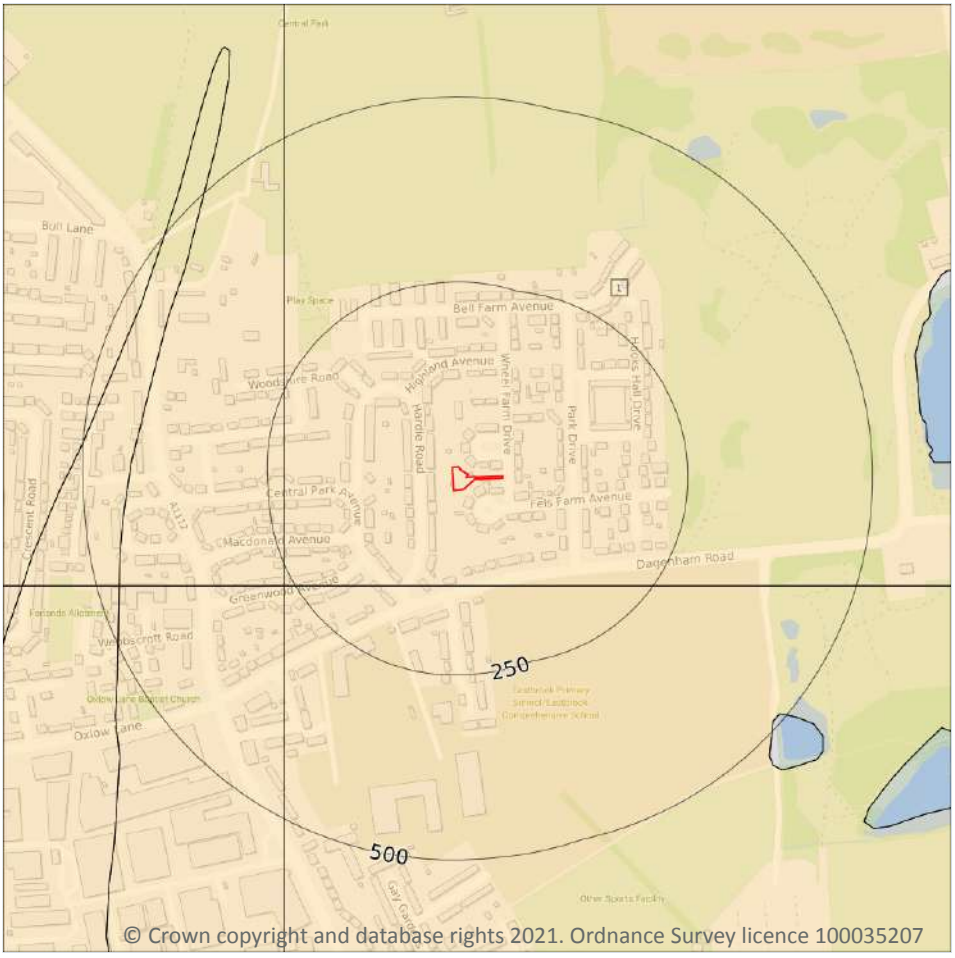
Aquifer status of groundwater held within bedrock geology.

Features are displayed on the Bedrock aquifer map on **page 35**

ID	Location	Designation	Description
1	**On site**	**Unproductive**	**These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow**
2	228m W	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow

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

Groundwater vulnerability



Site Outline

Search buffers in metres (m)

Superficial vulnerability
- Principal superficial aquifer, high vulnerability
- Secondary superficial aquifer, high vulnerability
- Principal superficial aquifer, medium vulnerability
- Secondary superficial aquifer, medium vulnerability
- Principal superficial aquifer, low vulnerability
- Secondary superficial aquifer, low vulnerability

Bedrock vulnerability
- Principal bedrock aquifer, high vulnerability
- Secondary bedrock aquifer, high vulnerability
- Principal bedrock aquifer, medium vulnerability
- Secondary bedrock aquifer, medium vulnerability
- Principal bedrock aquifer, low vulnerability
- Secondary bedrock aquifer, low vulnerability

Other information
- Unproductive aquifer
- Soluble rock risk
- Local information

5.3 Groundwater vulnerability

Records within 50m	1

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

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

Features are displayed on the Groundwater vulnerability map on **page 36**

ID	Location	Summary	Soil / surface	Superficial geology	Bedrock geology
1	On site	**Summary Classification: Secondary superficial aquifer - High Vulnerability Combined classification: Unproductive Bedrock Aquifer, Productive Superficial Aquifer**	**Leaching class: High Infiltration value: >70% Dilution value: <300mm/year**	**Vulnerability: High Aquifer type: Secondary Thickness: <3m Patchiness value: >90% Recharge potential: High**	**Vulnerability: Unproductive Aquifer type: Unproductive Flow mechanism: Mixed**

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

5.4 Groundwater vulnerability- soluble rock risk

Records on site	0

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

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

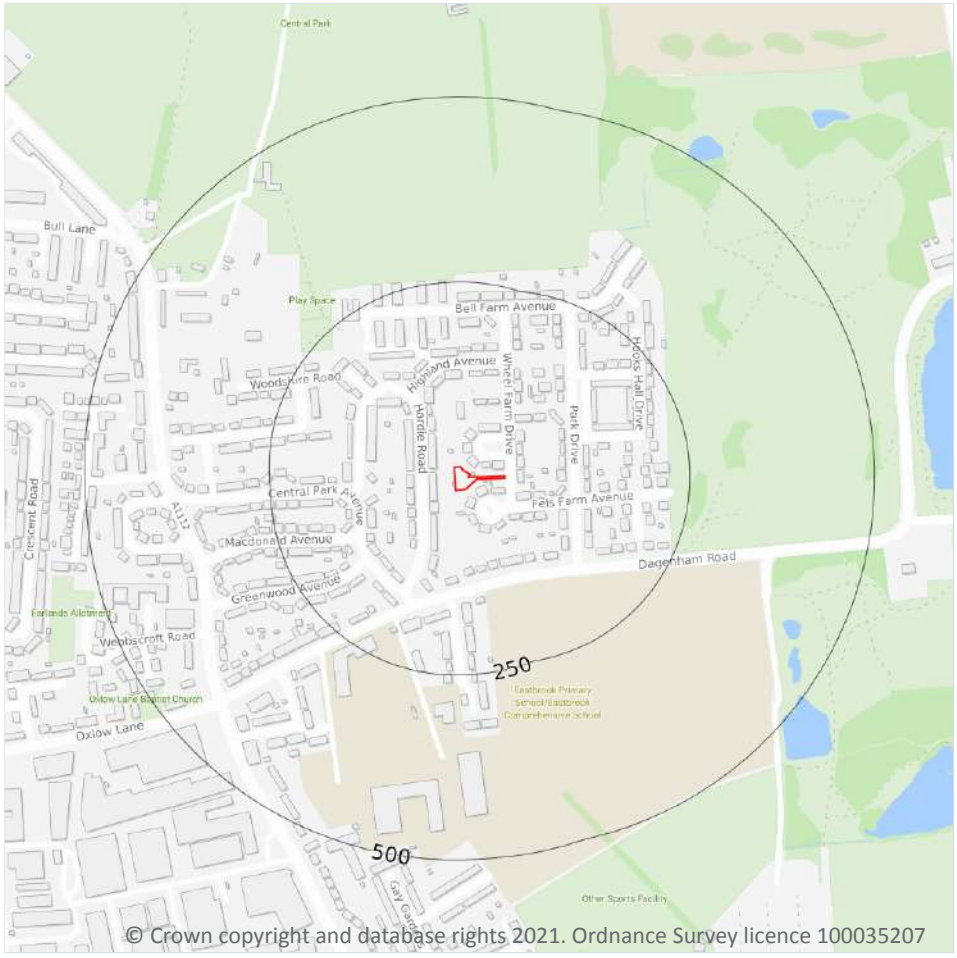
5.5 Groundwater vulnerability- local information

Records on site	0

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

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

Abstractions and Source Protection Zones



Site Outline

Search buffers in metres (m)

- Source Protection Zone 1 — Inner catchment
- Source Protection Zone 2 — Outer catchment
- Source Protection Zone 3 — Total catchment
- Source Protection Zone 4 — Zone of Special Interest
- Source Protection Zone 1c — Inner catchment - confined aquifer
- Source Protection Zone 2c — Outer catchment - confined aquifer
- Source Protection Zone 3c — Total catchment - confined aquifer
- Drinking water abstraction licences
- Drinking water abstraction licences — Polygon features
- Drinking water abstraction licences — Linear features
- Groundwater abstraction licence (point)
- Groundwater abstraction licence (area)
- Groundwater abstraction licence (linear)
- Surface Water Abstractions (point)
- Surface Water Abstractions (area)
- Surface Water Abstractions (linear)

5.6 Groundwater abstractions

Records within 2000m	15

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

Features are displayed on the Abstractions and Source Protection Zones map on **page 38**

ID	Location	Details	
-	772m S	Status: Historical Licence No: 08/37/55/0017 Details: Process water Direct Source: THAMES GROUNDWATER Point: RAINHAM ROAD SOUTH, DAGENHAM - BOREHOLE 4 Data Type: Point Name: MAY & BAKER LTD Easting: 550500 Northing: 185400	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 100 Version Start Date: 03/02/1967 Version End Date: -
-	772m S	Status: Historical Licence No: 08/37/55/0017 Details: Spray Irrigation - Direct Direct Source: THAMES GROUNDWATER Point: RAINHAM ROAD SOUTH, DAGENHAM - BOREHOLE 4 Data Type: Point Name: MAY & BAKER LTD Easting: 550500 Northing: 185400	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 100 Version Start Date: 03/02/1967 Version End Date: -
-	898m S	Status: Historical Licence No: 08/37/55/0017 Details: Spray Irrigation - Direct Direct Source: THAMES GROUNDWATER Point: RAINHAM ROAD SOUTH, DAGENHAM - BOREHOLE 1 Data Type: Point Name: MAY & BAKER LTD Easting: 550600 Northing: 185300	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 100 Version Start Date: 03/02/1967 Version End Date: -
-	898m S	Status: Historical Licence No: 08/37/55/0017 Details: Process water Direct Source: THAMES GROUNDWATER Point: RAINHAM ROAD SOUTH, DAGENHAM - BOREHOLE 1 Data Type: Point Name: MAY & BAKER LTD Easting: 550600 Northing: 185300	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 100 Version Start Date: 03/02/1967 Version End Date: -

ID	Location	Details	
-	948m S	Status: Historical Licence No: 08/37/55/0017 Details: Process Water Direct Source: THAMES GROUNDWATER Point: POINT 'A' AT THE CHEMICAL FACTORY, RAINHAM ROAD SOUTH Data Type: Point Name: MAY & BAKER LTD Easting: 550580 Northing: 185240	Annual Volume (m^3): 522790 Max Daily Volume (m^3): 2841.3 Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 102 Version Start Date: 01/12/2006 Version End Date: -
-	948m S	Status: Historical Licence No: 08/37/55/0017 Details: Spray Irrigation - Direct Direct Source: THAMES GROUNDWATER Point: POINT 'A' AT THE CHEMICAL FACTORY, RAINHAM ROAD SOUTH Data Type: Point Name: MAY & BAKER LTD Easting: 550580 Northing: 185240	Annual Volume (m^3): 522790 Max Daily Volume (m^3): 2841.3 Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 102 Version Start Date: 01/12/2006 Version End Date: -
-	1031m S	Status: Historical Licence No: 08/37/55/0017 Details: Process water Direct Source: THAMES GROUNDWATER Point: RAINHAM ROAD SOUTH, DAGENHAM - BOREHOLE 2 Data Type: Point Name: MAY & BAKER LTD Easting: 550300 Northing: 185100	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 100 Version Start Date: 03/02/1967 Version End Date: -
-	1031m S	Status: Historical Licence No: 08/37/55/0017 Details: Spray Irrigation - Direct Direct Source: THAMES GROUNDWATER Point: RAINHAM ROAD SOUTH, DAGENHAM - BOREHOLE 2 Data Type: Point Name: MAY & BAKER LTD Easting: 550300 Northing: 185100	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 100 Version Start Date: 03/02/1967 Version End Date: -

ID	Location	Details	
-	1075m S	Status: Historical Licence No: 08/37/55/0017 Details: Process Water Direct Source: THAMES GROUNDWATER Point: POINT 'B' AT THE CHEMICAL FACTORY, RAINHAM ROAD SOUTH Data Type: Point Name: MAY & BAKER LTD Easting: 550350 Northing: 185060	Annual Volume (m^3): 522790 Max Daily Volume (m^3): 2841.3 Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 102 Version Start Date: 01/12/2006 Version End Date: -
-	1075m S	Status: Historical Licence No: 08/37/55/0017 Details: Spray Irrigation - Direct Direct Source: THAMES GROUNDWATER Point: POINT 'B' AT THE CHEMICAL FACTORY, RAINHAM ROAD SOUTH Data Type: Point Name: MAY & BAKER LTD Easting: 550350 Northing: 185060	Annual Volume (m^3): 522790 Max Daily Volume (m^3): 2841.3 Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 102 Version Start Date: 01/12/2006 Version End Date: -
-	1171m SE	Status: Historical Licence No: 08/37/55/0017 Details: Process water Direct Source: THAMES GROUNDWATER Point: RAINHAM ROAD SOUTH, DAGENHAM - BOREHOLE 3 Data Type: Point Name: MAY & BAKER LTD Easting: 551200 Northing: 185400	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 100 Version Start Date: 03/02/1967 Version End Date: -
-	1171m SE	Status: Historical Licence No: 08/37/55/0017 Details: Spray Irrigation - Direct Direct Source: THAMES GROUNDWATER Point: RAINHAM ROAD SOUTH, DAGENHAM - BOREHOLE 3 Data Type: Point Name: MAY & BAKER LTD Easting: 551200 Northing: 185400	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 03/02/1967 Expiry Date: - Issue No: 100 Version Start Date: 03/02/1967 Version End Date: -

ID	Location	Details	
-	1175m SE	Status: Active Licence No: TH/037/0055/010 Details: Make-Up Or Top Up Water Direct Source: THAMES GROUNDWATER Point: BOYER'S PIT, WESTERN AVENUE, DAGENHAM, ESSEX Data Type: Point Name: Dear Easting: 550860 Northing: 185114	Annual Volume (m^3): 17,677 Max Daily Volume (m^3): 96.60 Original Application No: - Original Start Date: 26/02/2015 Expiry Date: 31/03/2025 Issue No: 2 Version Start Date: 25/09/2018 Version End Date: -
-	1980m S	Status: Historical Licence No: 08/37/55/0054 Details: Potable Water Supply - Direct Direct Source: THAMES GROUNDWATER Point: DAGENHAM WELL 'A' Data Type: Point Name: NORTHUMBRIAN WATER LIMITED Easting: 550870 Northing: 184250	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 06/06/1968 Expiry Date: - Issue No: 100 Version Start Date: 01/04/1994 Version End Date: -
-	1980m S	Status: Historical Licence No: 08/37/55/0054 Details: Potable Water Supply - Direct Direct Source: THAMES GROUNDWATER Point: DAGENHAM PUMPING STATION - WELL Data Type: Point Name: NORTHUMBRIAN WATER LIMITED Easting: 550870 Northing: 184250	Annual Volume (m^3): 1,750,000 Max Daily Volume (m^3): 5909 Original Application No: - Original Start Date: 06/06/1968 Expiry Date: - Issue No: 101 Version Start Date: 30/11/2009 Version End Date: -

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

5.7 Surface water abstractions

Records within 2000m	**0**

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

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

5.8 Potable abstractions

Records within 2000m	2

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

Features are displayed on the Abstractions and Source Protection Zones map on **page 38**

ID	Location	Details	
-	1980m S	Status: Historical Licence No: 08/37/55/0054 Details: Potable Water Supply - Direct Direct Source: THAMES GROUNDWATER Point: DAGENHAM WELL 'A' Data Type: Point Name: NORTHUMBRIAN WATER LIMITED Easting: 550870 Northing: 184250	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 06/06/1968 Expiry Date: - Issue No: 100 Version Start Date: 01/04/1994 Version End Date: -
-	1980m S	Status: Historical Licence No: 08/37/55/0054 Details: Potable Water Supply - Direct Direct Source: THAMES GROUNDWATER Point: DAGENHAM PUMPING STATION - WELL Data Type: Point Name: NORTHUMBRIAN WATER LIMITED Easting: 550870 Northing: 184250	Annual Volume (m^3): 1,750,000 Max Daily Volume (m^3): 5909 Original Application No: - Original Start Date: 06/06/1968 Expiry Date: - Issue No: 101 Version Start Date: 30/11/2009 Version End Date: -

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

5.9 Source Protection Zones

Records within 500m	0

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

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

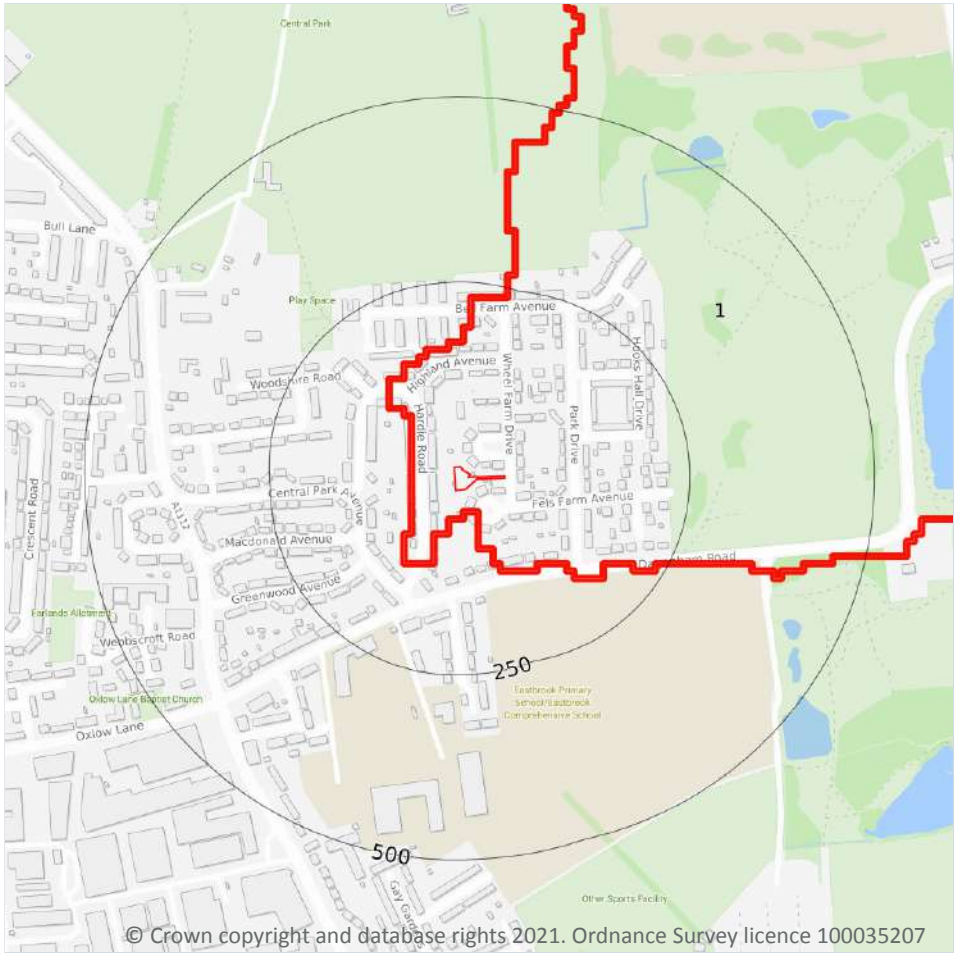
5.10 Source Protection Zones (confined aquifer)

Records within 500m	0

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

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

6 Hydrology



Site Outline

Search buffers in metres (m)

Water Network (OS MasterMap)

Surface water features (wider than 5m)

Surface water features (narrower than 5m)

WFD River, canal and surface water transfer water bodies

WFD Lake water bodies

WFD Transitional and coastal water bodies

WFD Surface water body catchments boundaries

WFD Groundwater body boundaries

6.1 Water Network (OS MasterMap)

Records within 250m	0

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

This data is sourced from the Ordnance Survey.

6.2 Surface water features

Records within 250m	0

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

This data is sourced from the Ordnance Survey.

6.3 WFD Surface water body catchments

Records on site	1

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

Features are displayed on the Hydrology map on **page 44**

ID	Location	Type	Water body catchment	Water body ID	Operational catchment	Management catchment
1	**On site**	**River WB catchment**	**Rom (Bourne Brook to Ravensbourne)**	**GB106037028120**	**Roding, Beam and Ingrebourne**	**Roding, Beam and Ingrebourne**

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

6.4 WFD Surface water bodies

Records identified	1

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

Features are displayed on the Hydrology map on **page 44**

ID	Location	Type	Name	Water body ID	Overall rating	Chemical rating	Ecological rating	Year
-	1287m E	River	Rom (Bourne Brook to Ravensbourne)	GB106037028120	Moderate	Good	Moderate	2016

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

6.5 WFD Groundwater bodies

Records on site	0

Groundwater bodies are also covered by the Directive and the same regime of objectives and reporting detailed in the previous section is in place. Click on the water body ID in the table to visit the EA Catchment Explorer to find out more about each groundwater body listed.

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

7 River and coastal flooding

7.1 Risk of Flooding from Rivers and Sea (RoFRaS)

Records within 50m	0

The chance of flooding from rivers and/or the sea in any given year, based on cells of 50m. Each cell is allocated one of four flood risk categories, taking into account flood defences and their condition; Very low (less than 1 in 1000 chance in any given year), Low (less than 1 in 100 but greater than or equal to 1 in 1000 chance), Medium (less than 1 in 30 but greater than or equal to 1 in 100 chance) or High (greater than or equal to 1 in 30 chance).

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

7.2 Historical Flood Events

Records within 250m	0

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

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

7.3 Flood Defences

Records within 250m	0

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

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

7.4 Areas Benefiting from Flood Defences

Records within 250m	0

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

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

7.5 Flood Storage Areas

Records within 250m	0

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

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

River and coastal flooding - Flood Zones

7.6 Flood Zone 2

Records within 50m	0

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

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

7.7 Flood Zone 3

Records within 50m	0

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

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

8 Surface water flooding



Site Outline

Search buffers in metres (m)

1 in 1000 return period
- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

1 in 250 return period
- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

1 in 100 return period
- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

1 in 30 return period
- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

8.1 Surface water flooding

Highest risk on site	**Negligible**
Highest risk within 50m	**1 in 30 year, 0.1m - 0.3m**

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

Features are displayed on the Surface water flooding map on **page 50**

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

The table below shows the maximum flood depths for a range of return periods for the site.

Return period	Maximum modelled depth
1 in 1000 year	Between 0.1m and 0.3m
1 in 250 year	Negligible
1 in 100 year	Negligible
1 in 30 year	Negligible

This data is sourced from Ambiental Risk Analytics.

9 Groundwater flooding



Site Outline

Search buffers in metres (m)

- High
- Moderate - High
- Moderate
- Low
- Negligible

9.1 Groundwater flooding

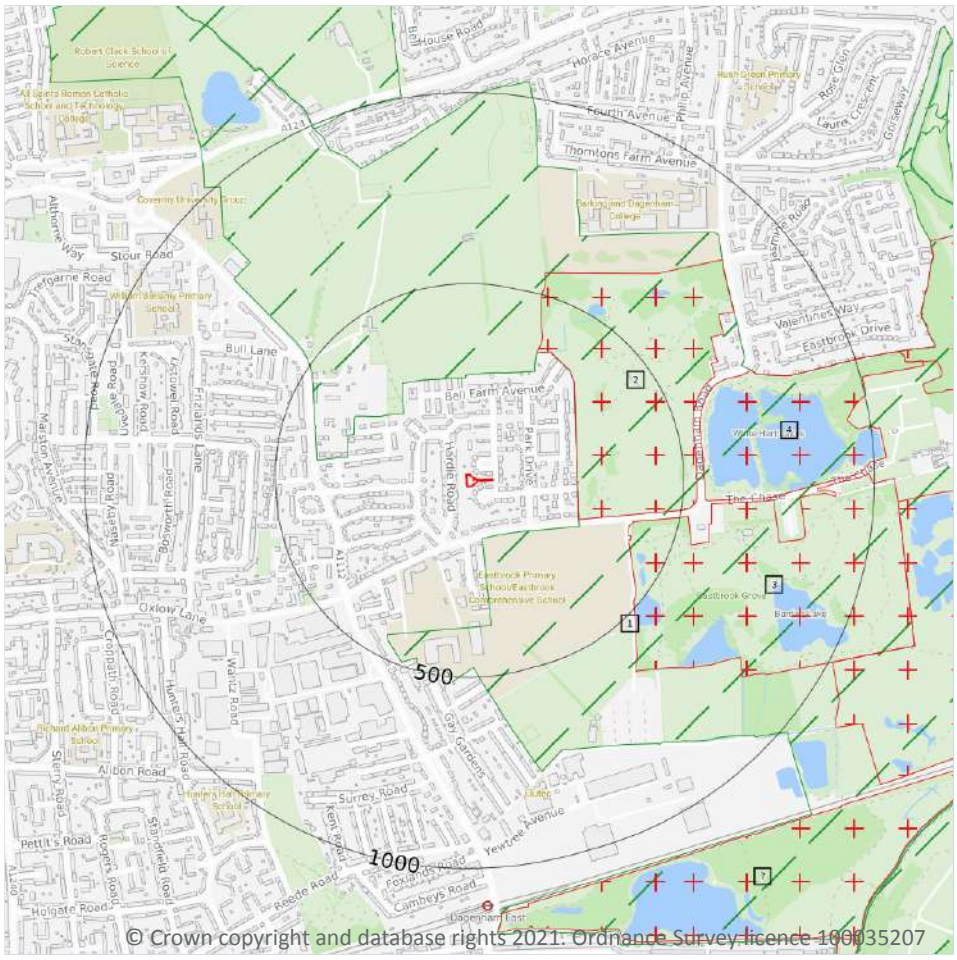
Highest risk on site	**Moderate**
Highest risk within 50m	**Moderate**

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

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

This data is sourced from Ambiental Risk Analytics.

10 Environmental designations



10.1 Sites of Special Scientific Interest (SSSI)

Records within 2000m	0

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

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

10.2 Conserved wetland sites (Ramsar sites)

Records within 2000m	0

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

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

10.3 Special Areas of Conservation (SAC)

Records within 2000m	0

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

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

10.4 Special Protection Areas (SPA)

Records within 2000m	0

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

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

10.5 National Nature Reserves (NNR)

Records within 2000m	0

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

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

10.6 Local Nature Reserves (LNR)

Records within 2000m	11

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

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

ID	Location	Name	Data source
2	222m E	East Brookend Country Park	Natural England
3	378m E	East Brookend Country Park	Natural England
4	553m E	East Brookend Country Park	Natural England
6	1009m SE	The Chase	Natural England
7	1088m S	Beam Valley	Natural England
-	1299m E	The Chase	Natural England
A	1498m SE	Beam Valley	Natural England
-	1526m E	The Chase	Natural England
-	1542m SE	Beam Valley	Natural England
-	1586m S	Dagenham Village Churchyard	Natural England
-	1991m S	Beam Valley	Natural England

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

10.7 Designated Ancient Woodland

Records within 2000m	0

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

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

10.8 Biosphere Reserves

Records within 2000m	0

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

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

10.9 Forest Parks

Records within 2000m	0

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

This data is sourced from the Forestry Commission.

10.10 Marine Conservation Zones

Records within 2000m	0

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

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

10.11 Green Belt

Records within 2000m	3

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

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

ID	Location	Name	Local Authority name
1	140m S	London	Barking and Dagenham
5	988m NW	London	Havering
8	1290m E	London	Havering

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

10.12 Proposed Ramsar sites

Records within 2000m	0

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

This data is sourced from Natural England.

10.13 Possible Special Areas of Conservation (pSAC)

Records within 2000m	0

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

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

10.14 Potential Special Protection Areas (pSPA)

Records within 2000m	0

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

This data is sourced from Natural England.

10.15 Nitrate Sensitive Areas

Records within 2000m	0

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

This data is sourced from Natural England.

10.16 Nitrate Vulnerable Zones

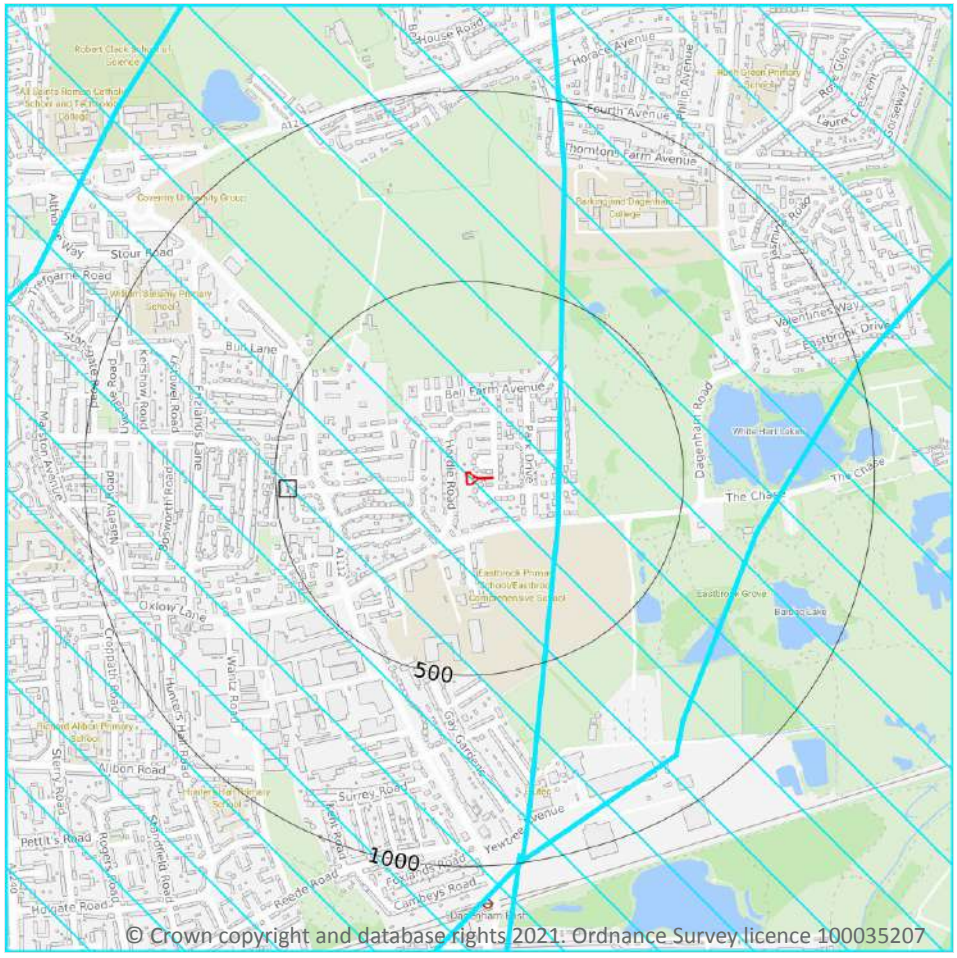
Records within 2000m	**1**

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

Location	Name	Type	NVZ ID	Status
258m N	Rom / Beam (Including Bourne Brook, from Watton's Green to confluence with Ravensbourne) NVZ	Surface Water	S439	Existing

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

SSSI Impact Zones and Units



Site Outline

Search buffers in metres (m)

SSSI Impact Risk Zones

SSSI Units

Not recorded

Favourable

Unfavourable - Recovering

Unfavourable - No change

Unfavourable - Declining

Partially destroyed

Destroyed

10.17 SSSI Impact Risk Zones

Records on site	1

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

Features are displayed on the SSSI Impact Zones and Units map on **page 59**

ID	Location	Type of developments requiring consultation
1	On site	**Infrastructure - Airports, helipads and other aviation proposals.** **Air pollution - Livestock & poultry units with floorspace > 500m², slurry lagoons > 750m² & manure stores > 3500t.** **Combustion - General combustion processes >50MW energy input. Incl: energy from waste incineration, other incineration, landfill gas generation plant, pyrolysis/gasification, anaerobic digestion, sewage treatment works, other incineration/ combustion** **Discharges - Any discharge of water or liquid waste of more than 20m³/day to ground (ie to seep away) or to surface water, such as a beck or stream (NB This does not include discharges to mains sewer which are unlikely to pose a risk at this location)**

This data is sourced from Natural England.

10.18 SSSI Units

Records within 2000m	**0**

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

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

11 Visual and cultural designations

11.1 World Heritage Sites

Records within 250m	0

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

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

11.2 Area of Outstanding Natural Beauty

Records within 250m	0

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

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

11.3 National Parks

Records within 250m	0

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

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

11.4 Listed Buildings

Records within 250m	0

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

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

11.5 Conservation Areas

Records within 250m	0

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

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

11.6 Scheduled Ancient Monuments

Records within 250m	0

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

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

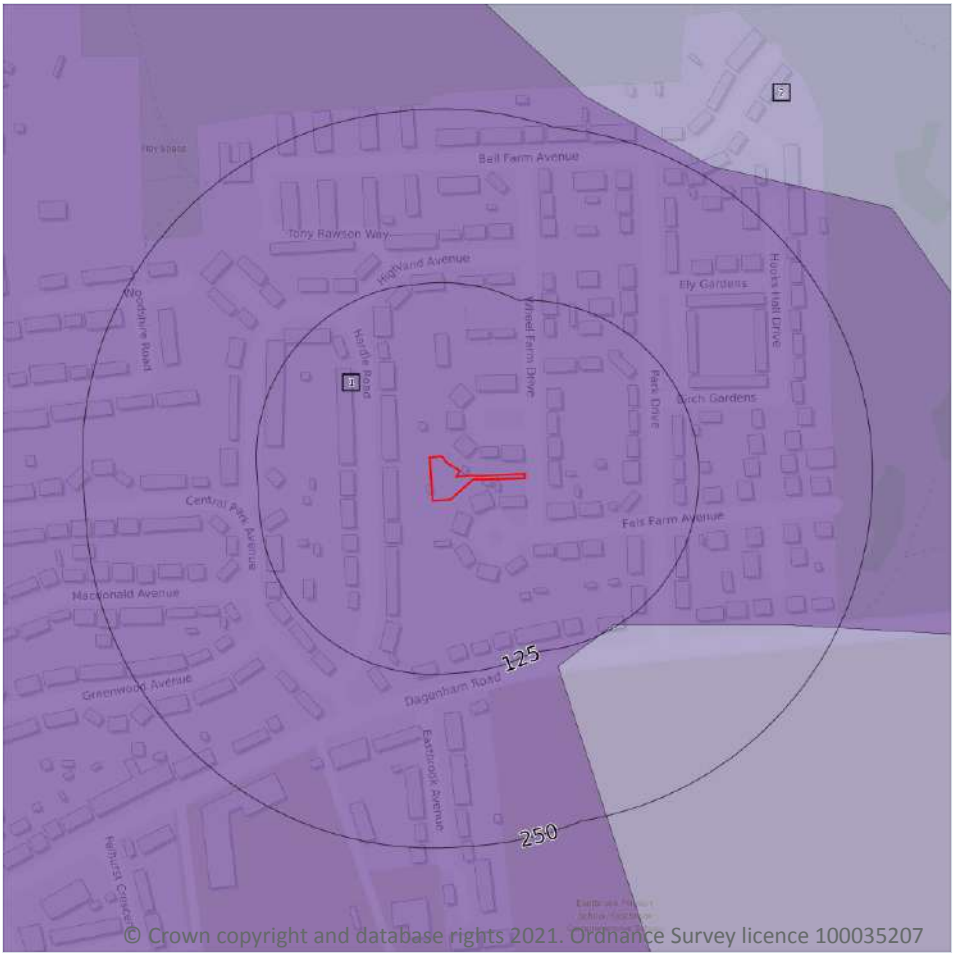
11.7 Registered Parks and Gardens

Records within 250m	0

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

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

12 Agricultural designations



Site Outline

Search buffers in metres (m)

- Grade 1 - excellent quality
- Grade 2 - very good quality
- Grade 3 - good to moderate quality
- Grade 3a - good quality
- Grade 3b - moderate quality
- Grade 4 - poor quality
- Grade 5 - very poor quality
- Non-agricultural land
- Urban land
- Exclusion land
- Tree felling licences
- Open Access land

12.1 Agricultural Land Classification

Records within 250m	2

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

Features are displayed on the Agricultural designations map on **page 63**

ID	Location	Classification	Description
1	**On site**	**Urban**	**-**
2	123m SE	Non Agricultural	-

This data is sourced from Natural England.

12.2 Open Access Land

Records within 250m	0

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

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

12.3 Tree Felling Licences

Records within 250m	0

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

This data is sourced from the Forestry Commission.

12.4 Environmental Stewardship Schemes

Records within 250m	0

Environmental Stewardship covers a range of schemes that provide financial incentives to farmers, foresters and land managers to look after and improve the environment.

This data is sourced from Natural England.

12.5 Countryside Stewardship Schemes

Records within 250m	0

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

This data is sourced from Natural England.

13 Habitat designations

13.1 Priority Habitat Inventory

Records within 250m	0

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

This data is sourced from Natural England.

13.2 Habitat Networks

Records within 250m	0

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

This data is sourced from Natural England.

13.3 Open Mosaic Habitat

Records within 250m	0

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

This data is sourced from Natural England.

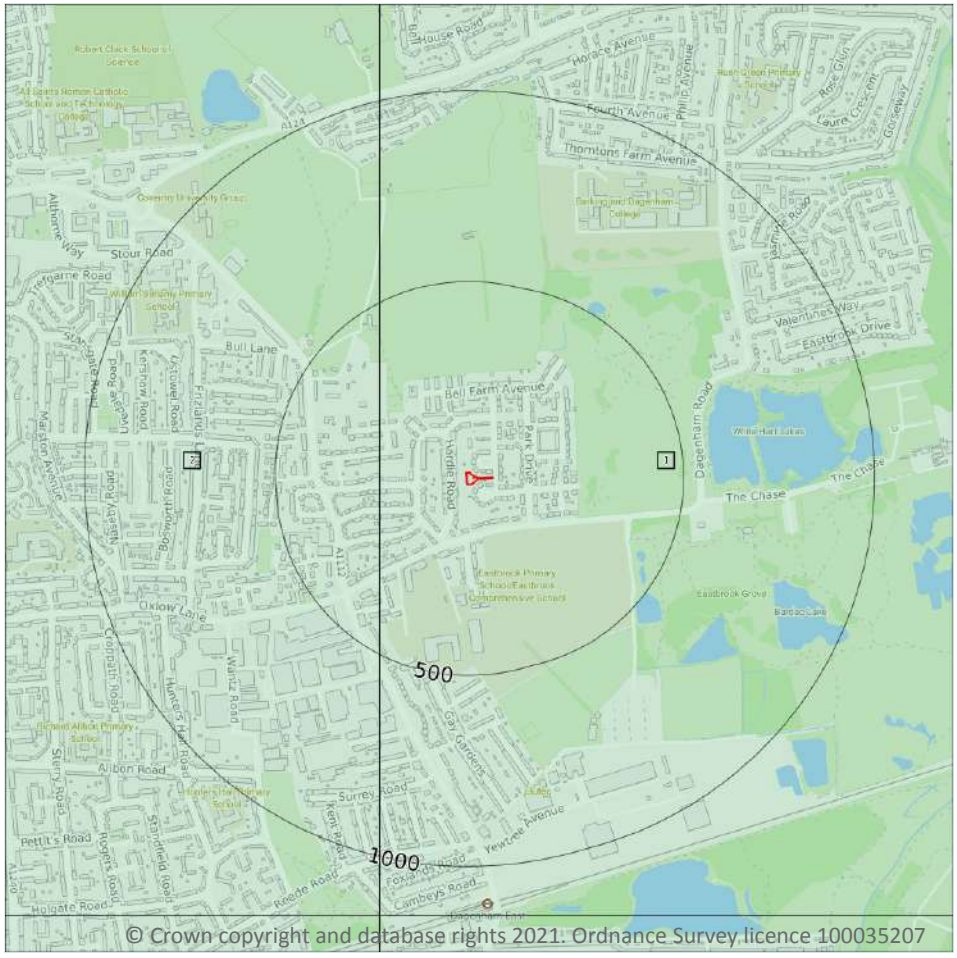
13.4 Limestone Pavement Orders

Records within 250m	0

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

This data is sourced from Natural England.

14 Geology 1:10,000 scale - Availability



14.1 10k Availability

Records within 500m	2

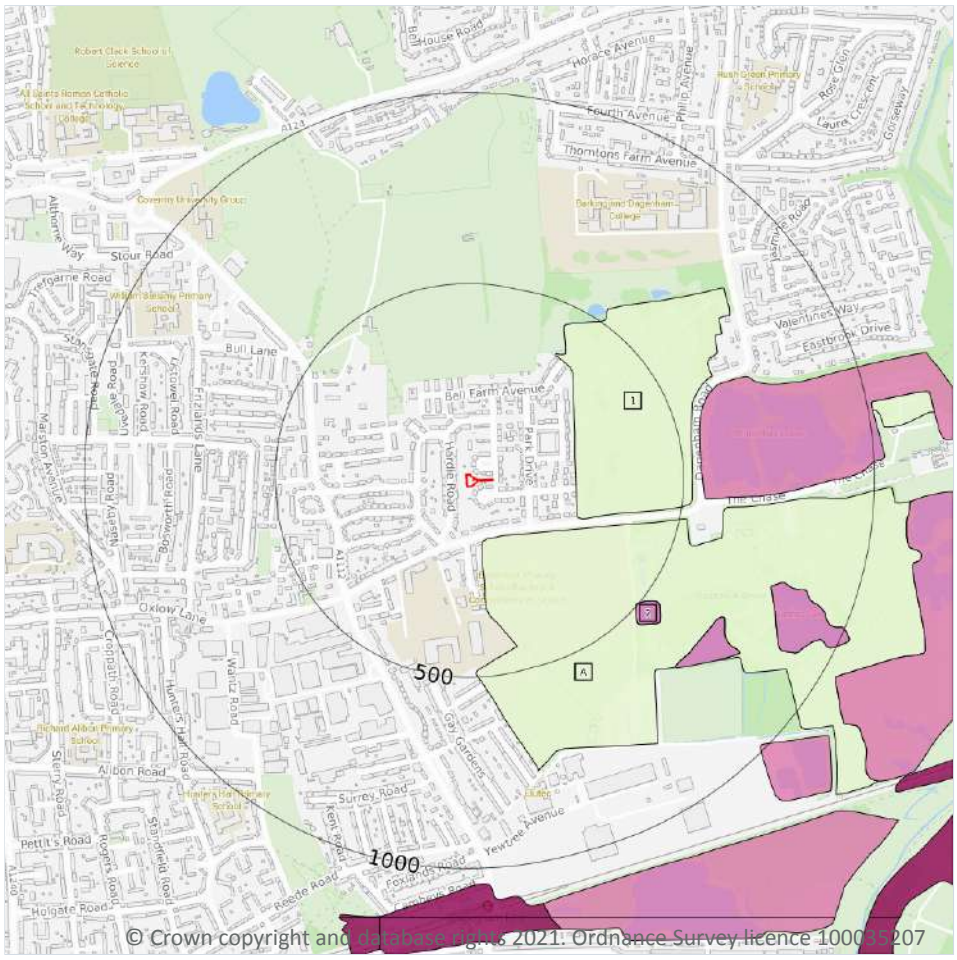
An indication on the coverage of 1:10,000 scale geology data for the site, the most detailed dataset provided by the British Geological Survey. Either 'Full', 'Partial' or 'No coverage' for each geological theme.

Features are displayed on the Geology 1:10,000 scale - Availability map on **page 66**

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	**On site**	**Full**	**Full**	**Full**	**No coverage**	**TQ58NW**
2	228m W	Full	Full	Full	No coverage	TQ48NE

This data is sourced from the British Geological Survey.

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



14.2 Artificial and made ground (10k)

Records within 500m	3

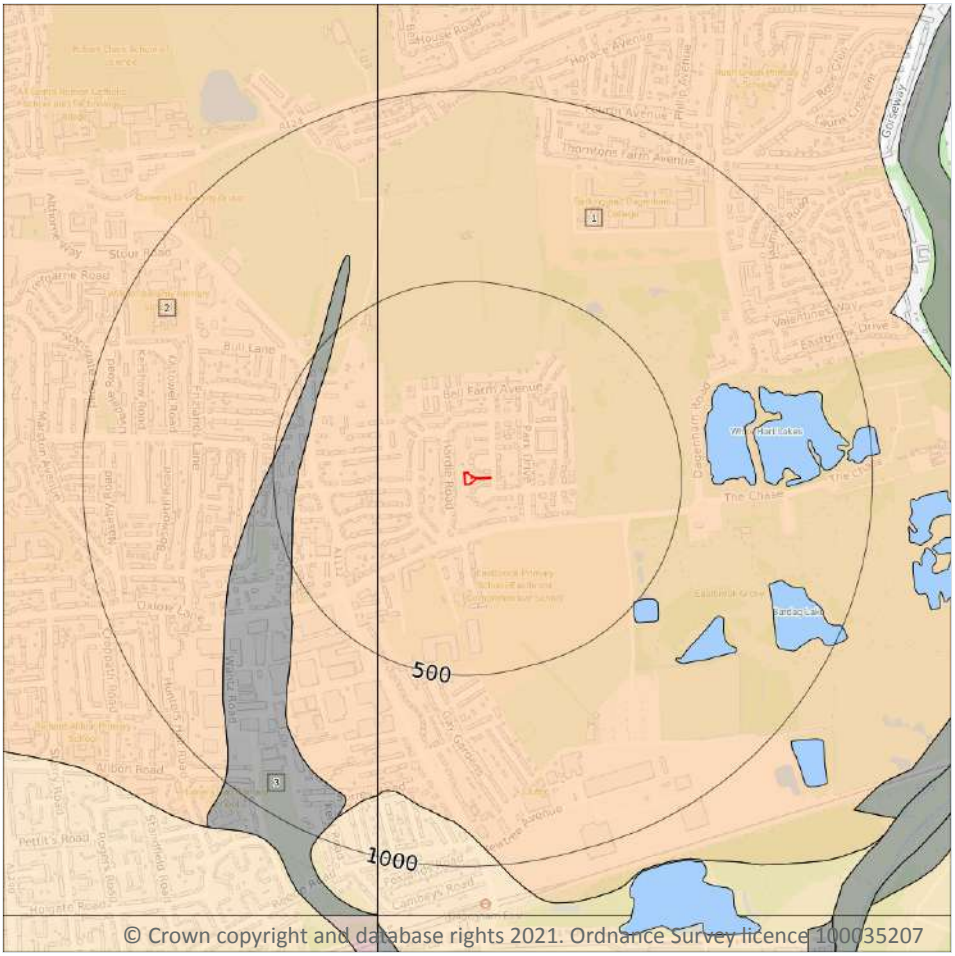
Details of made, worked, infilled, disturbed and landscaped ground at 1:10,000 scale. Artificial ground can be associated with potentially contaminated material, unpredictable engineering conditions and instability.

Features are displayed on the Geology 1:10,000 scale - Artificial and made ground map on **page 67**

ID	Location	LEX Code	Description	Rock description
A	144m S	WMGR-UKNOWN	Infilled Ground	Unknown/unclassified Entry
1	218m E	WMGR-UKNOWN	Infilled Ground	Unknown/unclassified Entry
2	497m SE	WGR-UKNOWN	Worked Ground (Undivided)	Unknown/unclassified Entry

This data is sourced from the British Geological Survey.

Geology 1:10,000 scale - Superficial



Site Outline

Search buffers in metres (m)

Landslip (10k)

Superficial geology (10k)
Please see table for more details.

14.3 Superficial geology (10k)

Records within 500m **3**

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

Features are displayed on the Geology 1:10,000 scale - Superficial map on **page 68**

ID	Location	LEX Code	Description	Rock description
1	**On site**	**HAGR-XSV**	**Hackney Gravel Member - Sand And Gravel**	**Sand And Gravel**
2	228m W	HAGR-XSV	Hackney Gravel Member - Sand And Gravel	Sand And Gravel
3	421m W	HEAD-C	Head - Clay (unlithified Deposits Coding Scheme)	Clay

This data is sourced from the British Geological Survey.

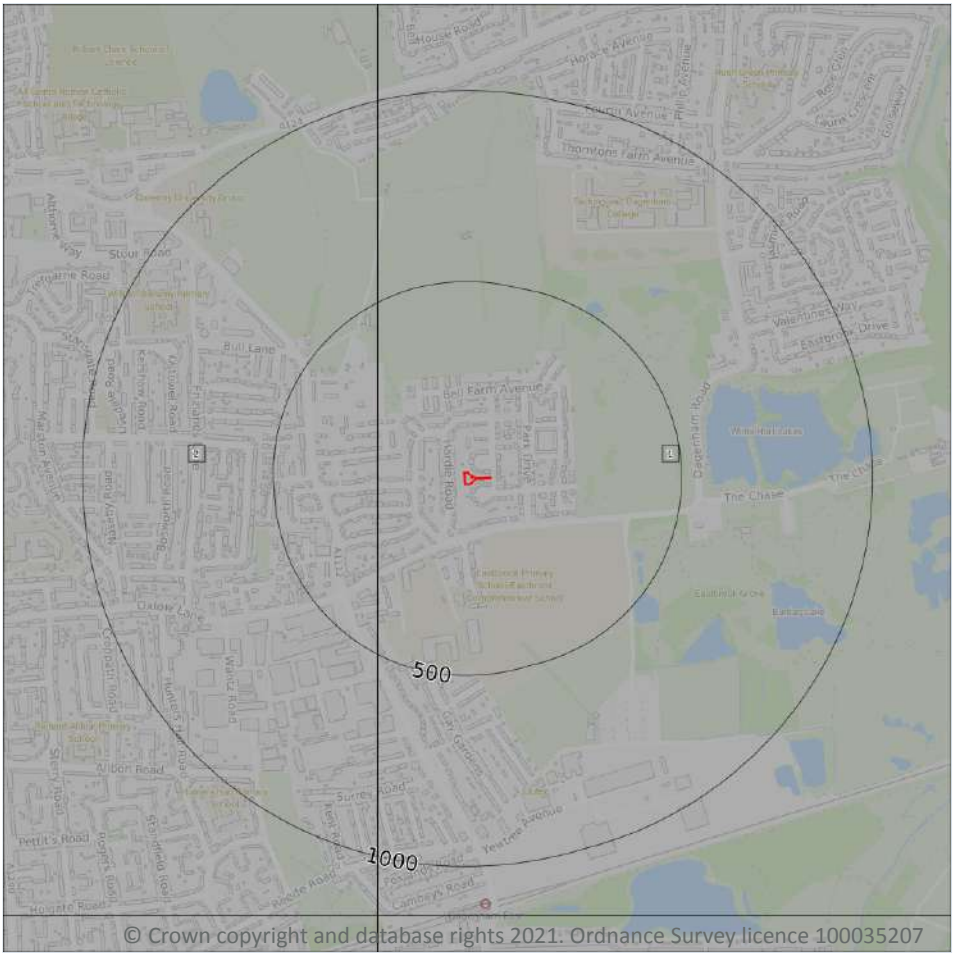
14.4 Landslip (10k)

Records within 500m	0

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

This data is sourced from the British Geological Survey.

Geology 1:10,000 scale - Bedrock



Site Outline

Search buffers in metres (m)

Bedrock faults and other linear features (10k)

Bedrock geology (10k)
Please see table for more details.

14.5 Bedrock geology (10k)

Records within 500m	2

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

Features are displayed on the Geology 1:10,000 scale - Bedrock map on **page 70**

ID	Location	LEX Code	Description	Rock age
1	**On site**	**LC-CLAY**	**London Clay Formation - Clay**	**Eocene Epoch**
2	228m W	LC-CLAY	London Clay Formation - Clay	Eocene Epoch

This data is sourced from the British Geological Survey.

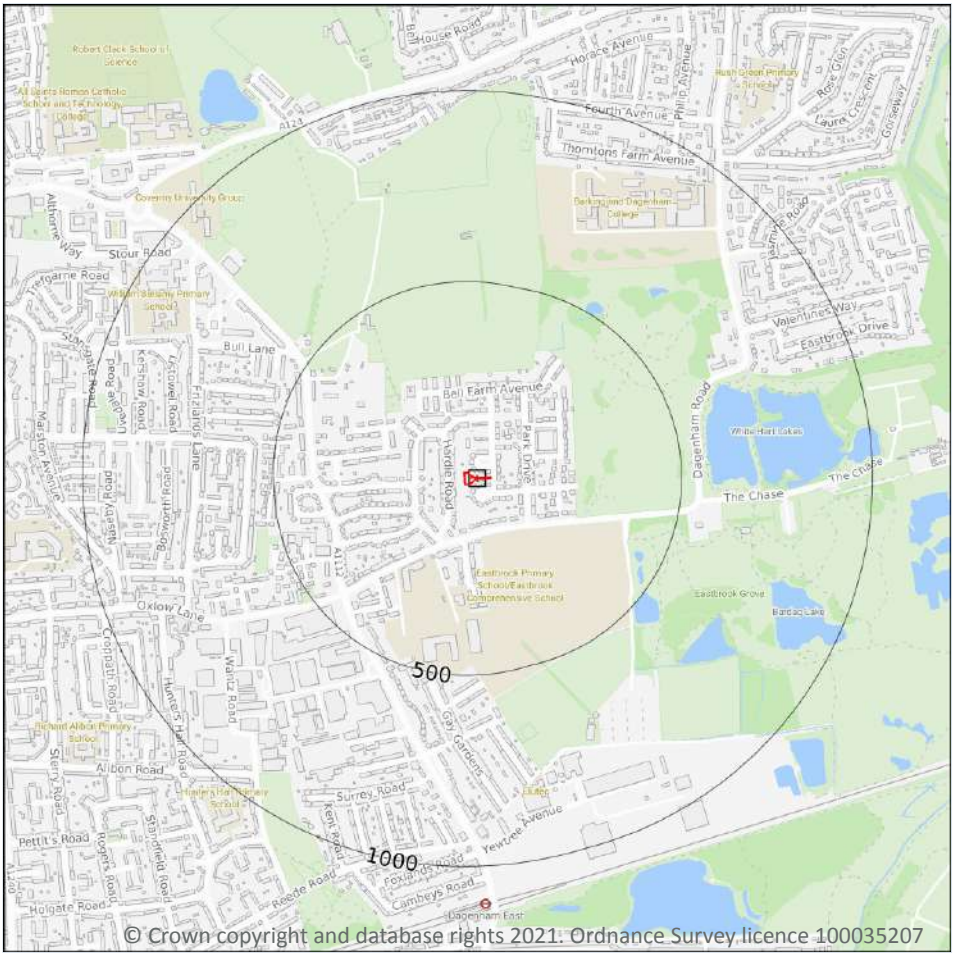
14.6 Bedrock faults and other linear features (10k)

Records within 500m	0

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

This data is sourced from the British Geological Survey.

15 Geology 1:50,000 scale - Availability



Site Outline

Search buffers in metres (m)

Geological map tile

15.1 50k Availability

Records within 500m	1

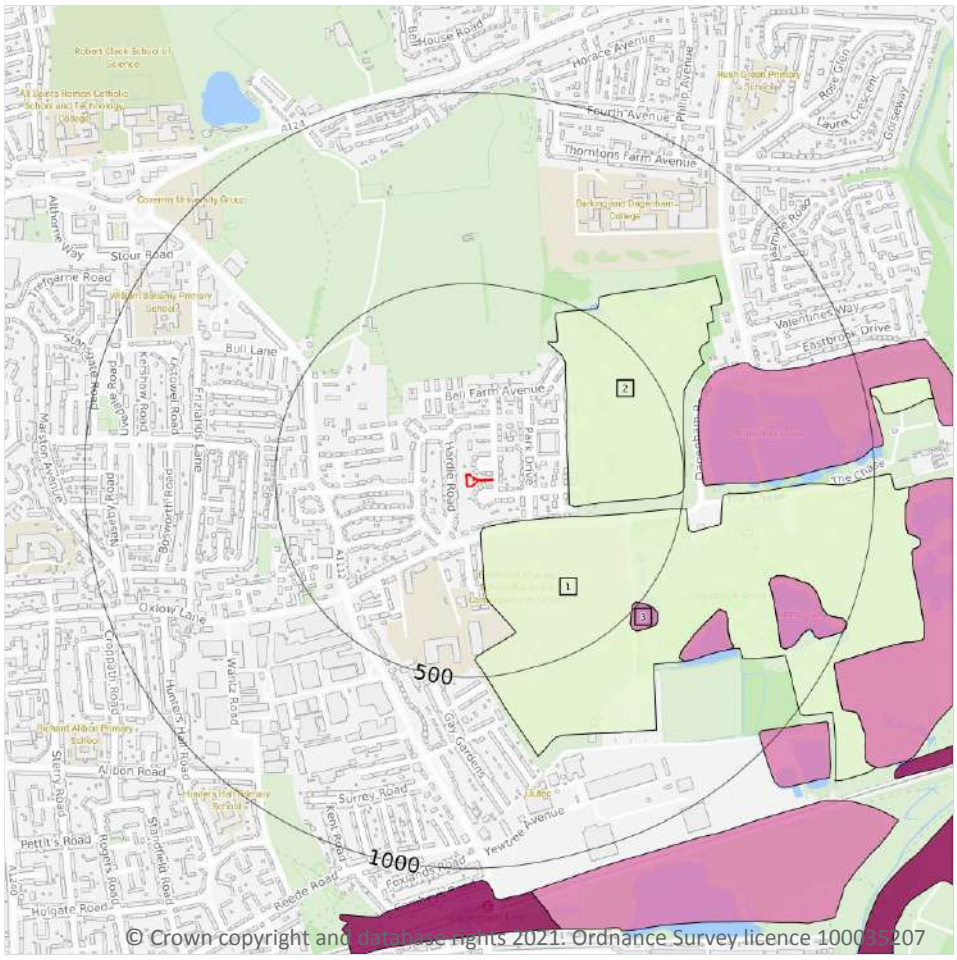
An indication on the coverage of 1:50,000 scale geology data for the site. Either 'Full' or 'No coverage' for each geological theme.

Features are displayed on the Geology 1:50,000 scale - Availability map on **page 72**

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	**On site**	**Full**	**Full**	**Full**	**Full**	**EW257_romford_v4**

This data is sourced from the British Geological Survey.

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



15.2 Artificial and made ground (50k)

Records within 500m	3

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

Features are displayed on the Geology 1:50,000 scale - Artificial and made ground map on **page 73**

ID	Location	LEX Code	Description	Rock description
1	114m S	WMGR-ARTDP	INFILLED GROUND	ARTIFICIAL DEPOSIT
2	198m E	WMGR-ARTDP	INFILLED GROUND	ARTIFICIAL DEPOSIT
3	492m SE	WGR-VOID	WORKED GROUND (UNDIVIDED)	VOID

This data is sourced from the British Geological Survey.

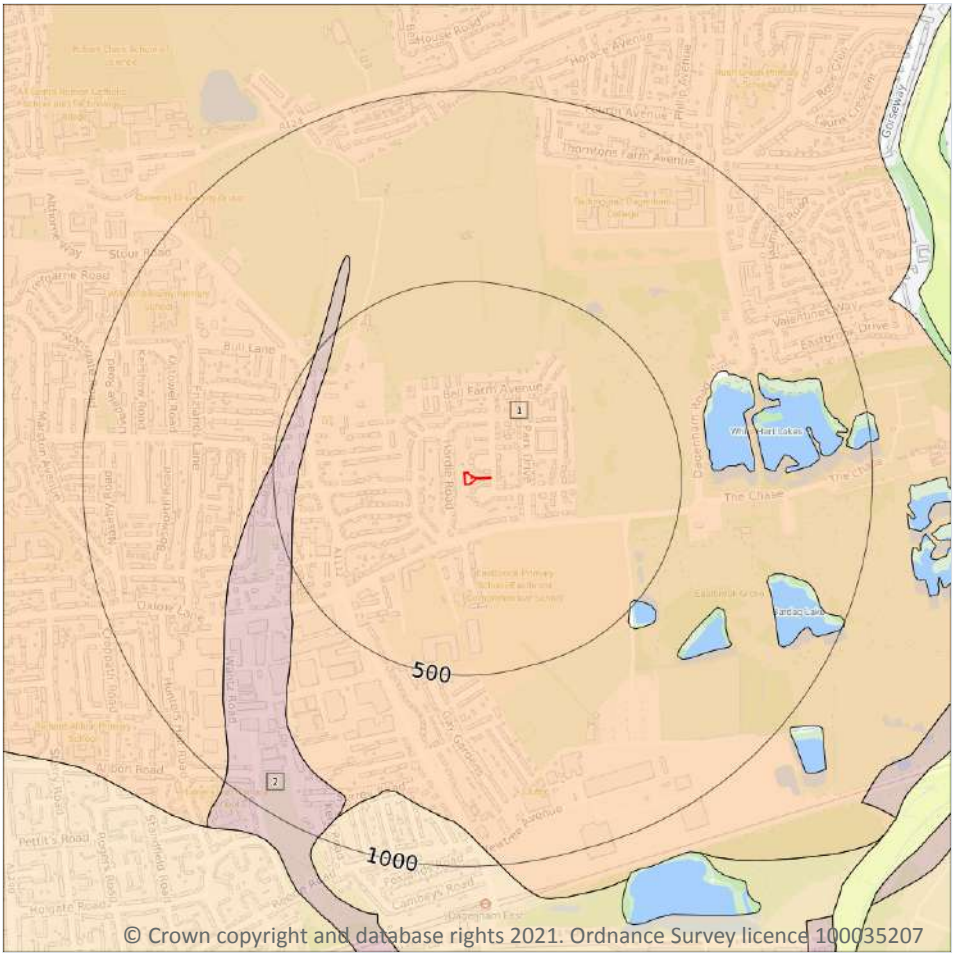
15.3 Artificial ground permeability (50k)

Records within 50m	0

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

This data is sourced from the British Geological Survey.

Geology 1:50,000 scale - Superficial



Site Outline

Search buffers in metres (m)

Landslip (50k)

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

15.4 Superficial geology (50k)

Records within 500m **2**

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

Features are displayed on the Geology 1:50,000 scale - Superficial map on **page 75**

ID	Location	LEX Code	Description	Rock description
1	**On site**	**HAGR-XSV**	**HACKNEY GRAVEL MEMBER**	**SAND AND GRAVEL**
2	422m W	HEAD-XCZSV	HEAD	CLAY, SILT, SAND AND GRAVEL

This data is sourced from the British Geological Survey.

15.5 Superficial permeability (50k)

Records within 50m	1

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

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

This data is sourced from the British Geological Survey.

15.6 Landslip (50k)

Records within 500m	0

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

This data is sourced from the British Geological Survey.

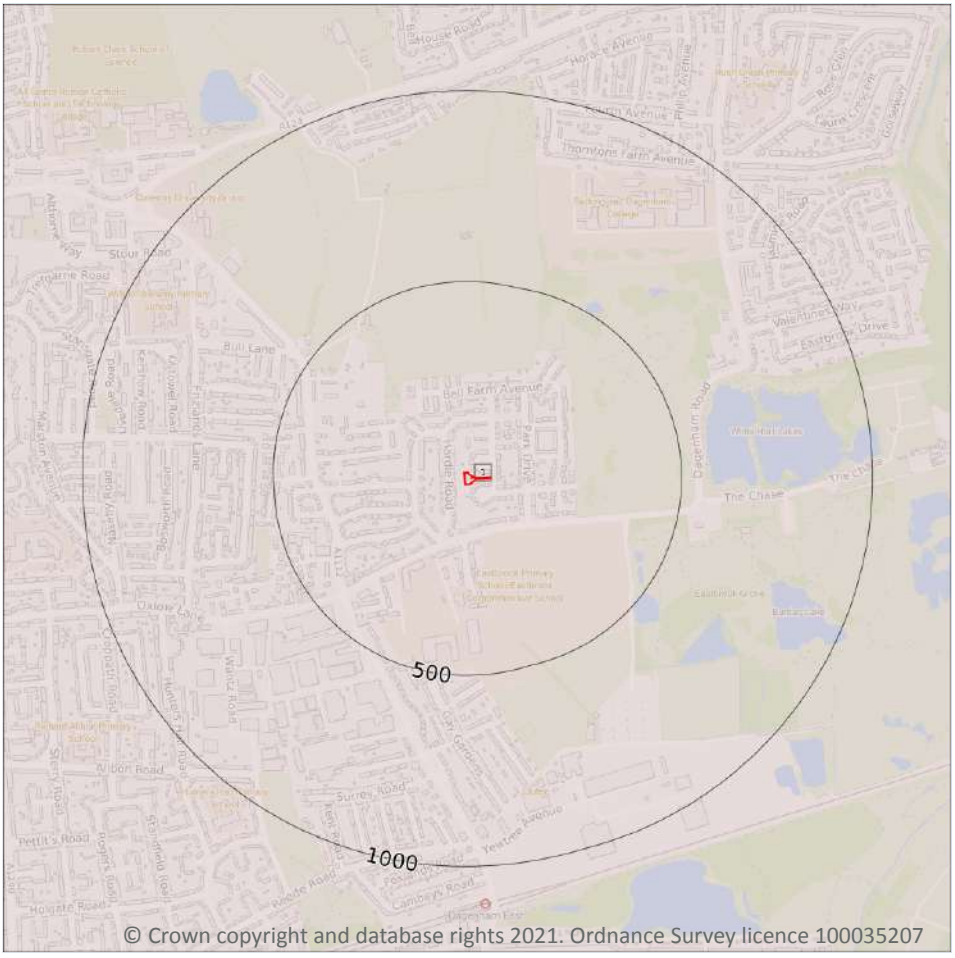
15.7 Landslip permeability (50k)

Records within 50m	0

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

This data is sourced from the British Geological Survey.

Geology 1:50,000 scale - Bedrock



Site Outline

Search buffers in metres (m)

Bedrock faults and other linear features (50k)

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

15.8 Bedrock geology (50k)

Records within 500m	1

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

Features are displayed on the Geology 1:50,000 scale - Bedrock map on **page 77**

ID	Location	LEX Code	Description	Rock age
1	**On site**	**LC-XCZS**	**LONDON CLAY FORMATION - CLAY, SILT AND SAND**	**YPRESIAN**

This data is sourced from the British Geological Survey.

15.9 Bedrock permeability (50k)

Records within 50m	1

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

Location	Flow type	Maximum permeability	Minimum permeability
On site	**Mixed**	**Moderate**	**Very Low**

This data is sourced from the British Geological Survey.

15.10 Bedrock faults and other linear features (50k)

Records within 500m	0

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

This data is sourced from the British Geological Survey.

16 Boreholes

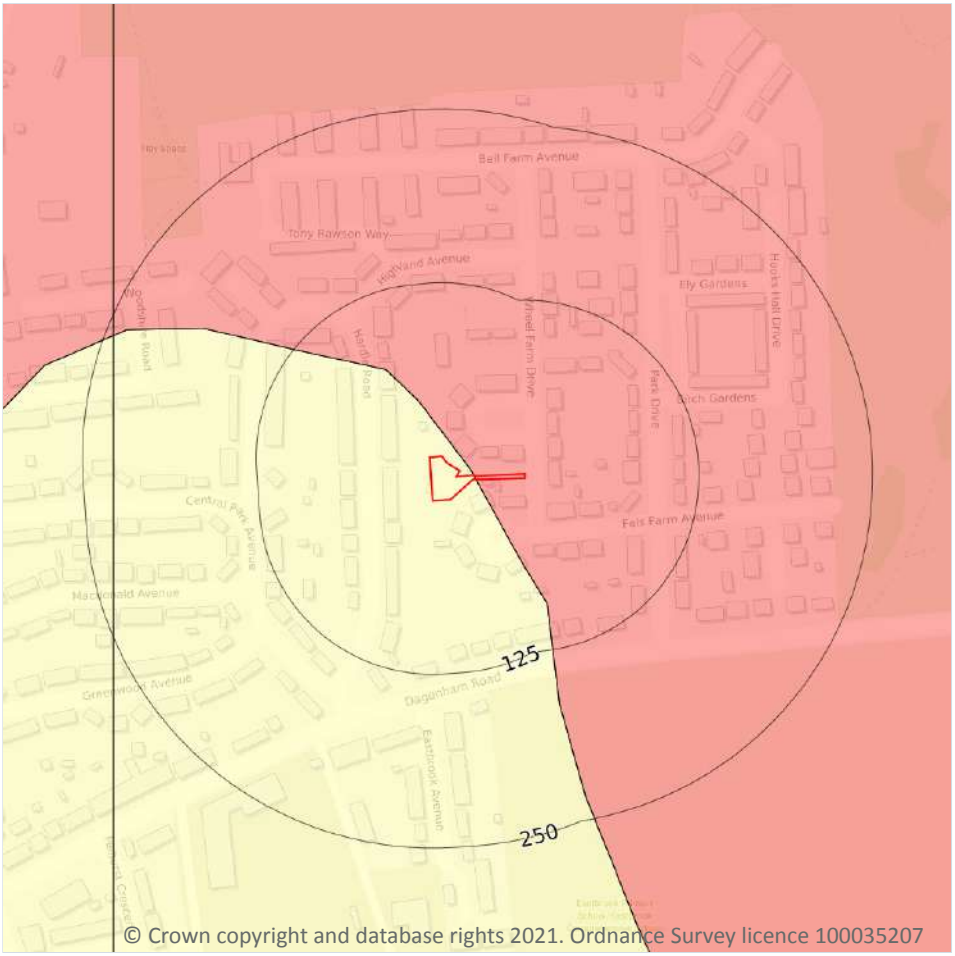
16.1 BGS Boreholes

Records within 250m	0

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

This data is sourced from the British Geological Survey.

17 Natural ground subsidence - Shrink swell clays



Site Outline

Search buffers in metres (m)

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

17.1 Shrink swell clays

Records within 50m	2

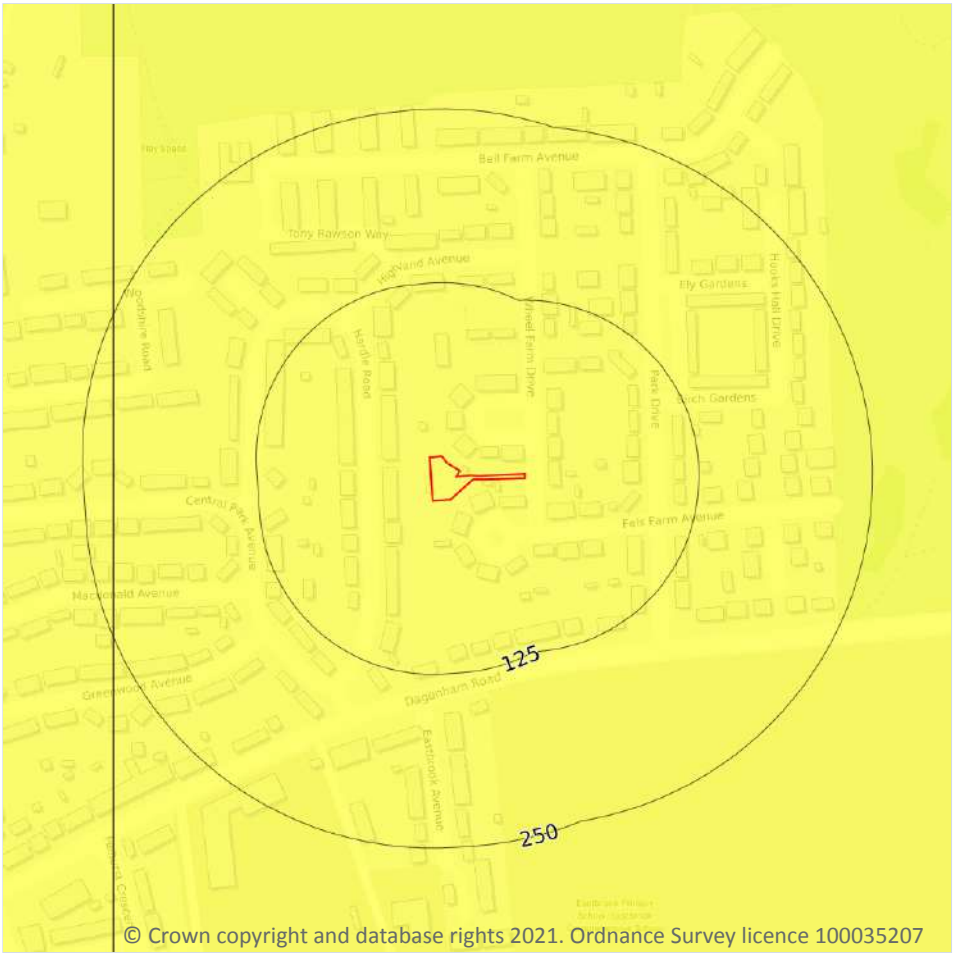
The potential hazard presented by soils that absorb water when wet (making them swell), and lose water as they dry (making them shrink). This shrink-swell behaviour is controlled by the type and amount of clay in the soil, and by seasonal changes in the soil moisture content (related to rainfall and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

Features are displayed on the Natural ground subsidence - Shrink swell clays map on **page 80**

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

This data is sourced from the British Geological Survey.

Natural ground subsidence - Running sands



Site Outline

Search buffers in metres (m)

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

17.2 Running sands

Records within 50m	1

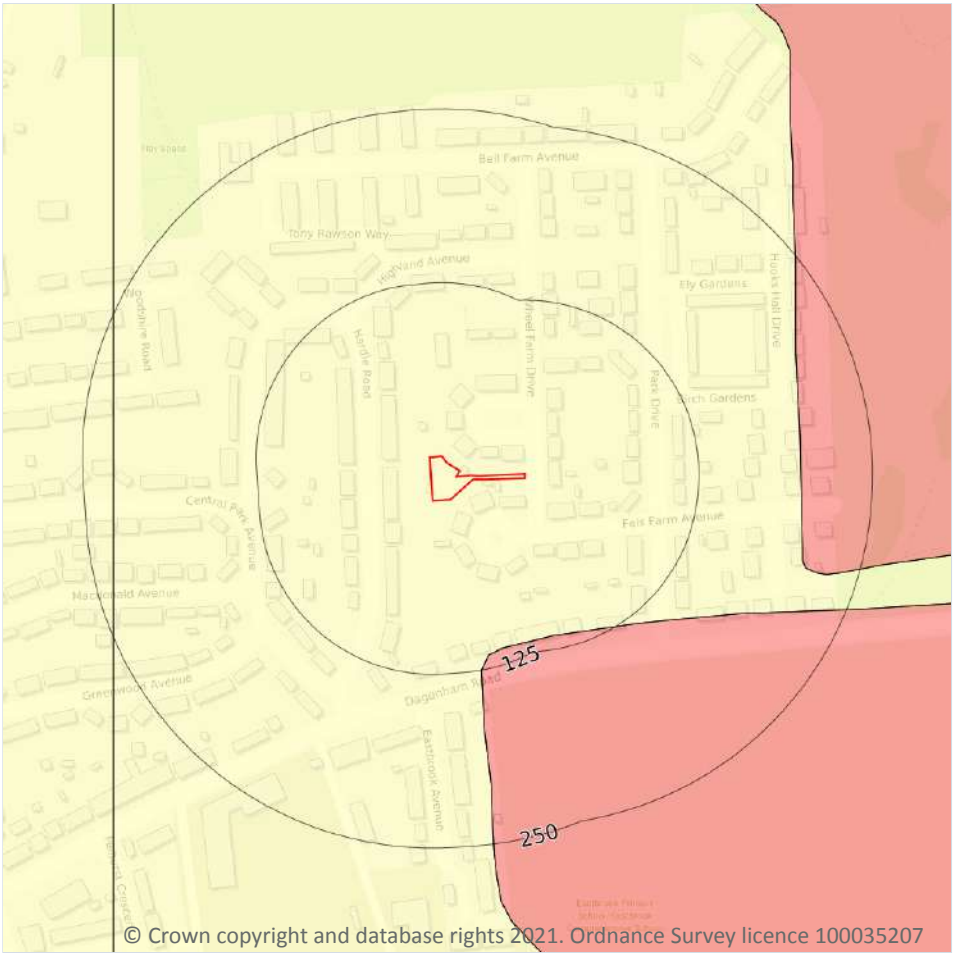
The potential hazard presented by rocks that can contain loosely-packed sandy layers that can become fluidised by water flowing through them. Such sands can 'run', removing support from overlying buildings and causing potential damage.

Features are displayed on the Natural ground subsidence - Running sands map on **page 81**

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

This data is sourced from the British Geological Survey.

Natural ground subsidence - Compressible deposits



Site Outline

Search buffers in metres (m)

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

17.3 Compressible deposits

Records within 50m	1

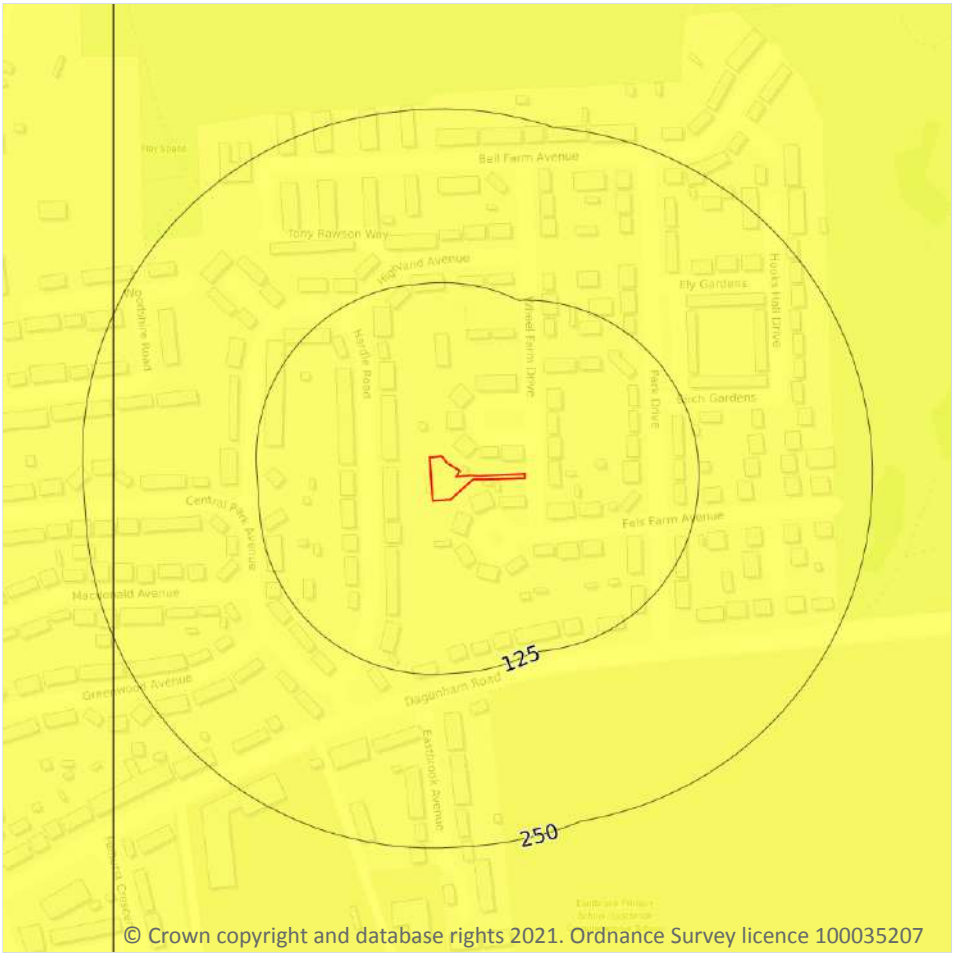
The potential hazard presented by types of ground that may contain layers of very soft materials like clay or peat and may compress if loaded by overlying structures, or if the groundwater level changes, potentially resulting in depression of the ground and disturbance of foundations.

Features are displayed on the Natural ground subsidence - Compressible deposits map on **page 82**

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

This data is sourced from the British Geological Survey.

Natural ground subsidence - Collapsible deposits



Site Outline

Search buffers in metres (m)

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

17.4 Collapsible deposits

Records within 50m	1

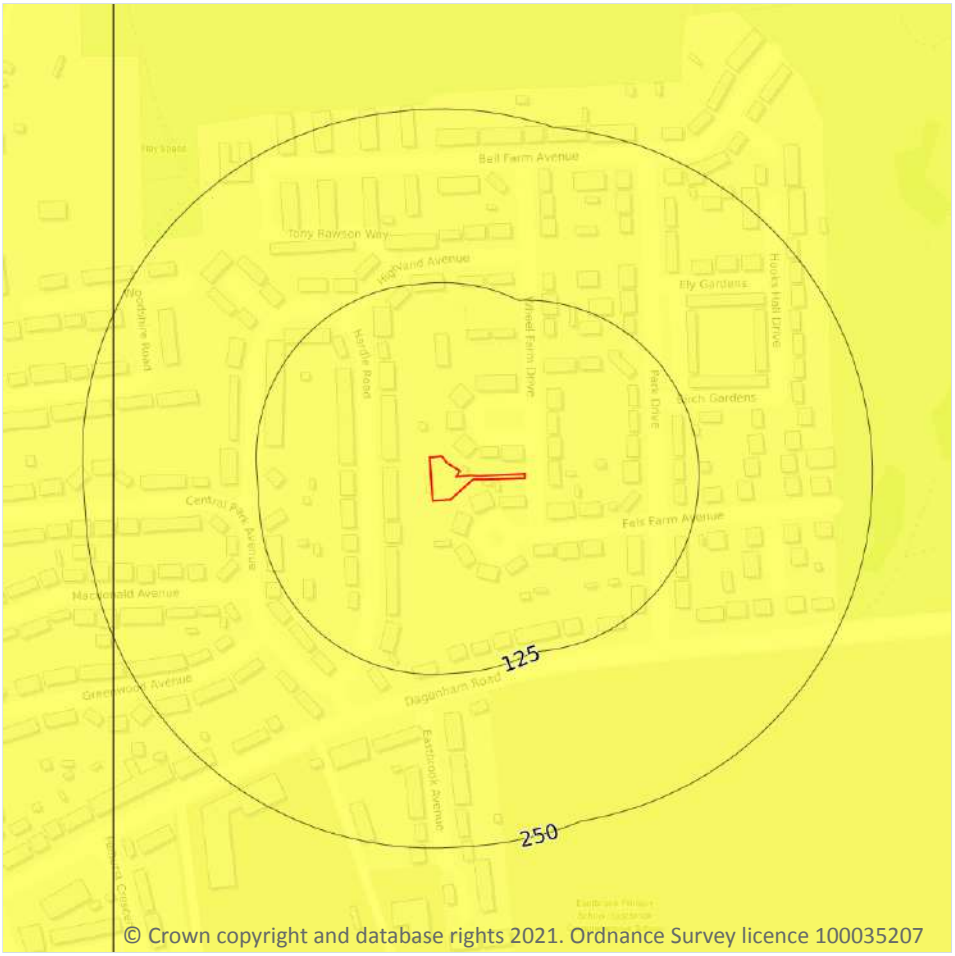
The potential hazard presented by natural deposits that could collapse when a load (such as a building) is placed on them or they become saturated with water.

Features are displayed on the Natural ground subsidence - Collapsible deposits map on **page 83**

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

This data is sourced from the British Geological Survey.

Natural ground subsidence - Landslides



Site Outline

Search buffers in metres (m)

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

17.5 Landslides

Records within 50m	1

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

Features are displayed on the Natural ground subsidence - Landslides map on **page 84**

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

This data is sourced from the British Geological Survey.

Natural ground subsidence - Ground dissolution of soluble rocks



Site Outline

Search buffers in metres (m)

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

17.6 Ground dissolution of soluble rocks

Records within 50m	1

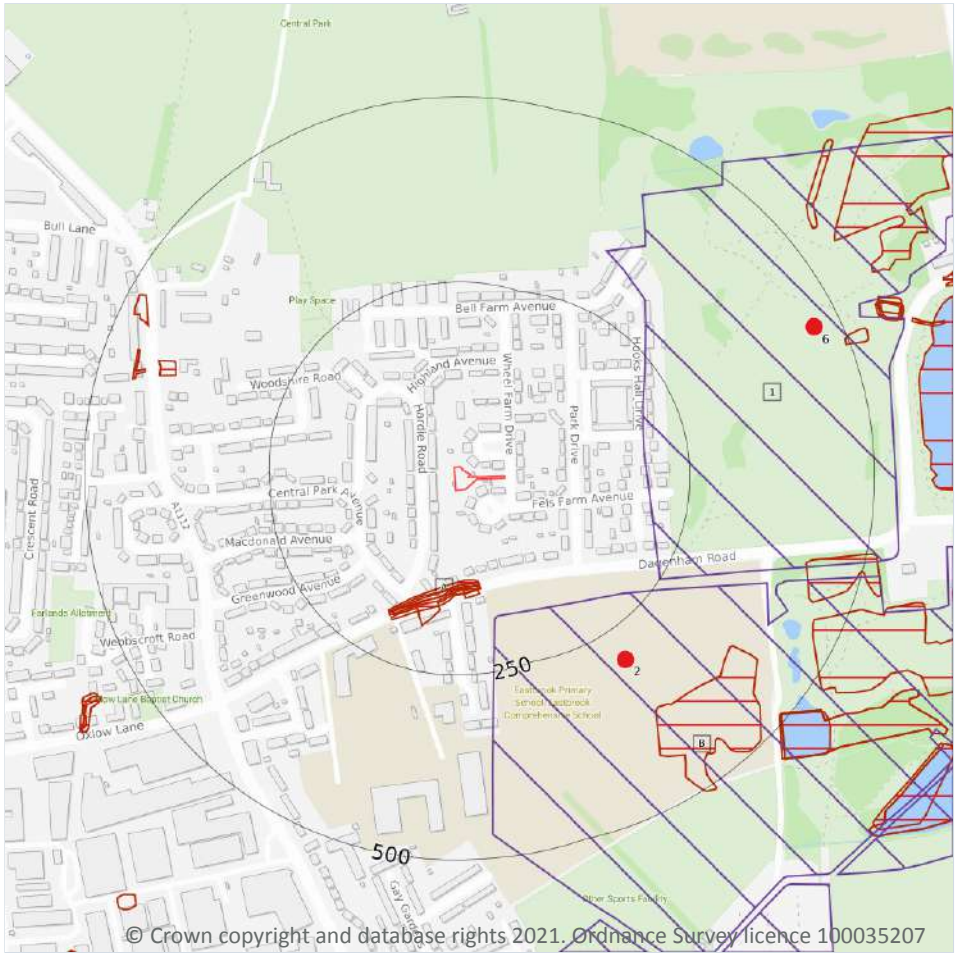
The potential hazard presented by ground dissolution, which occurs when water passing through soluble rocks produces underground cavities and cave systems. These cavities reduce support to the ground above and can cause localised collapse of the overlying rocks and deposits.

Features are displayed on the Natural ground subsidence - Ground dissolution of soluble rocks map on **page 85**

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

This data is sourced from the British Geological Survey.

18 Mining, ground workings and natural cavities



Site Outline

Search buffers in metres (m)

- Natural cavities (Area)
- Natural cavities (Point)
- BritPits
- Surface ground workings
- Underground workings
- Historical Mineral Planning Areas
- Mining Cavities

Non Coal Mining

- Sporadic underground mining of restricted extent possible
- Localised small scale underground mining possible
- Small scale mining possible
- Underground mining known or likely within or in close proximity
- Underground mining known within or in very close proximity

18.1 Natural cavities

Records within 500m	0

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

This data is sourced from Peter Brett Associates (PBA).

18.2 BritPits

Records within 500m	2

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

Features are displayed on the Mining, ground workings and natural cavities map on **page 86**

ID	Location	Details	Description
2	294m SE	Name: Eastbrookend Gravel Pit Address: DAGENHAM, Essex Commodity: Sand & Gravel Status: Ceased	Type: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
6	464m NE	Name: Eastbrook Farm & Fels Farm Address: DAGENHAM, Essex Commodity: Sand & Gravel Status: Ceased	Type: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority

This data is sourced from the British Geological Survey.

18.3 Surface ground workings

Records within 250m	4

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

Features are displayed on the Mining, ground workings and natural cavities map on **page 86**

ID	Location	Land Use	Year of mapping	Mapping scale
A	122m S	Ponds	1895	1:10560
A	128m S	Ponds	1921	1:10560
A	131m S	Ponds	1862	1:10560
A	134m S	Ponds	1921	1:10560

This is data is sourced from Ordnance Survey/Groundsure.

18.4 Underground workings

Records within 1000m	0

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

This is data is sourced from Ordnance Survey/Groundsure.

18.5 Historical Mineral Planning Areas

Records within 500m	2

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

Features are displayed on the Mining, ground workings and natural cavities map on **page 86**

ID	Location	Site Name	Mineral	Type	Planning Status	Planning Status Date
B	176m S	Eastbrookend	Sand and gravel	Surface mineral working	Valid	17/3/60
1	191m E	Eastbrook and Fels Farm	Sand and gravel	Surface mineral working	Valid	17/3/66, 24/9/55

This data is sourced from the British Geological Survey.

18.6 Non-coal mining

Records within 1000m	0

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

This data is sourced from the British Geological Survey.

18.7 Mining cavities

Records within 1000m	0

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

This data is sourced from Peter Brett Associates (PBA).

18.8 JPB mining areas

Records on site	0

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

This data is sourced from Johnson Poole and Bloomer.

18.9 Coal mining

Records on site	0

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

This data is sourced from the Coal Authority.

18.10 Brine areas

Records on site	0

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

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

18.11 Gypsum areas

Records on site	0

Generalised areas that may be affected by gypsum extraction.

This data is sourced from British Gypsum.

18.12 Tin mining

Records on site	0

Generalised areas that may be affected by historical tin mining.

This data is sourced from Mining Searches UK.

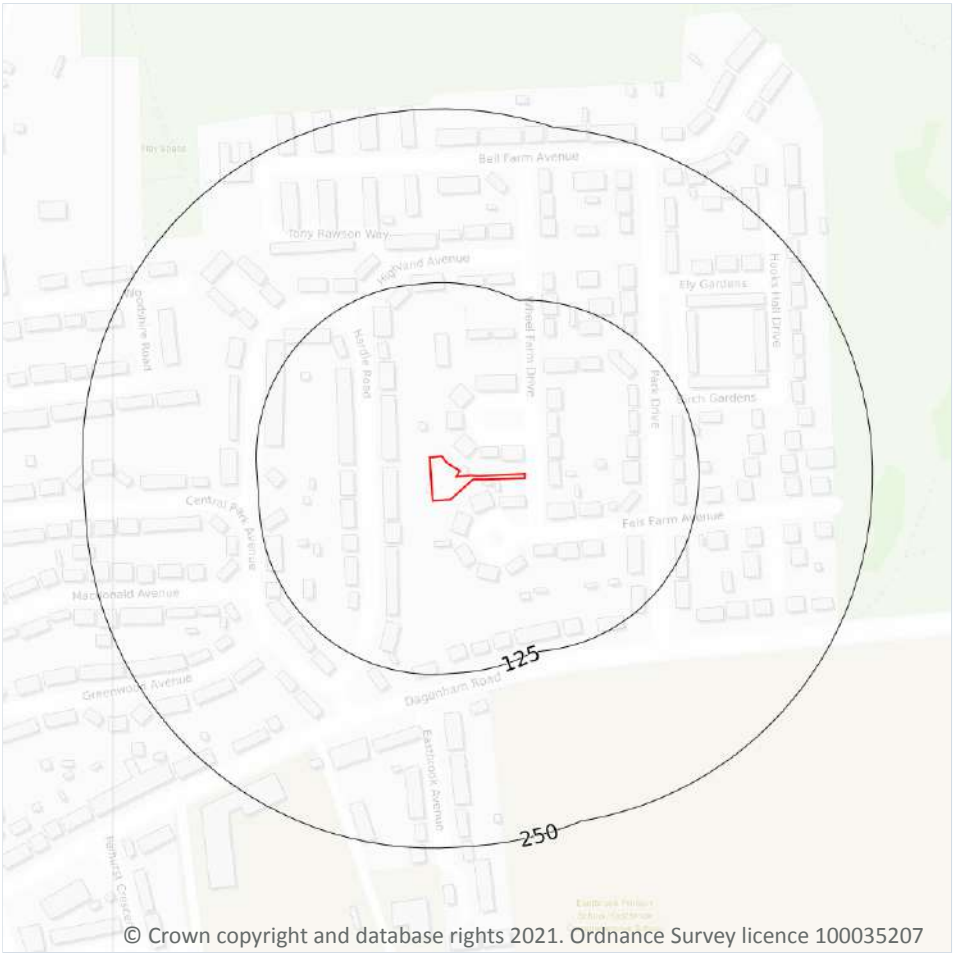
18.13 Clay mining

Records on site	0

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

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

19 Radon



Site Outline

Search buffers in metres (m)

- Greater than 30%
- Between 10% and 30%
- Between 5% and 10%
- Between 3% and 5%
- Between 1% and 3%
- Less than 1%

19.1 Radon

Records on site	1

Estimated percentage of dwellings exceeding the Radon Action Level. This data is the highest resolution radon dataset available for the UK and is produced to a 75m level of accuracy to allow for geological data accuracy and a 'residential property' buffer. The findings of this section should supersede any estimations derived from the Indicative Atlas of Radon in Great Britain. The data was derived from both geological assessments and long term measurements of radon in more than 479,000 households.

Features are displayed on the Radon map on **page 91**

Location	Estimated properties affected	Radon Protection Measures required
On site	**Less than 1%**	**None****

This data is sourced from the British Geological Survey and Public Health England.

20 Soil chemistry

20.1 BGS Estimated Background Soil Chemistry

Records within 50m	1

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

Location	Arsenic	Bioaccessible Arsenic	Lead	Bioaccessible Lead	Cadmium	Chromium	Nickel
On site	**15 mg/kg**	**No data**	**No data**	**No data**	**No data**	**60 - 90 mg/kg**	**15 - 30 mg/kg**

This data is sourced from the British Geological Survey.

20.2 BGS Estimated Urban Soil Chemistry

Records within 50m	8

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

Location	Arsenic (mg/kg)	Bioaccessible Arsenic (mg/kg)	Lead (mg/kg)	Bioaccessible Lead (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Nickel (mg/kg)	Tin (mg/kg)
On site	**14**	**2.5**	**186**	**128**	**0.8**	**64**	**45**	**20**	**31**
4m E	13	2.3	128	88	0.7	62	39	20	21
28m W	14	2.5	183	126	0.8	63	44	20	29
29m S	14	2.5	232	159	0.8	64	56	22	50
39m N	13	2.3	137	94	0.7	64	36	17	18
42m SW	14	2.5	248	170	0.8	65	58	23	54
45m SE	13	2.3	165	113	0.6	60	45	21	29
48m NW	13	2.3	132	91	0.7	63	34	17	17

This data is sourced from the British Geological Survey.

20.3 BGS Measured Urban Soil Chemistry

Records within 50m	0

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

This data is sourced from the British Geological Survey.

21 Railway infrastructure and projects

21.1 Underground railways (London)

Records within 250m	0

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

This data is sourced from publicly available information by Groundsure.

21.2 Underground railways (Non-London)

Records within 250m	0

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

This data is sourced from publicly available information by Groundsure.

21.3 Railway tunnels

Records within 250m	0

Railway tunnels taken from contemporary Ordnance Survey mapping.

This data is sourced from the Ordnance Survey.

21.4 Historical railway and tunnel features

Records within 250m	0

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

This data is sourced from Ordnance Survey/Groundsure.

21.5 Royal Mail tunnels

Records within 250m	0

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

This data is sourced from Groundsure/the Postal Museum.

21.6 Historical railways

Records within 250m	0

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

This data is sourced from OpenStreetMap.

21.7 Railways

Records within 250m	0

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

This data is sourced from Ordnance Survey and OpenStreetMap.

21.8 Crossrail 1

Records within 500m	0

The Crossrail railway project links 41 stations over 100 kilometres from Reading and Heathrow in the west, through underground sections in central London, to Shenfield and Abbey Wood in the east.

This data is sourced from publicly available information by Groundsure.

21.9 Crossrail 2

Records within 500m	0

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

This data is sourced from publicly available information by Groundsure.

21.10 HS2

Records within 500m	0

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

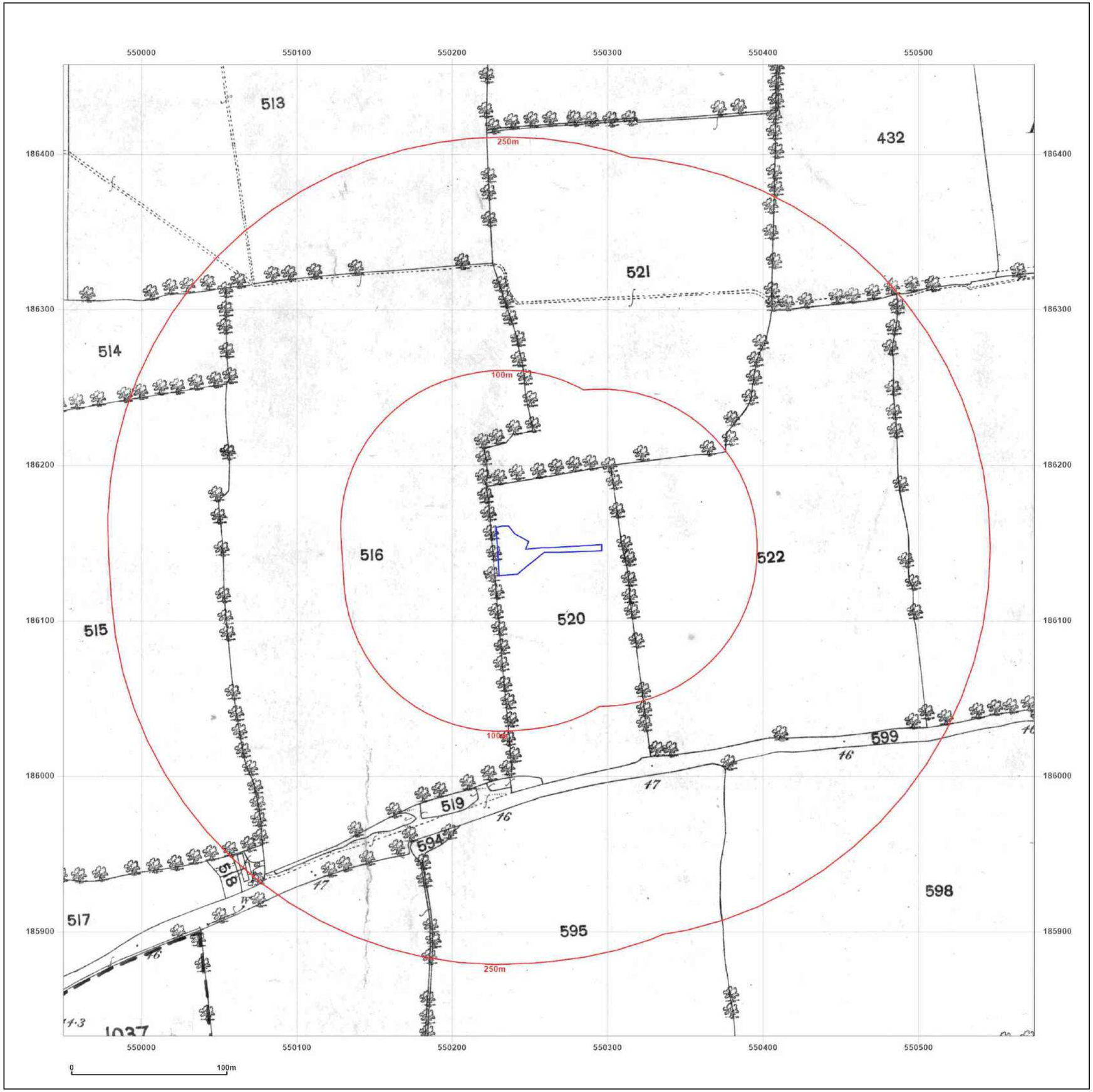
This data is sourced from HS2 ltd.

Data providers

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

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Site Details:

WHEEL FARM DRIVE, RM10 7AJ

Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: County Series

Map date: **1864**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1862
Revised N/A
Edition 1864
Copyright N/A
Levelled N/A

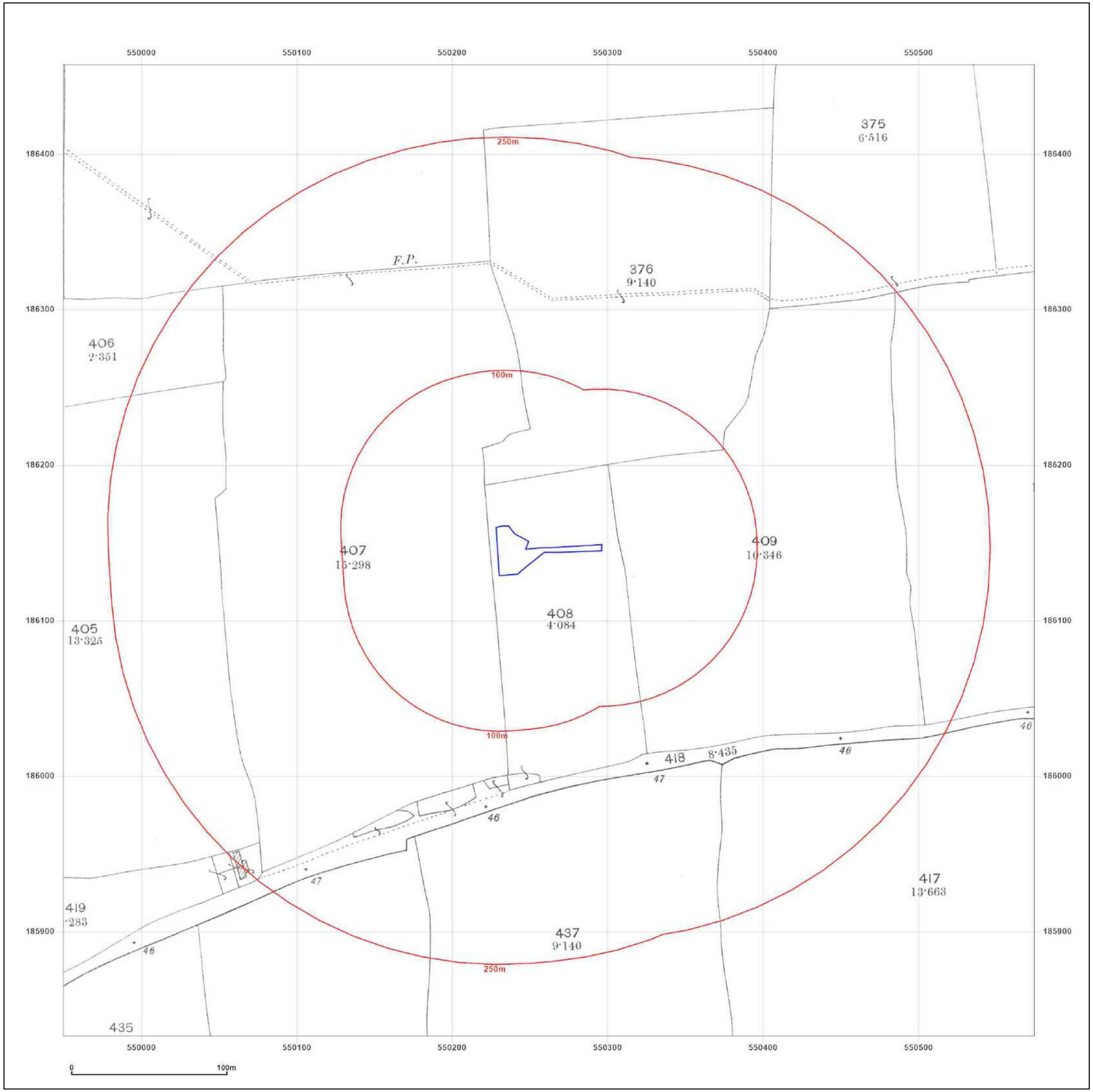
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Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: County Series
Map date: **1897**
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Printed at: 1:2,500

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Surveyed 1897
Revised 1897
Edition N/A
Copyright N/A
Levelled N/A

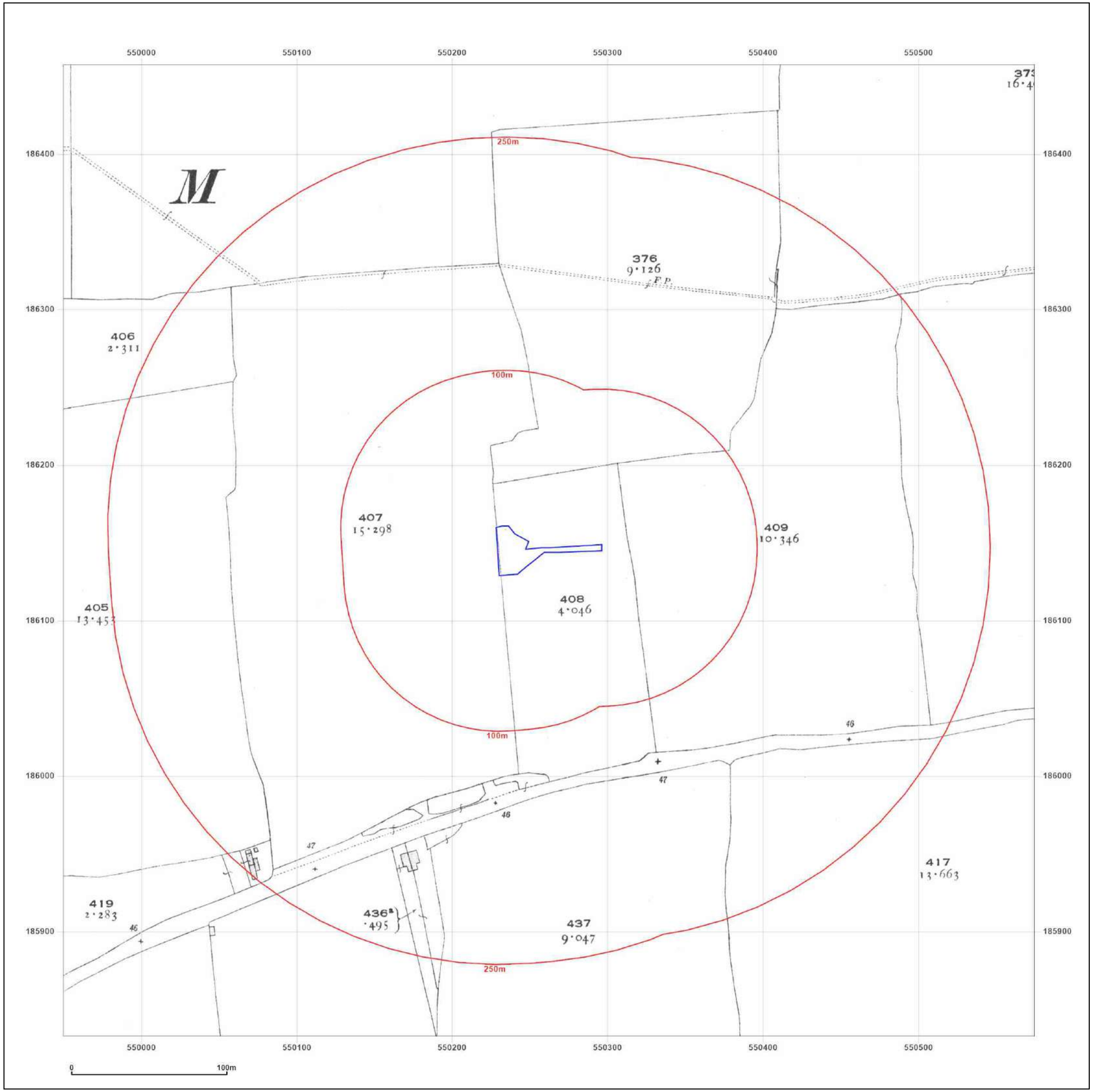
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Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: County Series

Map date: **1920**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1920
Revised 1920
Edition N/A
Copyright N/A
Levelled N/A

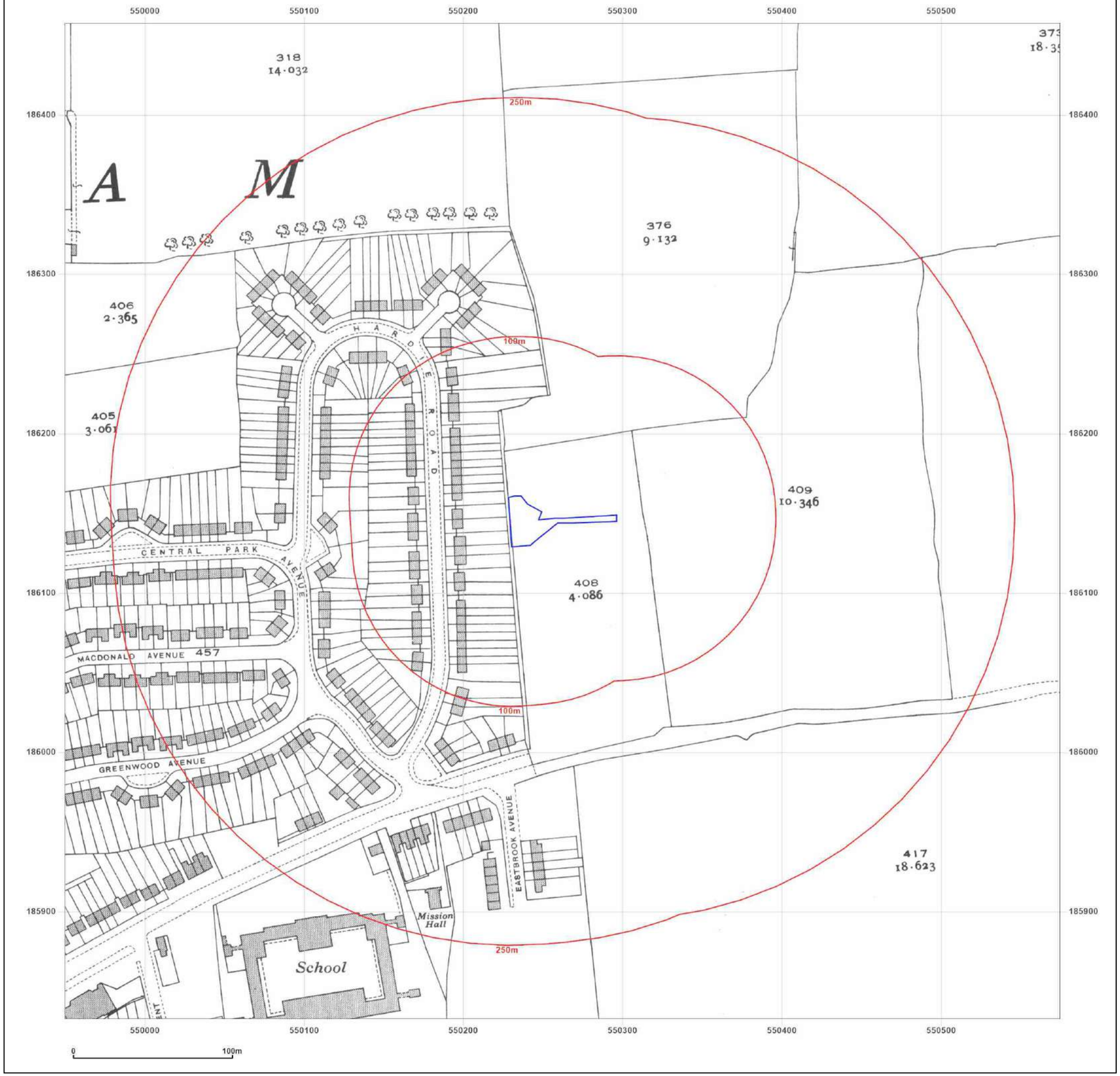
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Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: County Series

Map date: **1939**

Scale: 1:2,500

Printed at: 1:2,500

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Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: National Grid

Map date: **1960-1961**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed N/A Revised N/A Edition N/A Copyright N/A Levelled N/A	Surveyed 1961 Revised 1961 Edition N/A Copyright 1963 Levelled N/A
Surveyed 1960 Revised 1960 Edition 1961 Copyright 1961 Levelled 1948	Surveyed 1961 Revised 1961 Edition 1962 Copyright 1962 Levelled 1948

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Site Details:

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Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: National Grid
Map date: **1961-1962**
Scale: 1:1,250
Printed at: 1:2,000

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Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: National Grid

Map date: **1959-1963**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1959
Revised 1959
Edition 1961
Copyright 1961
Levelled 1948

Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
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Surveyed N/A
Revised N/A
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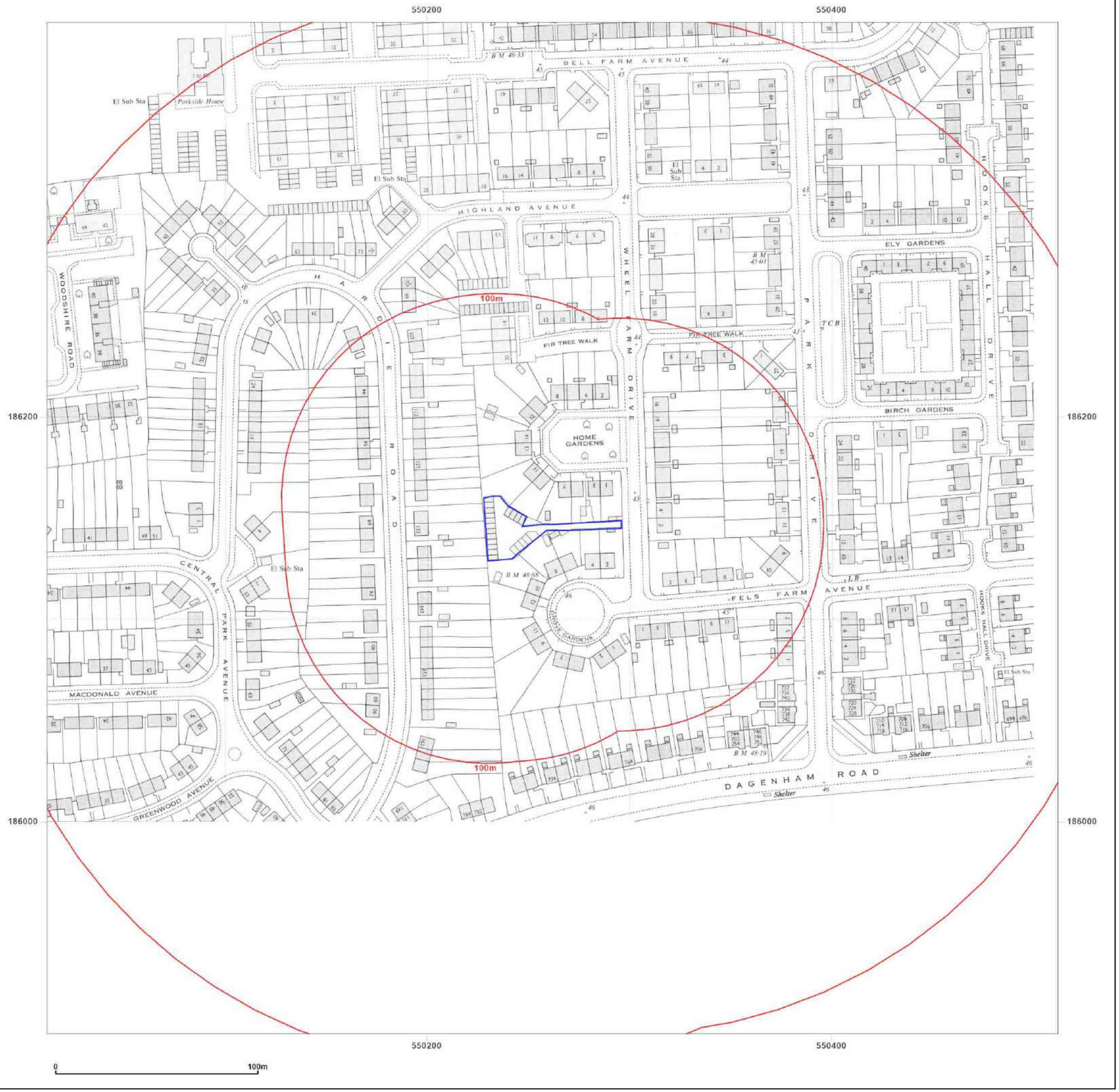
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Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: National Grid

Map date: **1969**

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Surveyed 1961
Revised 1961
Edition N/A
Copyright 1969
Levelled 1961

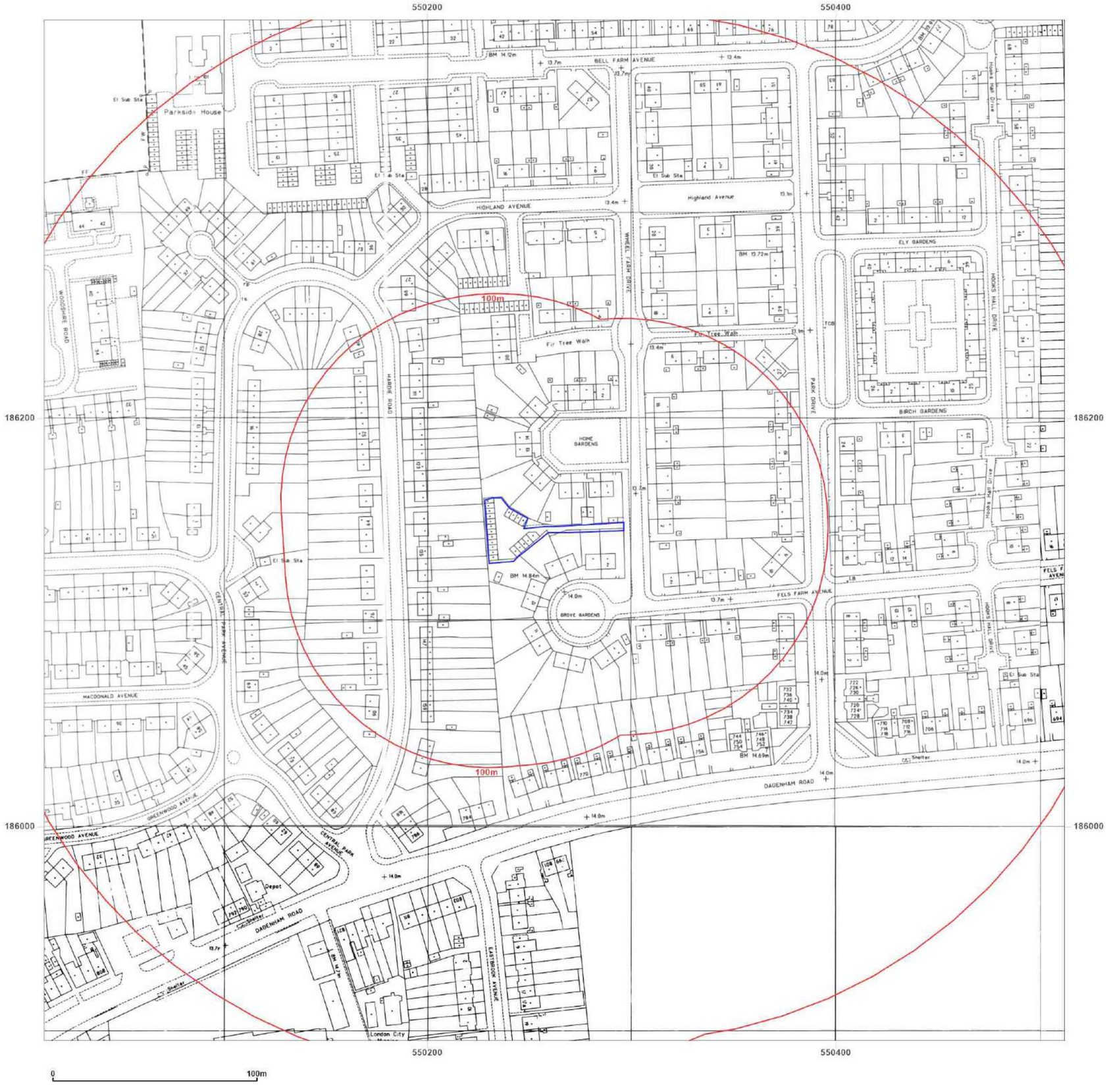
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Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: National Grid

Map date: **1992**

Scale: 1:1,250

Printed at: 1:2,000

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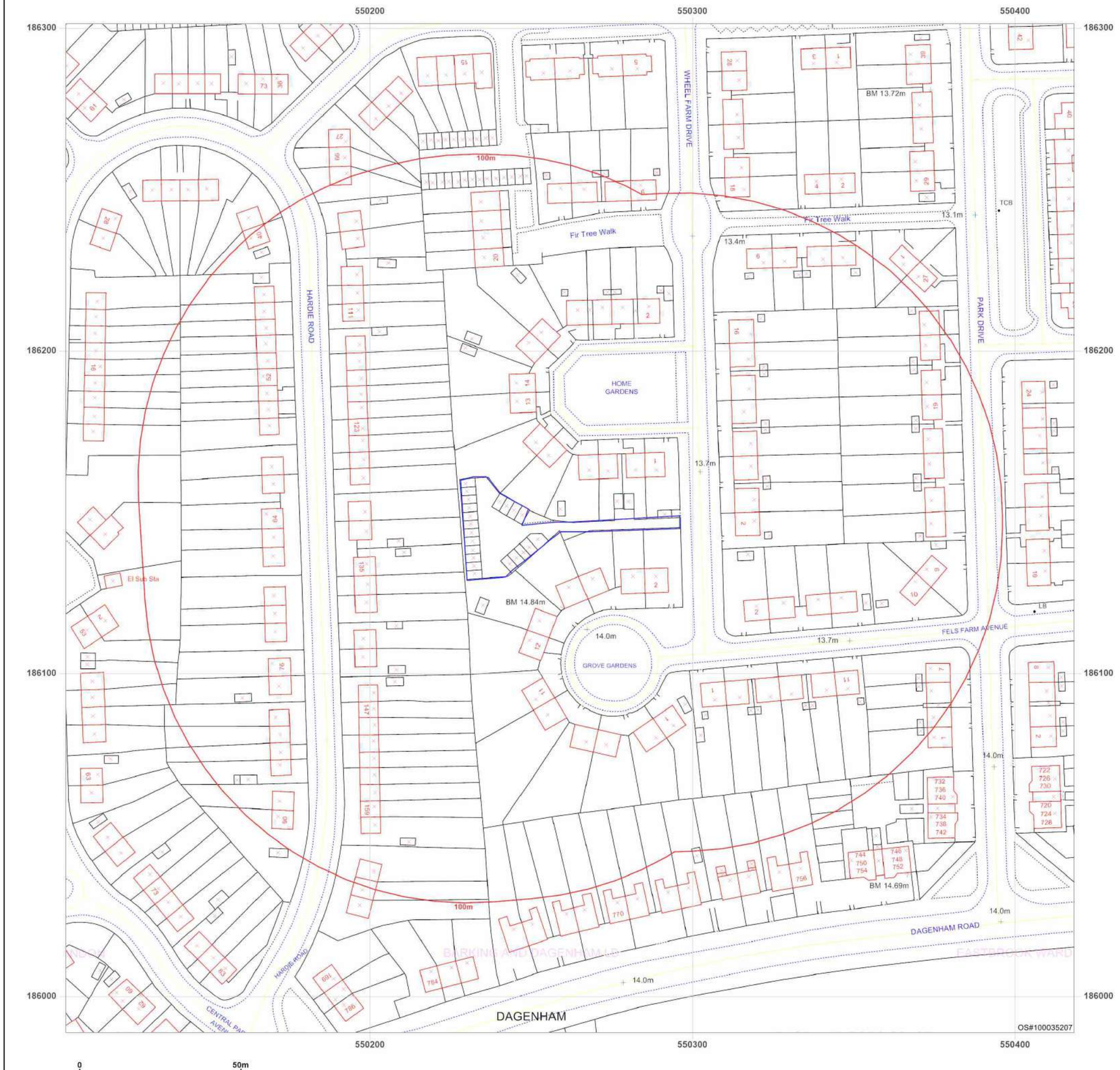
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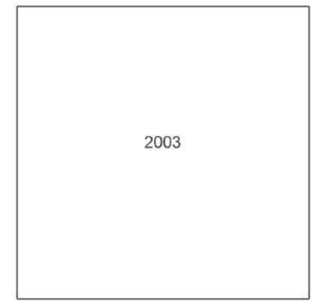
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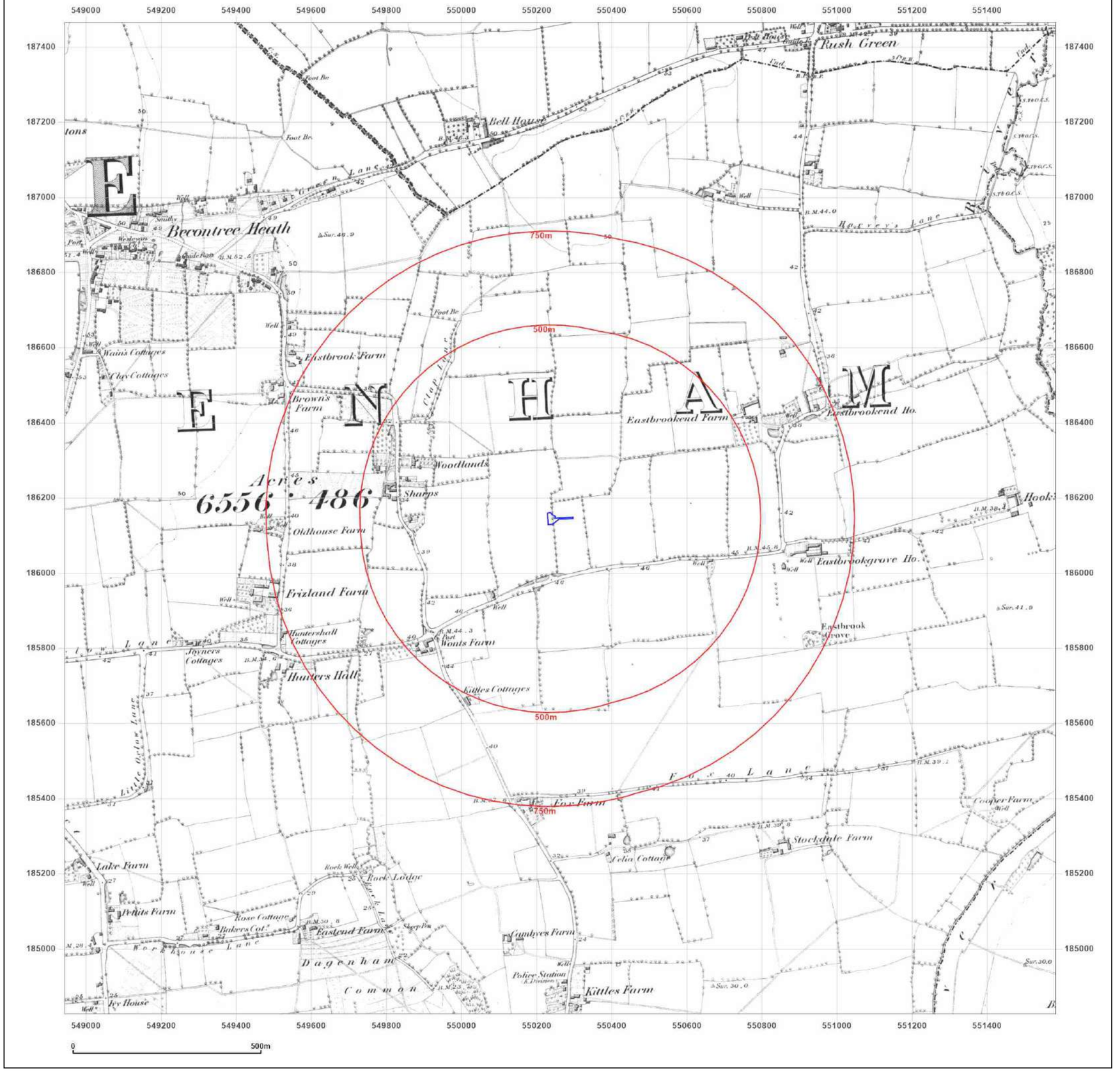
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Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: County Series

Map date: **1862**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1862
Revised 1862
Edition N/A
Copyright N/A
Levelled N/A

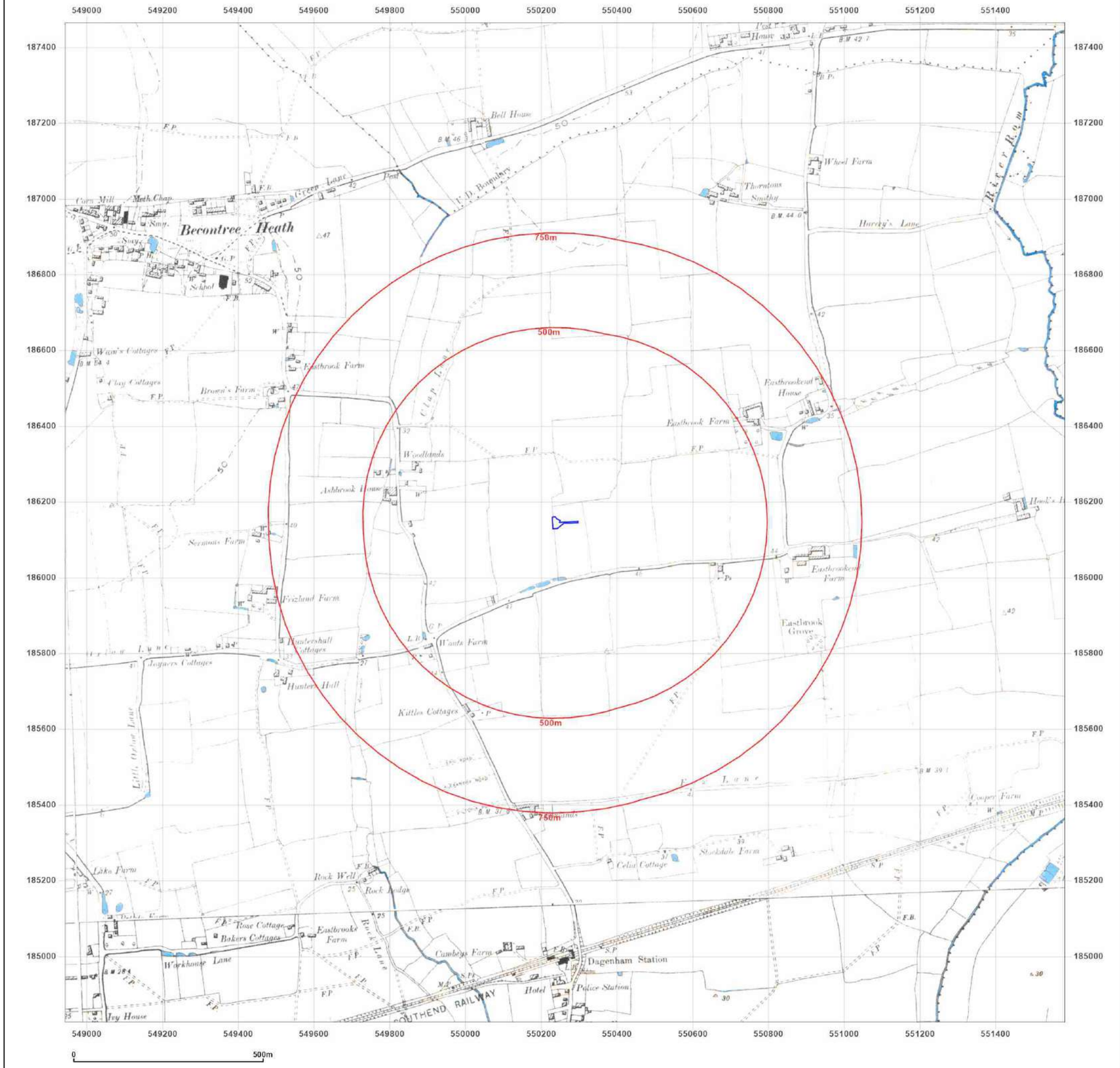
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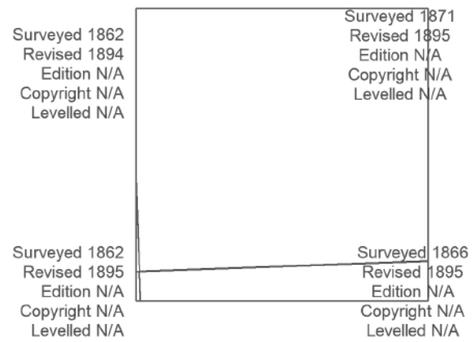
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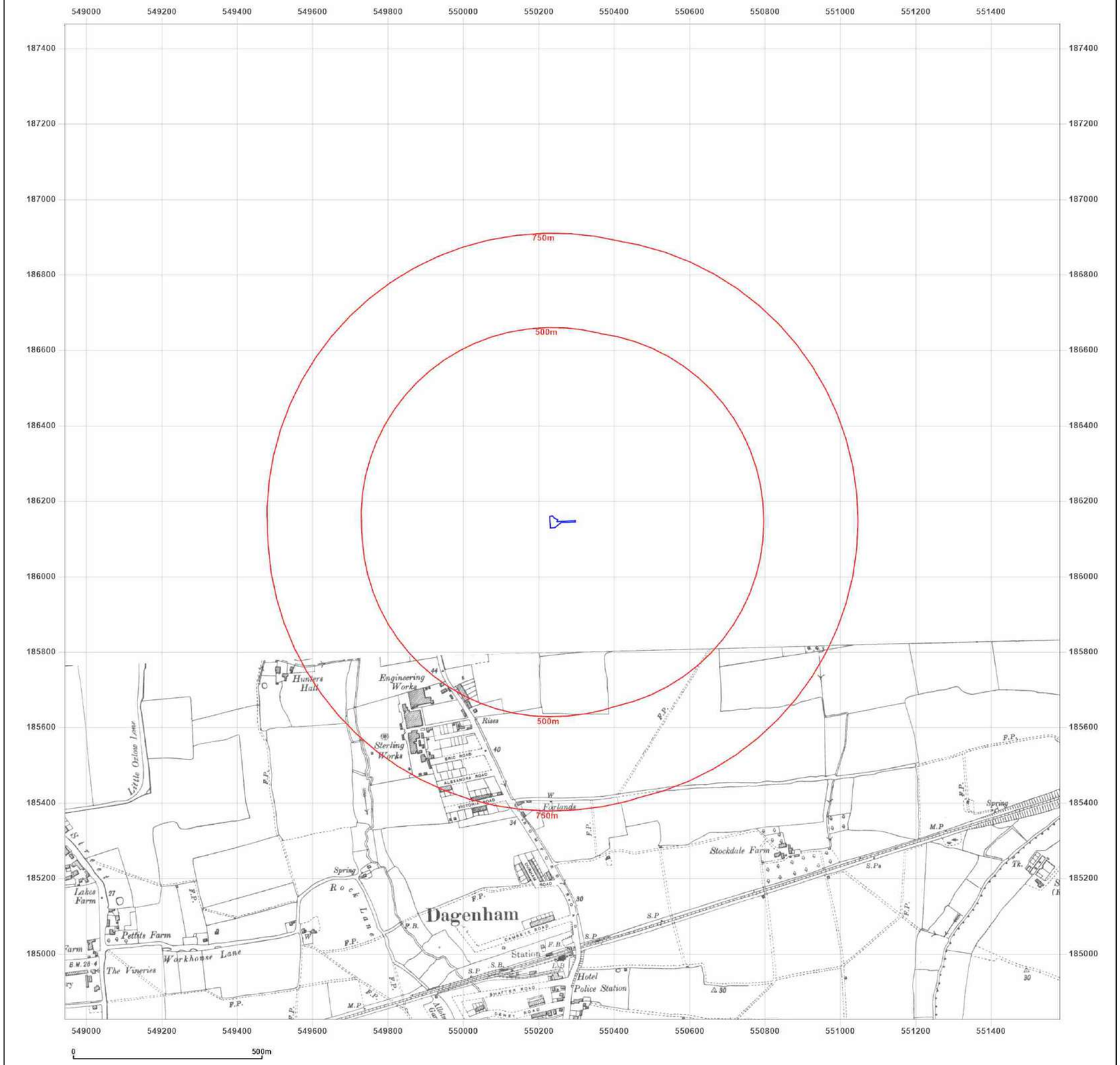
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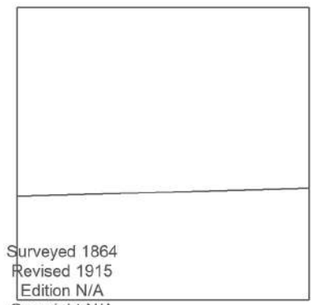
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Grid Ref: 550262, 186145

Map Name: County Series
Map date: **1915**
Scale: 1:10,560
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Surveyed 1864
Revised 1915
Edition N/A
Copyright N/A
Levelled N/A

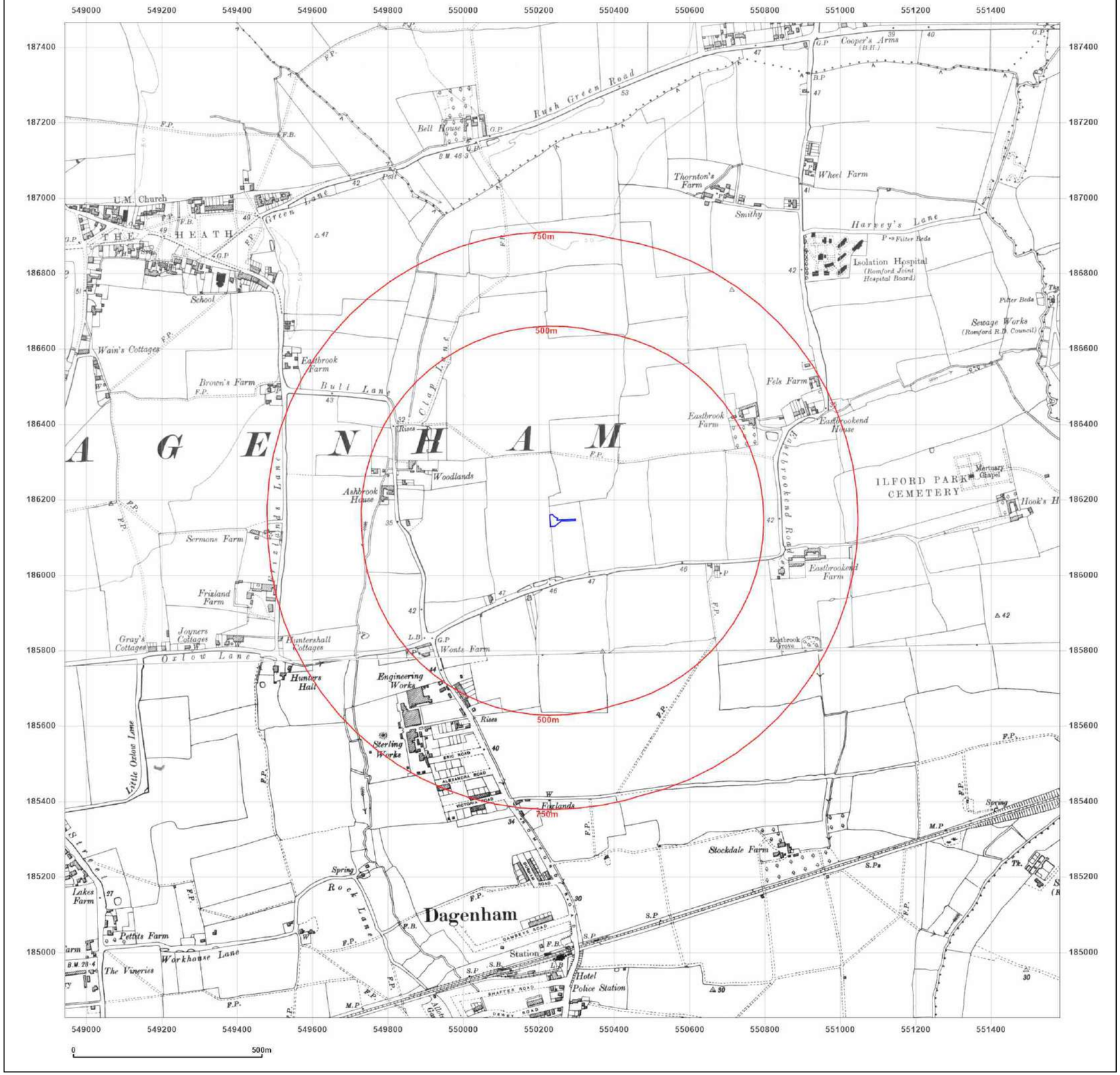
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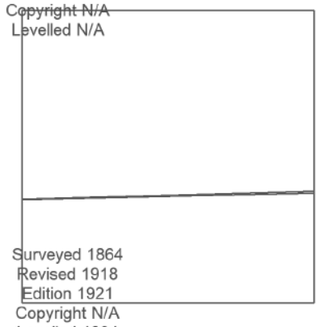
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Surveyed 1871
Revised 1921
Edition 1921
Copyright N/A
Levelled N/A



Surveyed 1864
Revised 1918
Edition 1921
Copyright N/A
Levelled 1894

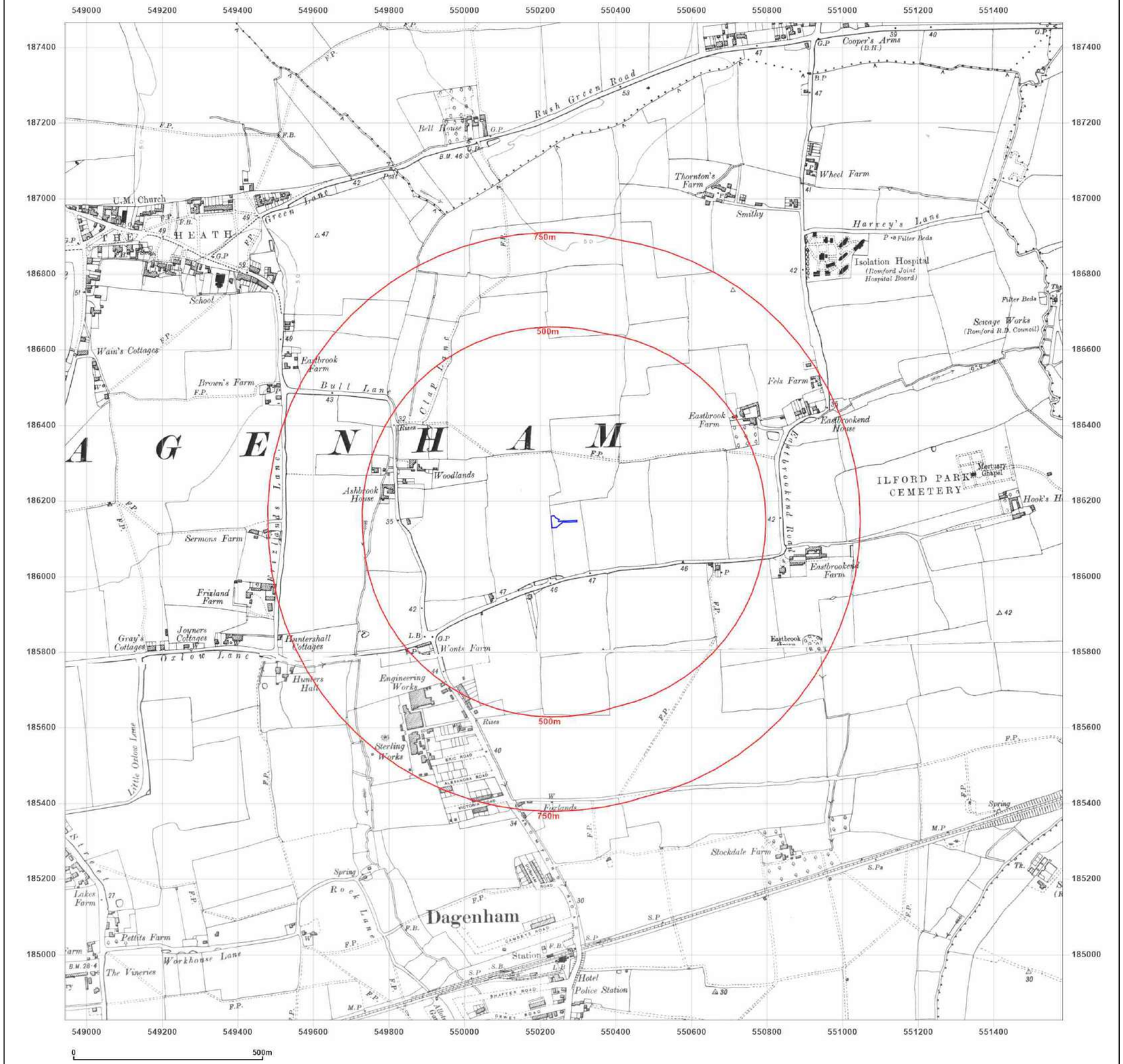
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Report Ref: GS-7642798
Grid Ref: 550262, 186145

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Map date: **1921**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1871
Revised 1921
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1864
Revised 1921
Edition 1921
Copyright N/A
Levelled N/A

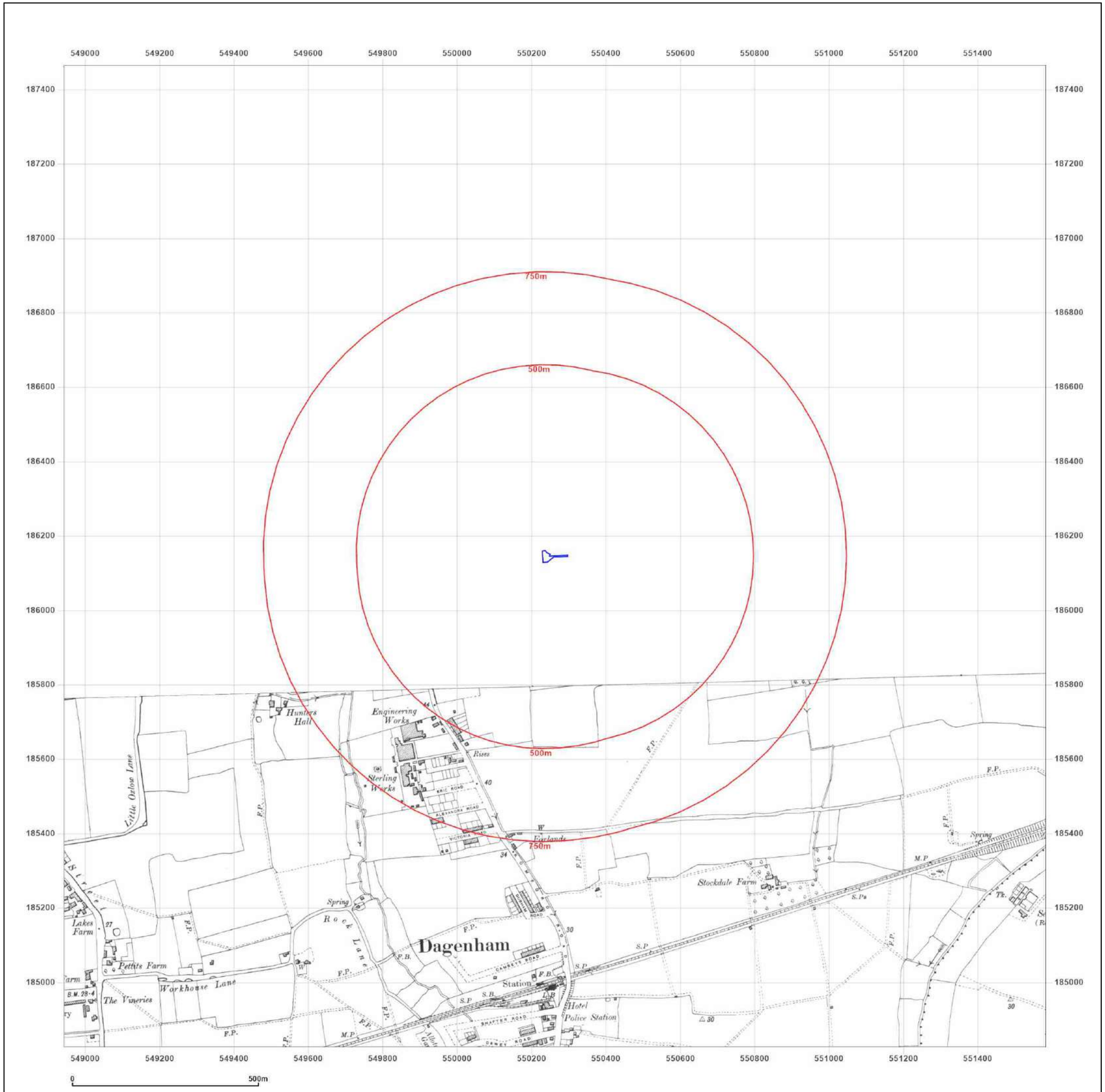
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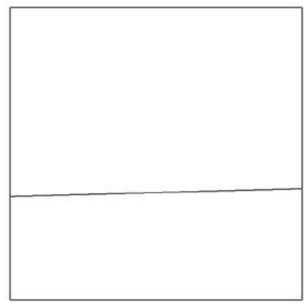
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Surveyed 1864
Revised 1921
Edition N/A
Copyright N/A
Levelled N/A

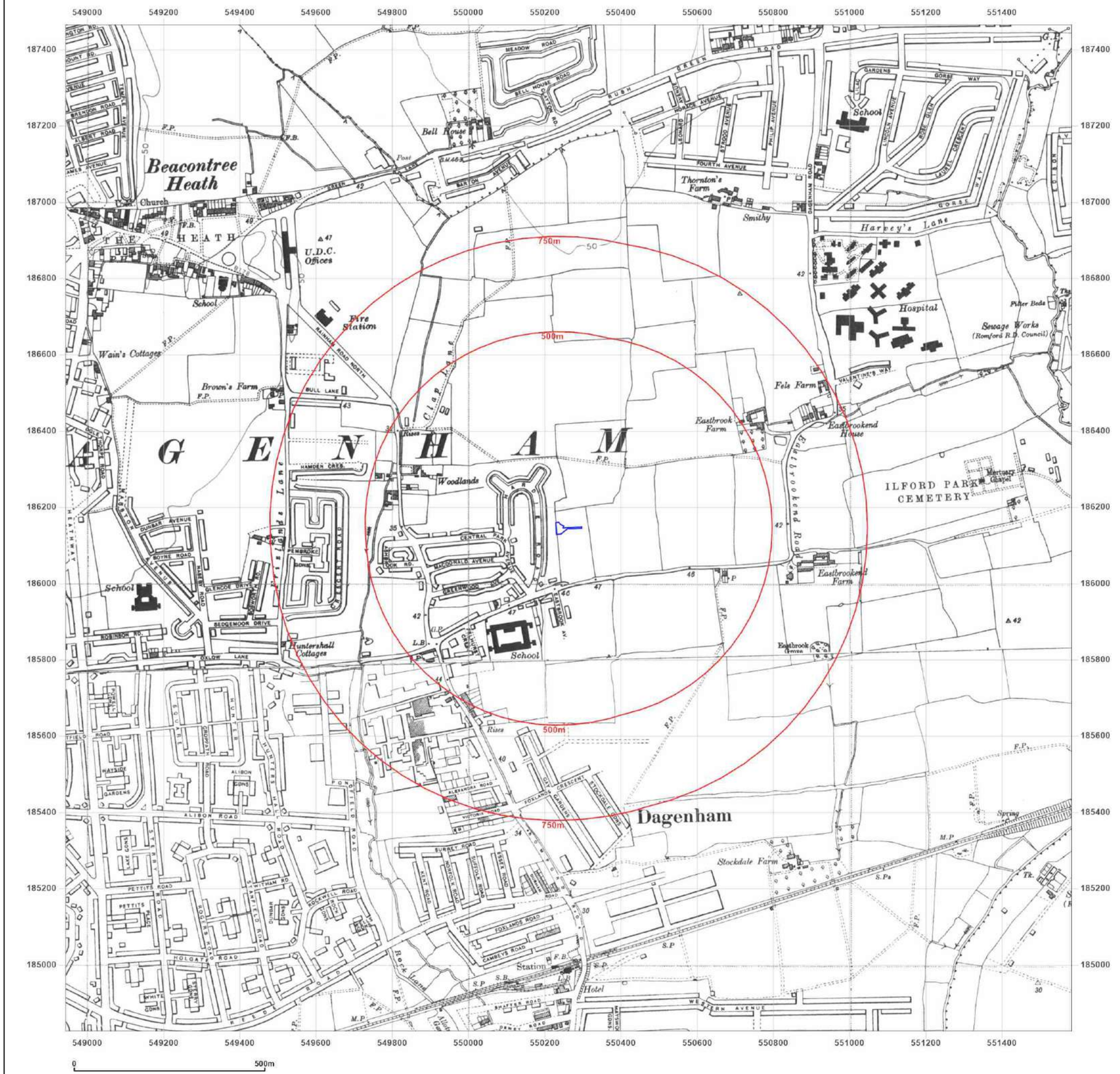
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Report Ref: GS-7642798
Grid Ref: 550262, 186145

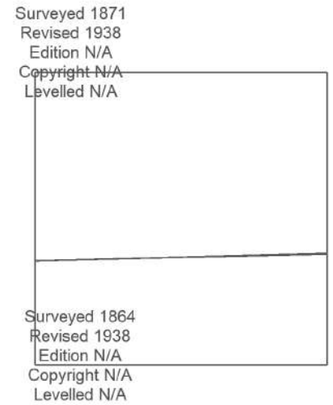
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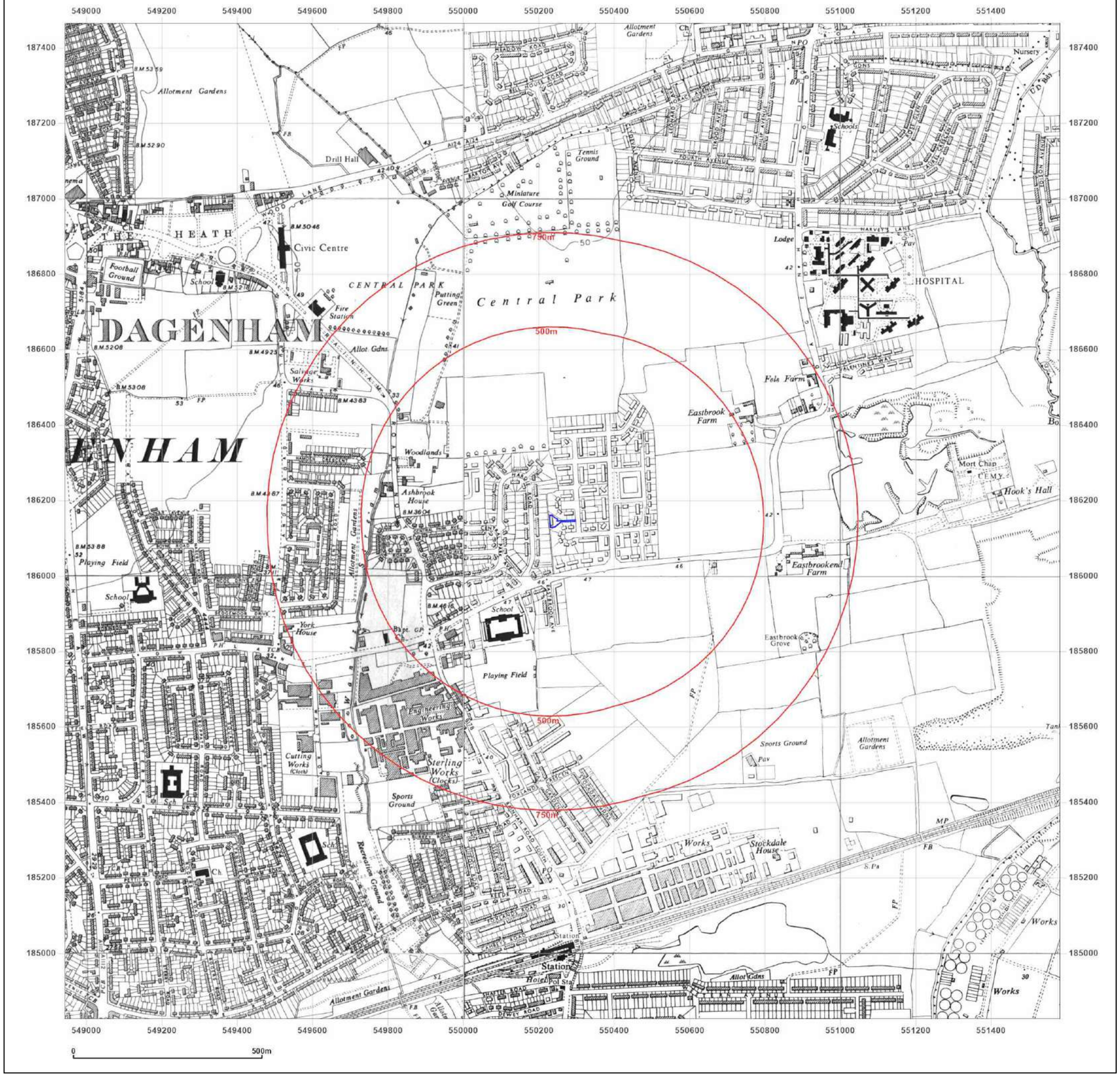
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Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: Provisional
Map date: **1950-1955**
Scale: 1:10,560
Printed at: 1:10,560

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Surveyed N/A
Revised 1950
Edition N/A
Copyright 1951
Levelled N/A

Surveyed 1955
Revised 1955
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised 1949
Edition 1950
Copyright N/A
Levelled N/A

Surveyed 1955
Revised 1955
Edition N/A
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Levelled N/A

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Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: Provisional
Map date: **1967-1969**
Scale: 1:10,560
Printed at: 1:10,560

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Surveyed N/A
Revised 1968
Edition N/A
Copyright 1968
Levelled N/A

Surveyed 1967
Revised 1967
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1969
Revised 1969
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1967
Revised 1967
Edition N/A
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Levelled N/A

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Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: National Grid

Map date: **1973-1975**

Scale: 1:10,000

Printed at: 1:10,000

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Surveyed 1974
Revised 1975
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1974
Revised 1975
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1973
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Copyright N/A
Levelled N/A

Surveyed 1971
Revised 1973
Edition N/A
Copyright N/A
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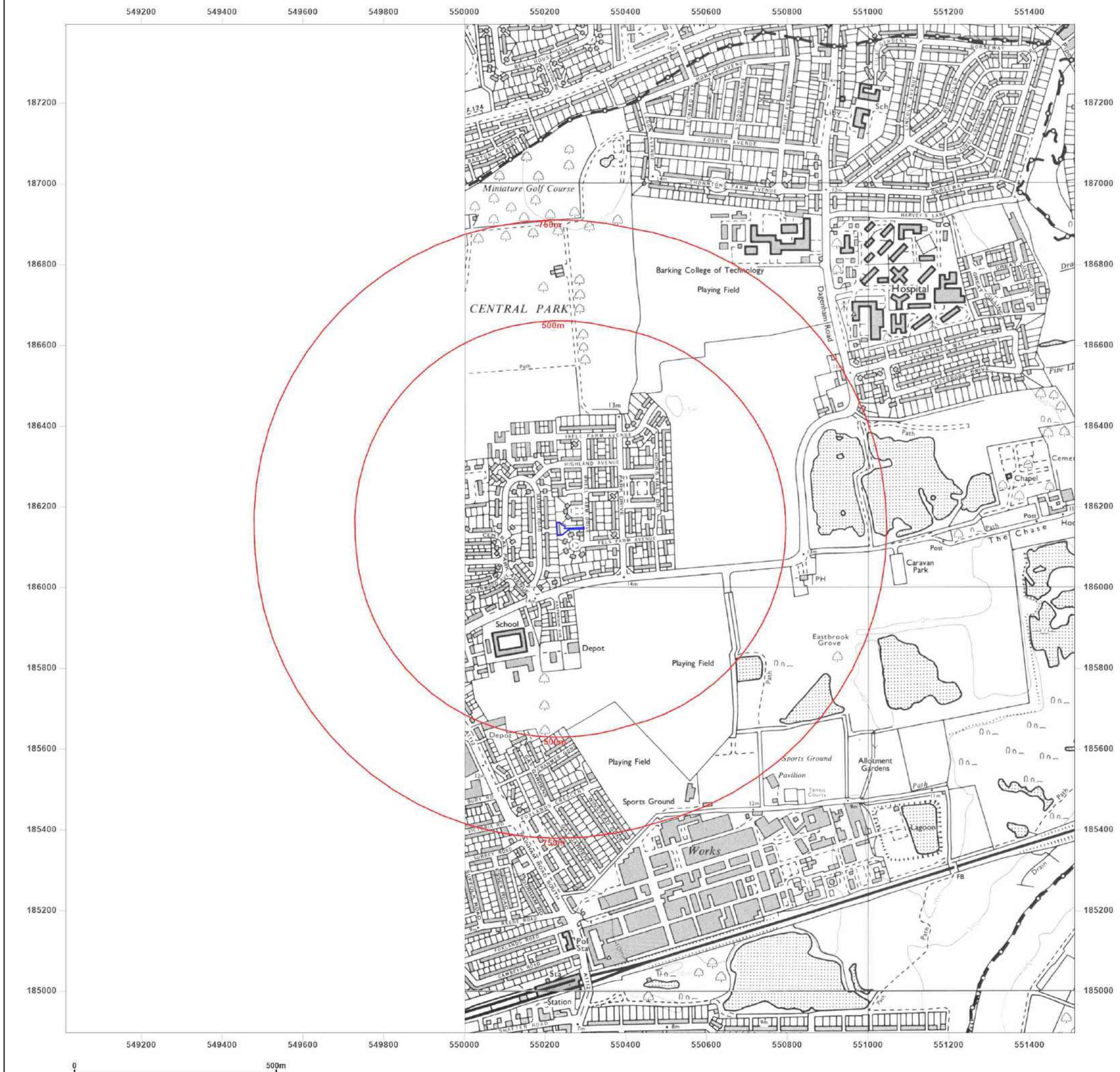
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Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
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Map Name: National Grid

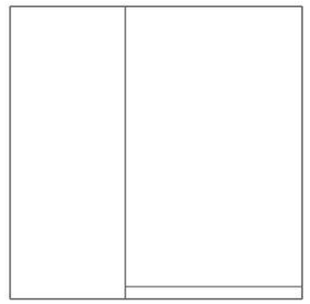
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Surveyed 1988
Revised 1989
Edition N/A
Copyright N/A
Levelled N/A



Surveyed 1973
Revised 1992
Edition N/A
Copyright N/A
Levelled N/A

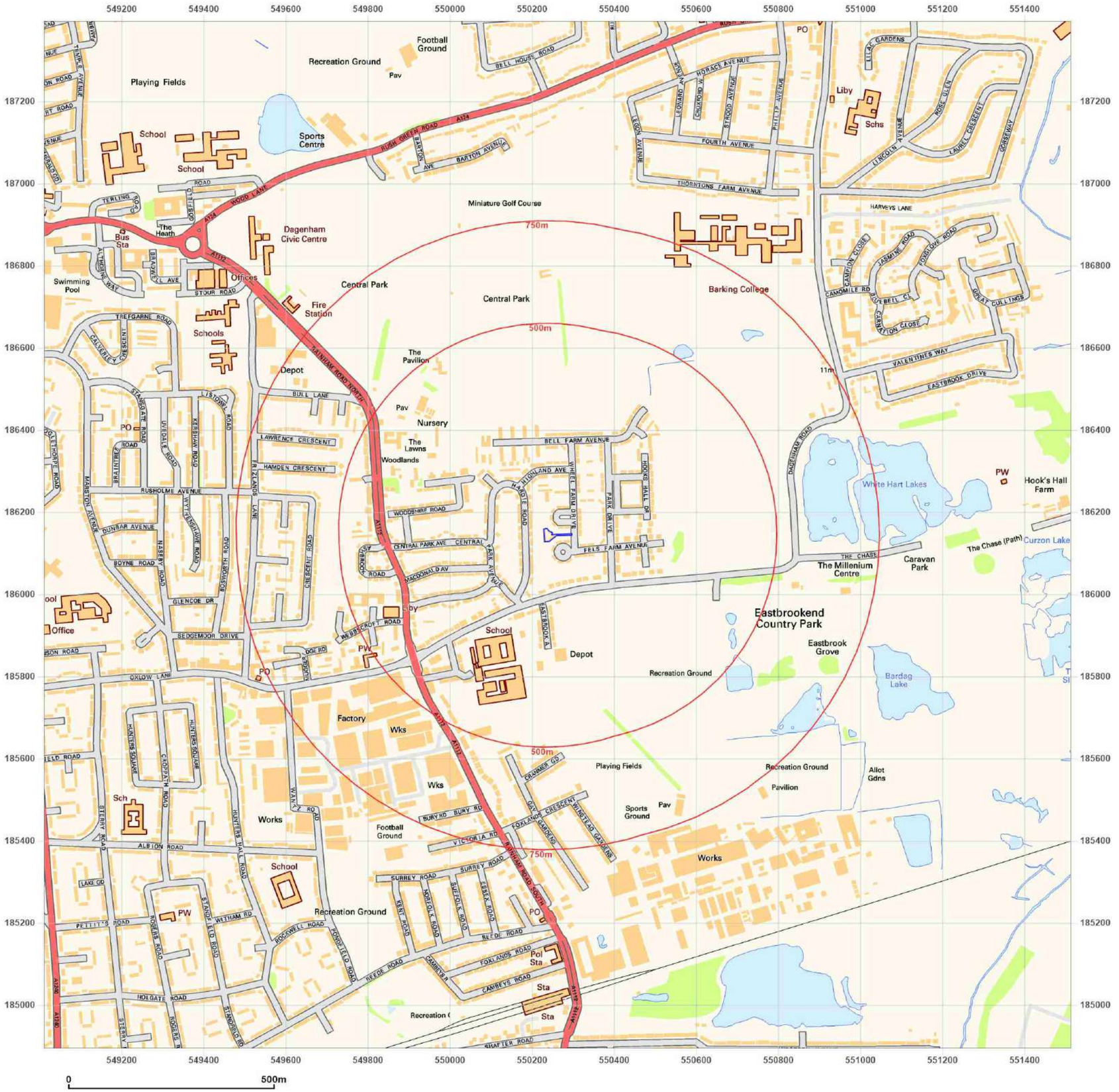
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Grid Ref: 550262, 186145

Map Name: National Grid

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Scale: 1:10,000

Printed at: 1:10,000

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Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: National Grid
Map date: **2010**
Scale: 1:10,000
Printed at: 1:10,000

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Client Ref: PO14047811_PN10046791_WHEEL_FM_DRV
Report Ref: GS-7642798
Grid Ref: 550262, 186145

Map Name: National Grid
Map date: **2021**
Scale: 1:10,000
Printed at: 1:10,000

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2021

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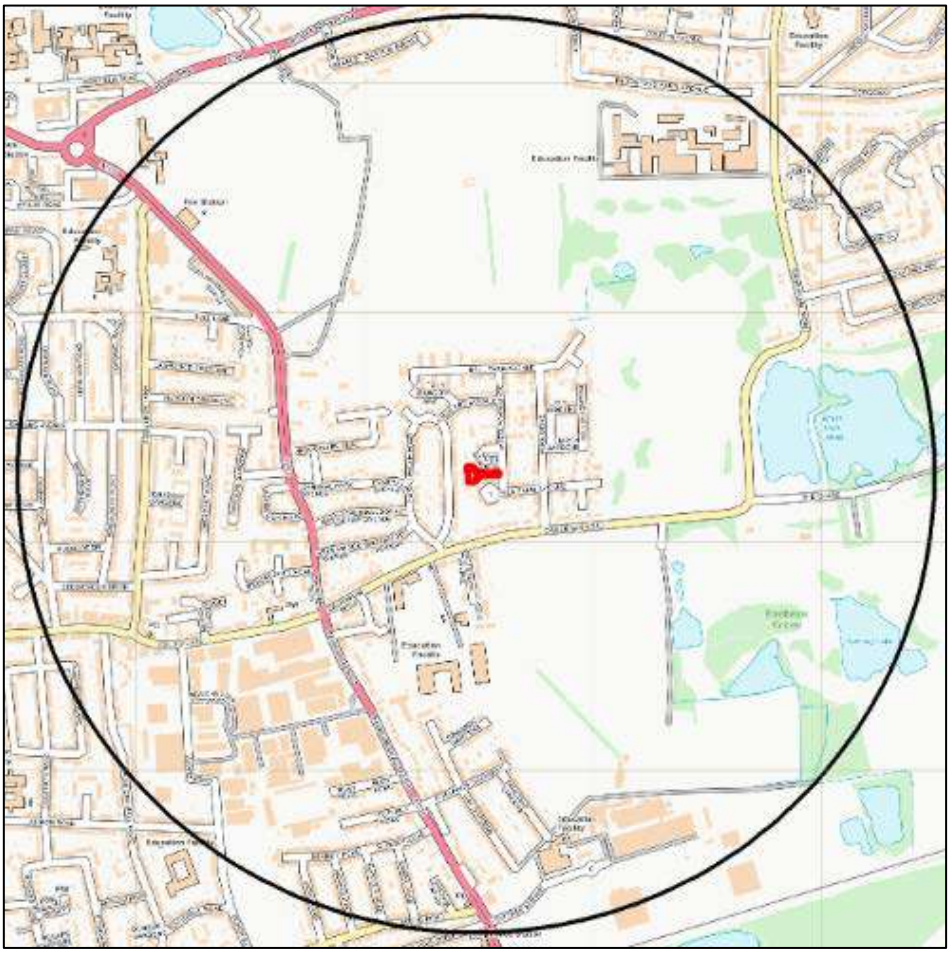
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APPENDIX C

UXO Report

Detailed Unexploded Ordnance (UXO) Threat & Risk Assessment

Meeting the requirements of *CIRIA* C681 'Unexploded Ordnance (UXO) A guide for the Construction Industry' Risk Management Framework



PROJECT NUMBER	8584_10	**ORIGINATOR**	D. Barrett
VERSION NUMBER	1.0	**REVIEWED BY**	B. Wilkinson (24th March 2021)
CLIENT	Arcadis	**RELEASED BY**	L. Gregory (24th March 2021)
STUDY SITE	Wheel Farm Drive, RM10 7AJ		
RATING	**MEDIUM** - This Study Site requires limited further action to reduce risk to ALARP during intrusive activities.		

alpha ASSOCIATES
special risks consultancy

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T: +44 (0)2033 713 900 | W: www.6alpha.com

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Acronyms and Abbreviations

AA	Anti-Aircraft
AAA	Anti-Aircraft Ammunition
ALARP	As Low As Reasonably Practicable
AOD	Above Ordnance Datum
ARP	Air Raid Precaution
AXO	Abandoned Explosive Ordnance
BD	Bomb Disposal
BDO	Bomb Disposal Officer
bgl	Below Ground Level
BGS	British Geological Survey
BH	Borehole
BPD	Bomb Penetration Depth
CDP	Cast Driven Piles
CFA	Continuous Flight Auger
CIRIA	Construction Industry Research and Information Association
CPT	Cone Penetration Testing
CS	County Series
EO	Explosive Ordnance
EOC	Explosive Ordnance Clearance
EOD	Explosive Ordnance Disposal
GI	Ground Investigation
GIS	Geographic Information Systems
GL	Ground Level
GP	General Purpose
GPS	Global Positioning Systems
HAA	Heavy Anti-Aircraft
HE	High Explosive
HO	Home Office
HSE	Health and Safety Executive
IB	Incendiary Bomb
kg	Kilograms
km	Kilometres
LAA	Light Anti-Aircraft
LCC	London County Council
LE	Low Explosive
LSA	Land Service Ammunition
m	Metres
MoD	Ministry of Defence
mm	Millimetres
NEQ	Net Explosive Quantity
NFF	National Filling Factory
NGR	National Grid Reference
OD	Ordnance Datum
OS	Ordnance Survey
PM	Parachute Mine
PoW	Prisoner of War
RADAR	Radio Detection And Ranging
RAF	Royal Air Force
RN	Royal Navy
RNAS	Royal Naval Air Service
ROF	Royal Ordnance Factory
SAA	Small Arms Ammunition
TA	Territorial Army
TNT	Trinitrotoluene
UK	United Kingdom
UN	United Nations
USAAF	United States Army Air Force
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
V Weapons	*Vergeltungswaffen* – Vengeance Weapons
WD	War Department
WWI	World War One
WWII	World War Two

EXECUTIVE SUMMARY

Study Site

The Client has defined the Study Site as "Wheel Farm Drive, RM10 7AJ" and is centred on NGR 550244, 186145.

Risk Level

MEDIUM

Potential Threat Sources

The most probable UXO threat is posed by WWII *German* HE bombs, whilst IBs and *British* AAA projectiles (which were used to defend against *German* bombing raids) pose a residual threat.

Risk Pathway

Whilst there is a residual UXO risk within this Study Site, 6 Alpha do not believe there is a significant risk pathway to warrant on-site pro-active UXO risk mitigation measures.

Key Findings

During WWII, the Study Site was situated within *Dagenham Municipal Borough,* which recorded 18 HE bomb strikes per 100 hectares, a low level of bombing.

Luftwaffe aerial reconnaissance photography associated with the Study Site did not identify any primary bombing targets on-site or within 1,000m of it.

ARP records associated with the Study Site did not note any HE bomb strikes within it. However, five were recorded in the vicinity of the Study Site; 85m to the east-south-east, 90m to the south-east, 120m to the north-east, 180m to the north-east and 255m to the south-west.

LCC bomb damage mapping did not cover the Study Site and an analysis of post-war mapping and further research of historical records did not identify any potential bomb damage on-site – although it should be noted that given that the Study Site was undeveloped during WWII, it is unlikely that bomb damage would be evidenced on post-war mapping. Nonetheless, further research of historical records identified bomb damage near the *Sterling Armament Works* (approximately 470m to the south-west), and to *Rush Green Hospital* (835m to the north-east).

Pre-WWII mapping (1938) and 1945 aerial photography associated with the Study Site shows that the Study Site was located within a developing urban area during WWII, with the Study Site itself consisting of undeveloped ground – though the areas surrounding the Study Site appear to have been undergoing significant construction operations at that time. As a result, footfall within the Study Site itself is unlikely to have been particularly high, though it may have been more frequent in the surrounding areas. Nonetheless, as on-site footfall may have been relatively low, it is possible that a UXB could have impacted within the Study Site unnoticed.

Between the end of WWII and 1963, structures had been developed on-site, although it has remained largely unchanged since then. Consequently, it is considered likely that any UXO within post-war disturbed and developed ground would potentially have been discovered and removed, however, the potential for deep buried UXO to be present within remaining areas of undisturbed ground is assessed to be extant.

Given that WWII bombing was recorded in the vicinity of the Study Site, the following risk mitigation measures are recommended as a minimum, in order to reduce risks ALARP, during intrusive works in all previously undisturbed ground i.e. that which has not previously been excavated, probed, drilled or otherwise intrusively disturbed since it was potentially contaminated with UXO.

EXECUTIVE SUMMARY (…continued)

Recommended Risk Mitigation Measures Overview

"Open" Intrusive Works

Engineering Methodology	UXO Emergency Response Plan	UXO Safety and Awareness Briefing	On-Call EODE	UXO Risk Rating (Post-Mitigation)
Excavations	✔	✔	✔	**ALARP**

Engineering Methodology	UXO Emergency Response Plan	UXO Safety and Awareness Briefing	On-Call EODE	UXO Risk Rating (Post-Mitigation)
Boreholes	✔	✔	✔	**ALARP**
Window Sampling	✔	✔	✔	

A full and detailed guide to the recommended risk mitigation measures is presented at Section 5 of this report.

For further information, please contact *6 Alpha Associates*:

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ASSESSMENT METHODOLOGY

Approach

6 Alpha Associates is an independent, specialist risk management consultancy practice, which has assessed the risk of encountering UXO (as well as buried bulk high explosives) at this Study Site, by employing a process advocated for this purpose by *CIRIA*. The *CIRIA* guide for managing UXO risks in the construction industry (C681) not only represents best practice but has also been endorsed by the *HSE*. Any risk mitigation solution is recommended *only* because it delivers the Client a risk reduced to ALARP at best value.

UXO hazards can be identified through the investigation of local and national archives associated with the Study Site, *MoD* archives, local historical sources, historical mapping as well as contemporaneous aerial photography (if it is available). Hazards will have only been recorded if there is specific information that could reasonably place them within the boundaries of the Study Site. The amalgamation of information is then assessed to enable the researcher to provide relevant and accurate risk mitigation practices.

The assessment of UXO risk is a measure of *probability of encounter* and *consequence of encounter*; the former being a function of the identified hazard and proposed development methodology; the latter being a function of the type of hazard and the proximity of personnel (and/or other 'sensitive receptors', such as equipment) to the hazard, at the moment of encounter.

If UXO risks are identified, the methods of mitigation we have recommended are considered reasonably and sufficiently robust to reduce them to ALARP. We advocate the adoption of the legal ALARP principle because it is a key factor in efficiently and effectively ameliorating UXO risks. It also provides a ready means for assessing the Client's tolerability of UXO risk. In essence, the principle states that if the cost of reducing a risk significantly outweighs the benefit, then the risk may be considered tolerable. This does not mean that there is never a requirement for UXO risk mitigation, but that any mitigation must demonstrate that it is beneficial. Any additional mitigation that delivers diminishing benefits and that consume disproportionate time, money and effort are considered *de minimis* and thus unnecessary. Because of this principle, UXB and UXO risks will rarely be reduced to zero (nor need they be).

Important Notes

Key source material is referenced within this document, whilst secondary/anecdotal information may be available upon request.

Although this report is up to date and accurate at the time of writing, our databases are continually being populated as and when additional information becomes available. Nonetheless, *6 Alpha* have exercised all reasonable care, skill and due diligence in providing this service and producing this report.

The assessment levels are based upon our professional opinion and have been supported by our interpretation of historical records and third-party data sources. Wherever possible, *6 Alpha* has sought to corroborate and to verify the accuracy of all data we have employed, but we are not accountable for any inherent errors that may be contained in third party data sets (e.g. *National Archive* or other library sources), and over which *6 Alpha* cannot exercise control.

STAGE ONE – STUDY SITE LOCATION AND DESCRIPTION

Study Site

The Client has defined the Study Site as "Wheel Farm Drive, RM10 7AJ". The Study Site is centred at NGR 550244, 186145 as presented at *Figures 1* and *2,* respectively.

Location Description

The Study Site is situated within *London Borough of Barking and Dagenham* and totals an area of 0.08 hectares (ha).

Furthermore, the Study Site is bounded by:

- North: *Home Gardens* and various structures*;*
- East: *Wheel Farm Drive;*
- South: *Grove Gardens* and various structures*;*
- West: *Hardie Road* and various structures.

Aerial Photography (2020) (*Figure 3*)

Current aerial photography corroborates the information above and shows that the Study Site is situated within a densely developed urban area. The Study Site itself consists of structures in the western section and hardstanding.

Proposed Works

The Client has informed *6 Alpha* of the following proposed works:

"We are proposing to undertake a one-day, 3-4 window sample holes at each site by way of preliminary ground investigation to a maximum depth of 6m bgl with installations for groundwater and ground gas monitoring purposes."

Ground Conditions

It is important to establish the specific ground conditions in order to determine the maximum *German* UXB penetration depth as well as the potential for other types of munitions to be buried.

If the site investigations and/or construction methodologies change, and/or if a specific methodology is to be employed, and/or if the scope of work is focused upon a specific part of the Study Site, then *6 Alpha* are to be informed so that the prospective UXO risks and the associated risk mitigation methodology might be re-assessed. Certain ground conditions may also constrain certain types of UXO risk mitigative works e.g. magnetometer survey is adversely affected in mineralised and made ground.

It is important to establish the provenance of made ground, where this is recorded as being part of the ground make-up, in order to accurately determine the ground levels at the time when UXO contamination may have occurred so as to accurately determine the average/maximum bomb penetration depths and subsequently to make appropriate recommendations aimed at reducing the risk to ALARP.

STAGE ONE – STUDY SITE LOCATION AND DESCRIPTION (…continued)

Ground Conditions

BGS borehole log "TQ58NW417 – Central Park Bell Farm Avenue" (located 360m to the north-east of the Study Site), recorded the following strata:

Depth bgl (m)	Strata	Description
0.00m to 0.50m	Made Ground	Light brown sandy, gravelly CLAY
0.50m to 2.00m	Clay	Sandy, gravelly CLAY. Sand is fine to coarse, Gravel is fine to medium, sub-angular to sub-rounded flint and chalk.
2.00m to 6.00m	Sand/Gravel	Clayey SANDS AND GRAVELS. Sand is fine to coarse, Gravel is fine to medium, sub-angular to rounded. Rare rounded coarse gravel.
6.00m to 21.00m	Clay	Stiff grey CLAY
21.00m to 55.00m	Clay	Stiff grey sandy CLAY.
55.00m to 100.00m	Chalk	CHALK. With flint coarse gravel.

In addition, the *British Geological Survey* describes the general area as being comprised of *"London Clay Formation, Clay, Silt And Sand"*.

STAGE TWO – REVIEW OF HISTORICAL DATASETS

Sources of Information Consulted

The following primary information sources have been used in order to establish the background UXO threat:

1. *6 Alpha*'s *Azimuth* Database;
2. *Home Office* WWII Bomb Census Maps;
3. WWII and post-WWII aerial photography;
4. Official Abandoned Bomb Register;
5. Information gathered from the *National Archives* at *Kew*;
6. Historic UXO information provided by *33 Engineer Regiment* (Explosive Ordnance Disposal) at *Carver Barracks, Wimbish*.

Potential Sources of UXO Contamination

In general, there are several activities that might contaminate a site with UXO, but the three most common ways are: legacy munitions from military training/exercises; deliberate or accidental dumping (AXO) and ordnance resulting from war fighting activities (also known as the Explosive Remnants of War (ERW)).

During WWII, the *Luftwaffe* undertook bombing campaigns all over the *UK*. The most common type of UXO discovered today is the aerially delivered high explosive (HE) bomb, which are comparatively thick-skinned and were dropped from *Luftwaffe* aircraft. If the bomb did not detonate when it was dropped, the force of impact enabled the UXO to penetrate the ground, often leaving behind it a UXB entry hole. These entry holes were not always apparent, and some went unreported, leaving the bomb buried and unrecorded. More rarely, additional forms of *German* UXO are occasionally discovered including *inter alia V1* and *V2* rockets, Incendiary Bombs (IBs), and Anti-personnel (AP) bomblets.

Although the *Luftwaffe* had designated primary bombing targets across the *UK*, their high-altitude night bombing was not accurate. As a result, thousands of buildings were damaged and civilian fatalities were common. Bombs were also jettisoned over opportunistic targets and residential areas were sometimes struck.

As the threat of invasion lingered over *Britain* during WWII, defensive actions were undertaken. The *British* and *Allied Forces* requisitioned large areas of land for military training and bomb storage (including HE bombs, naval shells, artillery and tank projectiles, explosives, LSA and SAA). Thousands of tonnes of these munitions were used for the *Allied Forces* weapon testing and military training alone. It has been estimated that at least 20 per cent of the *UK*'s land has been used for military training at some point.

The best practice guide for dealing with your UXO risks on land (CIRIA publication C681) suggests that approximately 10 per cent of all munitions deployed failed to function as designed. ERW are therefore, still commonly encountered, especially whist undertaking construction and civil engineering groundwork.

Furthermore, in exceptional circumstances, UXO is discovered unexpectedly and without apparent rational explanation. There are several ways this might occur:

- When *Luftwaffe* aircraft wished to swiftly escape e.g. from an aerial attack, they would jettison some or all of their bombs and flee. This is commonly referred to as *tip and run* and it has resulted in bombs being found in unexpected locations;
- Transportation of aggregate containing munitions to an area that was previously free of UXO, usually related to construction activities employing material dredged from a contaminated offshore borrow site;
- Poor precision during targeting (due to high altitude night bombing and/or poor visibility) resulted in bombs landing off target, but within the surrounding area;
- *British* decoy sites were also constructed to deliberately cause incorrect targeting. For obvious reasons, such sites were often built in remote and uninhabited areas.

Study Site Development History

From an analysis of the CS and OS historical mapping associated with the Study Site, the following history can be deduced:

Year	Analysis
1897 CS Map	The Study Site was located in a relatively undeveloped rural area. The Study Site did not consist of any structures.
1920 CS Map	Changes were not recorded at the Study Site.
1938 CS Map	Changes were not recorded at the Study Site.
1946 Aerial Photography	Changes were not recorded at the Study Site.
1963 OS Map	Structures had been developed in the western sector of the Study Site.
1978 OS Map	Changes were not recorded at the Study Site.
1990 OS Map	Changes were not recorded at the Study Site.
1999 Aerial Photography	Areas of hardstanding were visible across the Study Site.
2010 Aerial Photography	Changes were not recorded at the Study Site.
2021 OS Map	Changes were not recorded at the Study Site.

The Study Site history assessment is our best interpretation of the data available at the time of writing. Given that yearly revisions of neither CS and OS mapping, nor aerial photography, are available for analysis, there are gaps between the mapping revisions.

Consequently, it should not be assumed that any new structures and/or features that are labelled on a map revision were constructed, developed, installed or demolished in the exact year that the mapping illustrates the change. It is possible – and indeed likely – that the exact date of development occurred somewhere between the two closest mapping revisions. Specifically, this may be particularly relevant where there is a gap between pre and post-WWII mapping, as it may not be clear whether structures were present during WWII or if they were constructed in the post-WWII period.

WWII Site Use

The CS mapping prior to WWII (1938) and 1945 aerial photography, shows that the Study Site was located within a developing urban area during WWII, with the Study Site itself consisting of undeveloped ground – though the areas surrounding the Study Site appear to have been undergoing significant construction operations at that time. As a result, footfall within the Study Site itself is unlikely to have been particularly high, though it may have been more frequent in the surrounding areas. Nonetheless, as on-site footfall may have been relatively low, it is possible that a UXB could have impacted within the Study Site unnoticed.

WWII Bombing of *London*

The most intensive period of bombing over *London* was the nine months between October 1940 and May 1941, known as 'The Blitz'. During this period the *Luftwaffe* attempted to overwhelm *Britain's* air defences, destroy key military and industrial facilities, as well as logistical capabilities, prior to invasion.

A total of 18,000 tons of bombs were dropped on *London* between 1940 and 1945. Many residential, commercial and industrial buildings were targeted during air raids and sustained large scale damage. Public services were also affected, with gas, electricity and water supplies often cut-off following damage to either the installations themselves or to the supply infrastructure. In addition, thousands of civilians were killed and injured, and many were forced to evacuate as their homes were destroyed.

WWII HE Bomb Density (*Figure 4*)

The Study Site was located within *Dagenham Municipal Borough,* which recorded 18 HE bombs per 100 hectares, a low level of bombing.

WWII Luftwaffe Bombing Targets

Prior to WWII, the *Luftwaffe* conducted numerous aerial photographic reconnaissance missions over *Britain*, recording key military, industrial and commercial facilities for attack, in the event of war. In addition, logistics infrastructure and public services, such as railways, canals, power stations, reservoirs, water and gas works were also considered viable bombing targets.

Luftwaffe aerial reconnaissance photography associated with the Study Site did not identify any primary bombing targets on-site or within 1,000m of it.

WWII HE Bomb Strikes (*Figure 5*)

During WWII, ARP wardens compiled detailed logs of bomb strikes across their respective districts. However, ARP records associated with the Study Site did not note any HE bomb strikes within it. Nonetheless, five were recorded in the vicinity of the Study Site; 85m to the east-south-east, 90m to the south-east, 120m to the north-east, 180m to the north-east and 255m to the south-west.

Furthermore, whilst IBs may have fallen within the Study Site, they fell in such large numbers that accurate record keeping was either non-existent or perfunctory therefore, their prospective presence cannot be either corroborated or discounted. Nonetheless, analysis of additional official bomb strike mapping noted IB strikes 60m to the south-west. In addition, a parachute mine was identified landing 200m to the north-west, and five AAA projectiles were also encountered by ARP wardens; 40m to the west, 245m to the south-west, 275m to the south-west, 280m to the west-south-west and 740m to the south-east.

In addition to IBs and HE bomb strikes, during the latter part of the war when aerial bombing had significantly declined, the main threat came from *V* type weapons. The first recorded *V1* strike on *London* was on the 13th June 1944, with the first recorded *V2* strike on *London* on the 8th September 1944. *V1* and *V2* rockets were thin-skinned, unmanned and inaccurate weapons. Three *V1* rocket strikes were recorded; 530m to the north-west, 780m to the south-east and 960m to the north-east. One *V2* rocket strike was also identified 440m to the south-west.

The potential penetration depth of an UXB was dependent on a number of factors including but not restricted to those prior to striking the ground e.g. velocity and orientation of the UXB which in turn will be influenced on factors such as the release altitude from the aircraft and encounters with infrastructure during its fall; those encountered at the point of impact i.e. was the impact on concrete, grass, water etc. and finally, the below ground level conditions which were encountered such as infrastructure e.g. services, basements, foundations, and geology e.g. made ground, clay, sand, etc. Further, as the UXB penetrated the ground, it's velocity naturally slowed where, it either came to an abrupt stop e.g. against foundations or would continue for 10's of feet along a route of least resistance which often resulted in a curving of the trajectory back towards the surface. This is known as the "J Curve" effect and often resulted in a considerable horizontal off-set from the point of entry. This is often the reason why UXBs have been discovered against or under the foundations of buildings, which were present during WWII, or many meters from the point of impact.

WWII Bomb Damage

LCC bomb damage mapping did not cover the Study Site. An analysis of post-war mapping and further research of historical records did not identify any potential bomb damage on-site – although it should be noted that given the Study Site was undeveloped, it is unlikely bomb damage would be evidenced on post-war mapping. Nonetheless, further research of historical records identified bomb damage near the *Sterling Armament Works* (approximately 470m to the south-west), and to *Rush Green Hospital* (835m to the north-east).

Abandoned Bombs

An examination of the official abandoned bomb records did not identify any abandoned bombs on-site, nor within 1,000m of the Study Site boundary.

Records of WWII UXB Disposal Tasks

An examination of the civil defence records listing UXBs dealt with in the *Borough of Barking and Dagenham* from 1940-45 has identified the following tasks within the Study Site's vicinity:

- One 50kg UXB was removed from *Field adjoining Greys Farm, Dagenham Road* (situated approximately 470m to the north-east) on the 20th October 1940.

In addition, an analysis of ARP mapping associated with the Study Site identified seven UXB encounters; 400m to the south-west, 450m to the east, 500m to the south-west, 795m to the south, 825m to the north-west, 875m to the north-east and 905m to the south-east. One unexploded parachute mine was also recorded 755m to the south-south-east.

Furthermore, two unexploded AA shells (UXAA) were recorded 475m to the south-west and 480m to the west-south-west.

Records of Post-WWII UXB Disposal Tasks

An examination of the post-WWII BDO tasks associated with the area has not identified any BDO operations within the Study Site itself, nor within 1,000m of its boundary.

Military Activity

Sterling Armaments Company was located 470m to the south-west and was requisitioned to produce weapons and munitions during WWII, including the *Lanchester Submachine Gun,* and continued to produce a variety of arms after the war. In addition, *North Ockenden HAA Site* was located 620m to the south-west. Nonetheless, it is considered highly unlikely that munitions were stored, located and/or fired from this Study Site during WWII or that military training would have taken place as a result of any of the military activity and/or installations located within the wider area.

Sources of UXO Contamination

The most likely source of UXO contamination is from *German* aerially delivered ordnance, which ranges from small IBs through to large HE bombs (the latter forms the principal threat). Additional residual contamination may be present from *British* AAA projectiles (which were used to defend the UK against *German* bombing raids).

STAGE THREE – DATA ANALYSIS

Variable	Result	Comment
Was the area considered to be a primary bombing target?	✗	No primary targets were identified within 1,000m.
Was the Study Site or the immediate area bombed during WWII?	✓	ARP records identified five HE bomb strikes within 255m, the closest being 85m to the east-south-east.
Did the Study Site or the immediate area experience bomb damage?	✓	Bomb damage was identified as close as 470m to the south-west.
Was the ground undeveloped during WWII?	✓	The Study Site consisted of undeveloped ground.
Would the footfall have been high in the area?	✗	Given the lack of development on-site, it is likely that footfall would have been low.
Would a UXB entry hole have been observed during WWII?	✗	Given that footfall would have been low, it is unlikely a UXB entry hole would have been observed.
Have military personnel ever occupied the Study Site?	✗	No military facilities were identified on-site, or in the immediate vicinity of the Study Site.
Would munitions have been manufactured, stored and/or fired from the Study Site?	✗	There is no evidence to suggest munitions were located or fired from this Study Site.
Would previous intrusive works have removed the potential for UXO to be present?	✗	The Study Site has been subjected to varying levels of redevelopment; therefore, it is likely that any UXO within post-war disturbed and developed ground would potentially have been discovered and removed, whilst the surrounding areas remain extant.
Are proposed intrusive works likely to extend into previously undisturbed ground?	✓	Some areas of the Study Site have remained undeveloped since WWII and therefore some proposed works may extend into previously undisturbed ground.
Is there potential for an unplanned encounter with UXO to occur during proposed intrusive works?	✓	Given that WWII bombing was recorded in the vicinity of the Study Site, it is considered possible for an unplanned encounter with UXO to occur.
Does the probability of UXO vary across the Study Site?	✓	The probability of discovering UXO within post-war disturbed and developed ground is considered to be remote, however, the probability of UXO discovery within all previously undisturbed areas of the Study Site is extant.

N.B. The ✓ / ✗ symbology is intended to act only as a succinct visual indicator as to whether the data analysis has returned a positive (i.e. ✓) or negative (✗) answer to each question concerning the potential for UXO contamination at the Study Site.

STAGE FOUR – RISK ASSESSMENT

Threat Items

The most probable UXO threat items are *German* HE bombs, whilst IBs and *British* AAA projectiles pose a residual threat. The consequences of initiating *German* HE bombs are more severe than initiating IBs or AAA projectiles, and thus they pose the greatest prospective risk to intrusive works.

Bomb Penetration Depth

Considering the ground conditions (highlighted in Stage 1), the average BPD for a 250kg *German* HE bomb is assessed to be approximately 7m bgl, with the maximum BPD considered to be approximately 16m bgl. Although it is possible that the *Luftwaffe* deployed larger bombs in the area, their deployment was infrequent, and to use such larger (or the largest) bombs for BPD calculations are not justifiable on either technical or risk management grounds.

WWII *German* bombs have a greater penetration depth when compared to IBs and AAA projectiles, which are unlikely to be encountered at depths greater than 1m bgl. However, due to the "J Curve" and the potential for structures to impede the penetration into the ground, HE bombs have been discovered at much shallower depths than the average.

Risk Pathway

Whilst there is a residual UXO risk within this Study Site, 6 Alpha do not believe there is a significant risk pathway to warrant on-site pro-active UXO risk mitigation measures. Whilst not all UXO encountered aggressively will initiate upon contact, such a discovery could lead to serious impact on the project especially in terms of critical injury to personnel, damage to equipment and project delay.

Prospective Consequences

Consequences of UXO initiation include:

1. Fatally injure personnel;
2. Severe damage to plant and equipment;
3. Deliver blast and fragmentation damage to nearby buildings;
4. Rupture and damage underground utilities/services.

Consequences of UXO discovery include:

1. Delay to the project and blight;
2. Disruption to local community/infrastructure;
3. The expenditure of additional risk mitigation resources and EOD clearance;
4. Incurring additional time and cost.

UXO RISK CALCULATION

Site Activities

Although there is some variation in the probability of encountering and initiating items of UXO when conducting different types of intrusive activities, a number of investigative and construction methodologies have been described for analysis at this Study Site. The consequences of initiating UXO vary greatly, depending upon, *inter alia* the mass of HE in the UXO and how aggressively it might be encountered. For this reason, *6 Alpha* has conducted separate risk rating calculations for each investigative and construction methodology that might be employed.

Risk Rating Calculation

6 Alpha's Semi-Quantitative Risk Assessment assesses and rates the risks posed by the most probable threat items when conducting a number of different activities on the site. Risk Rating is determined by calculating the probability of encountering UXO and the consequences of initiating it.

UXO Risk Calculation Table – All Areas				
Activity	**Threat Item**	**Probability (SH+EM=P)**	**Consequence (D+PSR=C)**	**Risk Rating (PXC=RR)**
Window Sampling	HE Bombs	1+3=4	3+2=5	4x5=20
	AAA Projectiles	1+3=4	3+1=4	4x4=16
	IBs	1+3=4	3+1=4	4x4=16
Boreholes	HE Bombs	1+3=4	3+2=5	4x5=20
	AAA Projectiles	1+3=4	3+1=4	4x4=16
	IBs	1+3=4	3+1=4	4x4=16
Excavations	HE Bombs	1+2=3	3+3=6	3x6=18
	AAA Projectiles	1+2=3	3+1=4	3x4=12
	IBs	1+2=3	3+1=4	3x4=12
Abbreviations – Site History (SH), Engineering Methodology (EM), Probability (P), Depth (D), Consequence (C), Proximity to Sensitive Receptors (PSR) and Risk Rating (RR).				

STAGE FIVE – RECOMMENDED RISK MITIGATION MEASURES

Do the ground conditions support a geophysical UXO survey?

Non-Intrusive Methods of Mitigation – Magnetometer results may be affected by ferro-magnetic contamination due to previous construction activities and made ground within the Study Site.

Intrusive Methods of Mitigation – Intrusive magnetometry may be effective on this Study Site, prior to boreholing especially. However, any ferrous metal/red brick contamination in made ground/old foundations may affect the detection capability of the UXB survey equipment, as it passes through the contaminated layer especially. Nonetheless, beyond the contaminated strata such a survey should prove effective.

Mitigation Measures to Reduce Risk to 'ALARP'

Activity	Risk Mitigation Measures	Final Risk Rating
All Activities in All Areas	**1. Operational UXO Emergency Response Plan;** appropriate site management documentation should be held on-site to guide and plan for the actions which should be undertaken in the event of a suspected or real UXO discovery (this plan can be supplied by *6 Alpha*); **2. UXO Safety & Awareness Briefings;** the briefings are essential when there is a possibility of explosive ordnance encounter and are a vital part of the general safety requirement. All personnel working on the site should receive a briefing on the identification of a UXB, what actions they should take to keep people and equipment away from such a hazard and to alert site management. Information concerning the nature of the UXB threat should be held in the site office and displayed for general information on notice boards, both for reference and as a reminder for ground workers. The safety awareness briefing is an essential part of the *Health & Safety Plan* for the site and helps to evidence conformity with the principles laid down in the *CDM* regulations 2015 (this brief can be delivered directly, or in some cases remotely, by *6 Alpha*). **3. On-Call Engineer**; An on-call EOD Engineer will be able to identify and/or advise on the appropriate course of action in the event of any suspicious and/or real UXO finds. *6 Alpha* offer three tiers of immediate telephone and/or email response.	**ALARP**

This assessment has been conducted based on the information provided by the Client, should the proposed works change then *6 Alpha* should be re-engaged to refine this risk assessment

Report Figures

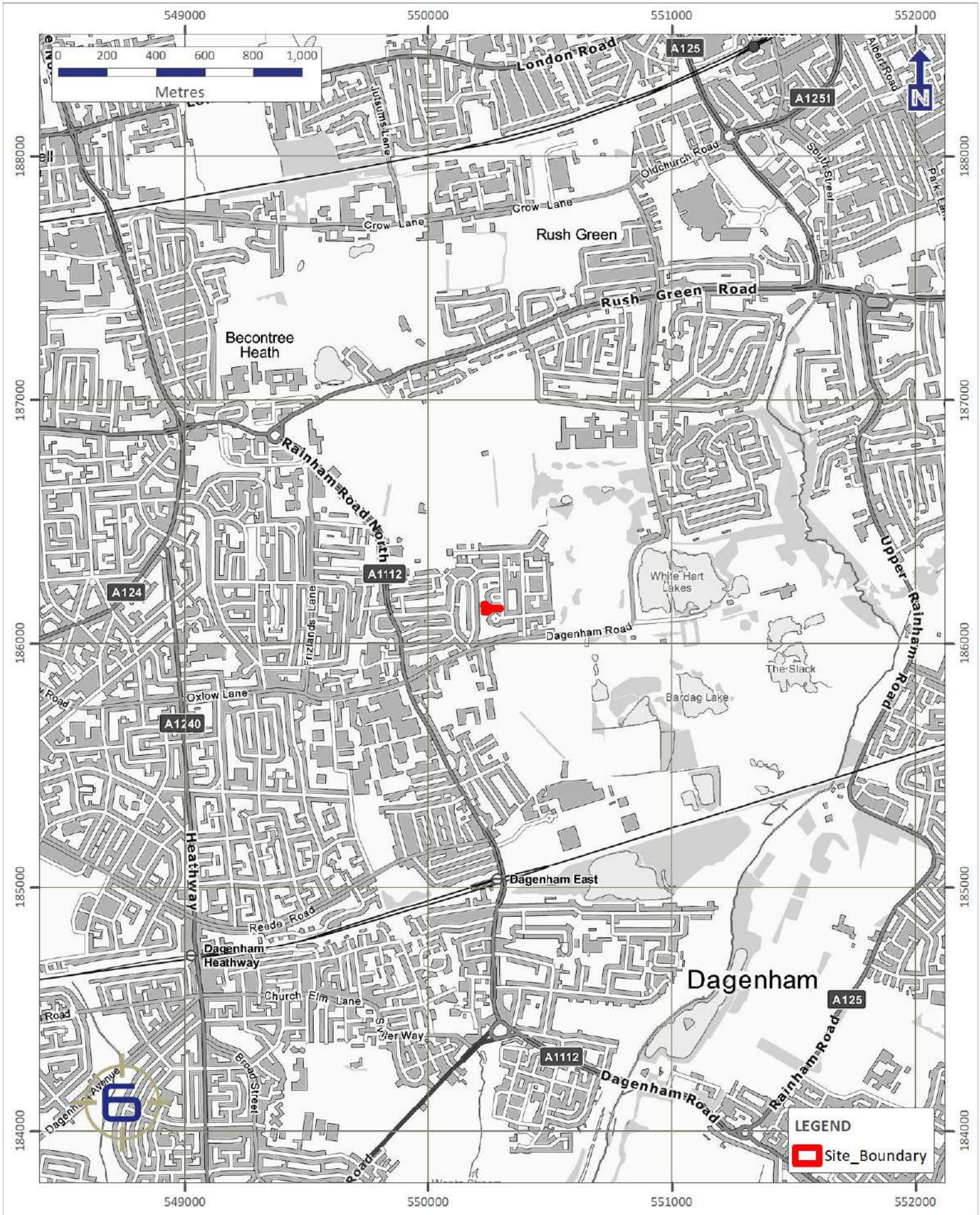
Figure One - Study Site Location

BRITISH NATIONAL GRID

WHEEL FARM DRIVE, RM10 7AJ

Site Location

BOMB SEARCH
WWW.6ALPHA.COM



PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE			
8584_10	1	CC	LG	18 March 2021	Contains Ordnance Survey data © Crown copyright and database right 2017	Produced by and Copyright to 6 Alpha Associates Ltd. Users noting any errors please notify 6 Alpha.	alpha ASSOCIATES

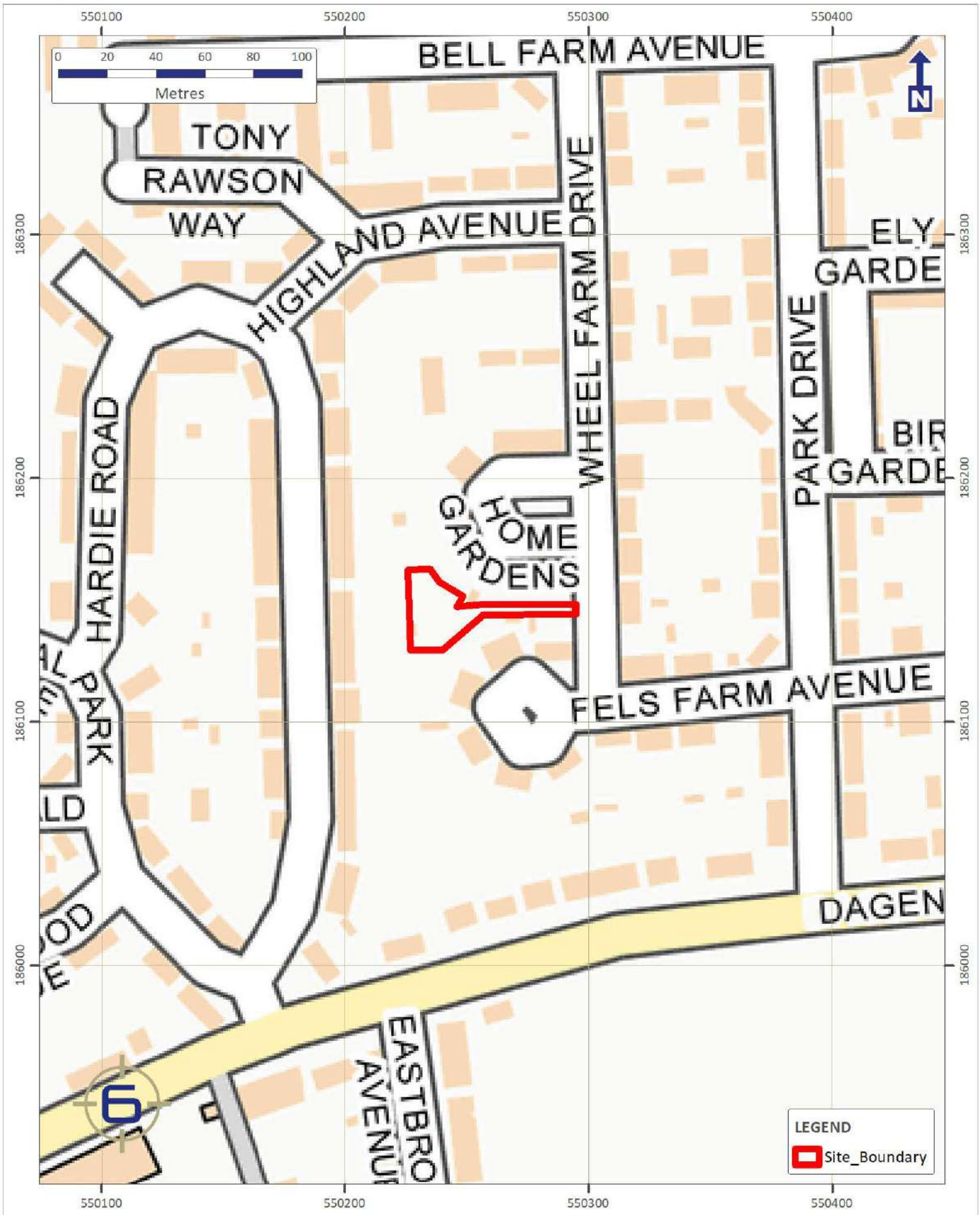
Figure Two - Study Site Boundary

BRITISH NATIONAL GRID

WHEEL FARM DRIVE, RM10 7AJ

Site Boundary

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PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE			
8584_10	2	CC	LG	18 March 2021	Contains Ordnance Survey data © Crown copyright and database right 2017	Produced by and Copyright to 6 Alpha Associates Ltd. Users noting any errors please notify 6 Alpha.	alpha ASSOCIATES

Figure Three - Aerial Photography (2020)

BRITISH NATIONAL GRID

WHEEL FARM DRIVE, RM10 7AJ

Aerial Photography (2020)

BOMB SEARCH
WWW.6ALPHA.COM



PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE		
8584_10	3	CC	LG	18 March 2021	Map data: Google	Produced by and Copyright to 6 Alpha Associates Ltd. Users noting any errors please notify 6 Alpha.

alpha ASSOCIATES

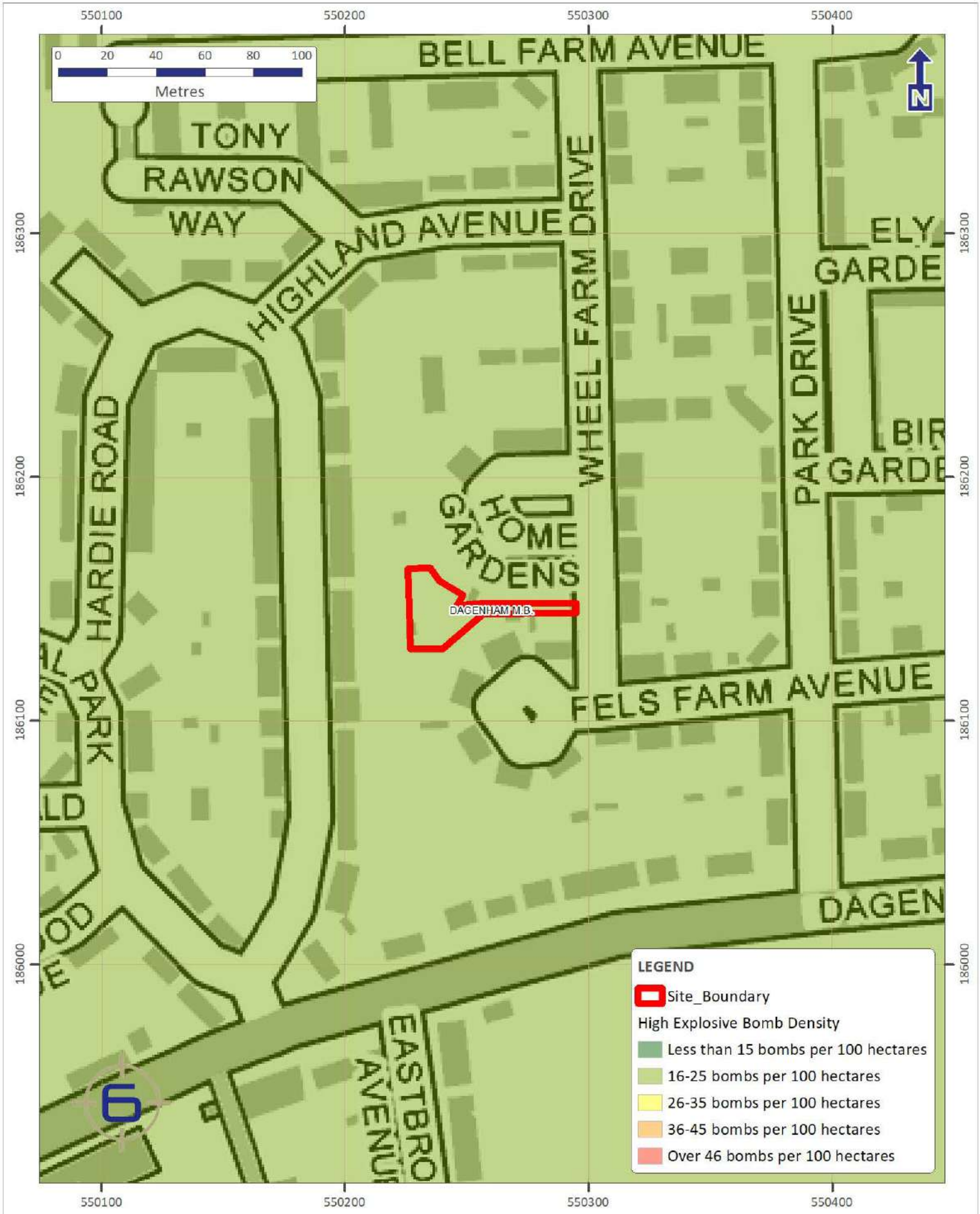
Figure Four - WWII High Explosive Bomb Density

BRITISH NATIONAL GRID

WHEEL FARM DRIVE, RM10 7AJ

WWII High Explosive Bomb Density

BOMB SEARCH
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PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE			
8584_10	4	CC	LG	18 March 2021	Contains Ordnance Survey data © Crown copyright and database right 2017	Produced by and Copyright to 6 Alpha Associates Ltd. Users noting any errors please notify 6 Alpha.	alpha ASSOCIATES

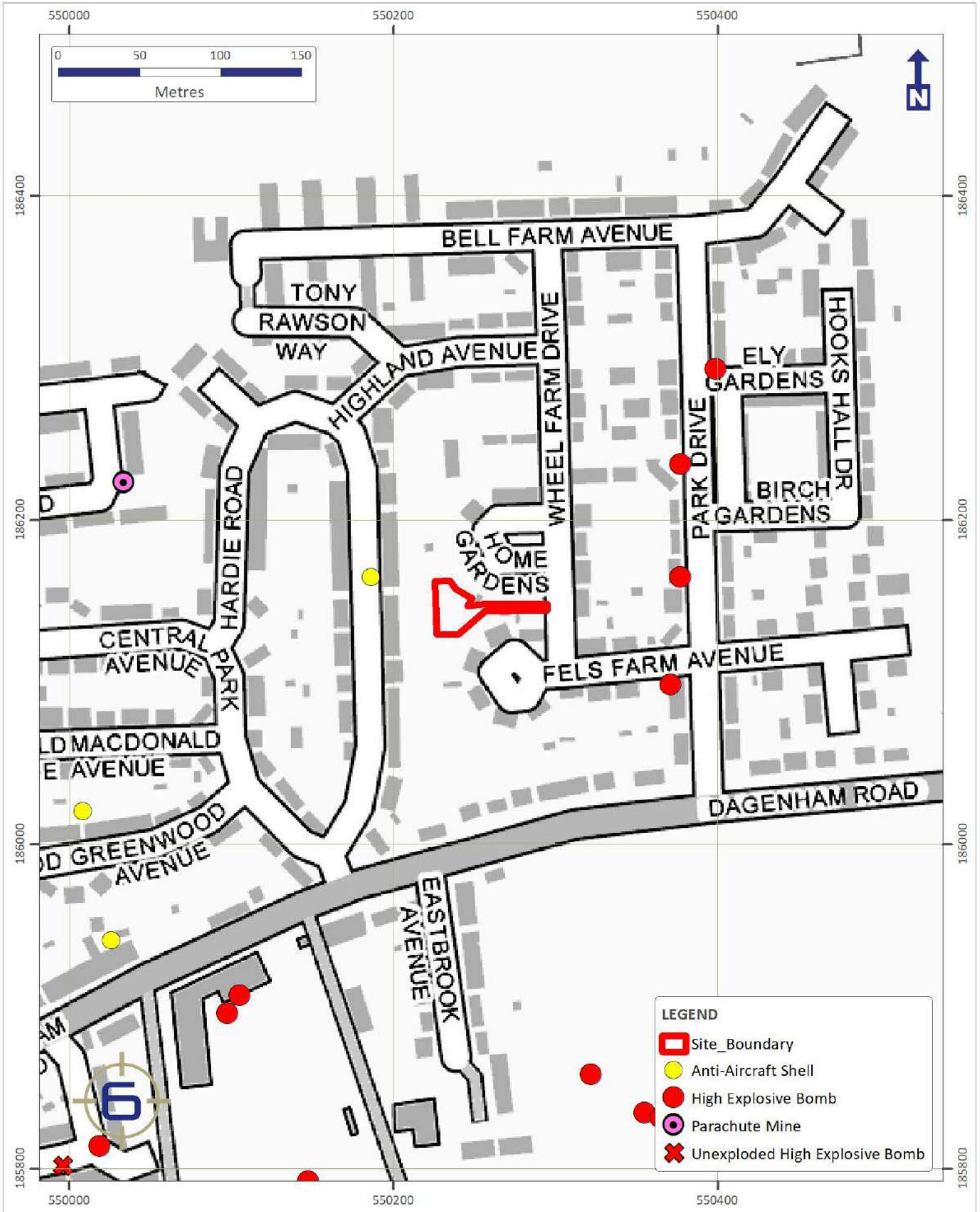
Figure Five - WWII Consolidated Bomb Strikes

BRITISH NATIONAL GRID

WHEEL FARM DRIVE, RM10 7AJ

WWII Consolidated Bomb Strikes

BOMB SEARCH
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PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE			
8584_10	5	CC	LG	18 March 2021	Contains Ordnance Survey data © Crown copyright and database right 2017	Produced by and Copyright to 6 Alpha Associates Ltd. Users noting any errors please notify 6 Alpha.	alpha ASSOCIATES

APPENDIX D

Exploratory Hole Plan



LEGEND

- SITE BOUNDARY
- EXPLORATORY HOLE LOCATION
- NOT DRILLED

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

N

0 0.75 1.5 3 4.5 6 7.5 Metres

TITLE: **EXPLORATORY HOLE LOCATION PLAN**

SITE : **WHEEL FARM DRIVE**

CLIENT : **BE FIRST REGENERATION LTD (ON BEHALF OF LONDON BOROUGH OF BARKING & DAGENHAM)**

PROJECT : **10046791**	**FIGURE 1**
DATE : 19/10/21	DRAWN BY : AP
DRG No. : 10046791-AUK-XX-XX-DR-ZZ-0139-P1 GIS	
SCALE : **1 : 250**	PRINT : **A3**

ARCADIS

ORDNANCE SURVEY © CROWN COPYRIGHT 2021. ALL RIGHTS RESERVED. LICENCE NUMBER 100022432. CONTACT ARCADIS UK IN CASE OF ANY QUERIES

APPENDIX E

Exploratory Hole Logs

Dynamic Sample Borehole Log

WS1103

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
London Borough of Barking and Dagenham	**10046791**	**14.19**	**02/06/2021**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Be First Regeneration Ltd.	**550248.43**	**186143.91**	**02/06/2021**	**Sheet 1 of 1**

SAMPLES	TESTS			PROGRESS		STRATA				
Type + Depth	Type + Depth	Results	Water Depth	Date & Time	Casing & Water Depth	Description	Legend	Depth (Thickness)	Level	Install/ Backfill
(D1) 0.20-0.30 (ES2) 0.30-0.40	PID (1) 0.20	<1ppm				MADE GROUND: black angular fine and medium GRAVEL of bituminous material. [Asphalt].		0.05 0.15	14.14 14.04	
(B3) 0.50-1.20 (ES4) 0.60-0.70	PID (2) 0.60	<1ppm				MADE GROUND: medium strong light grey CONCRETE with mixed aggregates of angular to rounded gravel.		(0.35) 0.50	13.69	
	PID (3) 1.10 SPT(S) 1.20	<1ppm N=18 (3,4/4,4,5,5)				MADE GROUND: silty gravelly SAND with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint. Cobbles are subrounded flint (~5%). Orangish brown slightly gravelly SAND. Sand is coarse. Gravel is subangular fine to coarse flint.		(1.00)		
(ES5) 1.50-1.60 (D6) 1.60-1.70	PID (4) 1.60 SPT(S) 1.70	<1ppm N=50 (9,9/12,12,13,13)				Bluish grey mottled brownish grey slightly gravelly SAND. Sand is medium to coarse. Gravel is angular fine to coarse flint.		1.50 (0.20) 1.70	12.69 12.49	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time (mins)	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00 0.10	0.10 1.20	Inspection Pit																

Remarks

Hammer drill from 0.00m to 0.15m.
SPT refusal at 1.70m.

Termination Depth: 1.70m

AGS

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used: **Dando Terrier Rig**

Contractor: **Arcadis**

Logged By: **Annabelle Randall**

Checked By: **JP**

Dynamic Sample Borehole Log

WS1104

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
London Borough of Barking and Dagenham	**10046791**	**14.05**	**02/06/2021**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Be First Regeneration Ltd.	**550235.23**	**186157.77**	**02/06/2021**	**Sheet 1 of 1**

SAMPLES	TESTS			PROGRESS		STRATA				
Type + Depth	Type + Depth	Results	Water Depth	Date & Time	Casing & Water Depth	Description	Legend	Depth (Thickness)	Level	Install/ Backfill
	PID (1) 0.20	<1ppm				MADE GROUND: black angular fine and medium GRAVEL of bituminous material. [Asphalt].		0.05 0.10	14.00 13.95	
(B1) 0.40-1.20 (ES2) 0.50-0.60	PID (2) 0.60	<1ppm				MADE GROUND: medium strong light grey CONCRETE with mixed aggregates of angular to rounded gravel.		(0.30) 0.40	13.65	
	SPT(S) 1.20 PID (3) 1.30	N=8 (2,2/2,2,2,2) <1ppm				MADE GROUND: greyish black clayey GRAVEL. Gravel is subangular medium to coarse bituminous material. Cobbles are 8 subrounded to subangular flint (~20%).				
	PID (4) 1.80	<1ppm				Brownish orange gravelly clayey SAND. Sand is fine to coarse. Gravel is angular fine to coarse flint. Cobbles are 5 subangular flint (~5%).		(1.40) 1.80	12.25	
(ES3) 2.20-2.30 (D4) 2.30-2.40	SPT(S) 2.00 PID (5) 2.30 SPT(S) 2.40	N=9 (1,2/2,2,2,3) <1ppm N=50 (10,10/12,12,13,13)				Bluish grey mottled orange slightly gravelly slightly organic SAND. Sand is medium to coarse. Gravel is subangular flint.		(0.60) 2.40	11.65	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time (mins)	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00 0.10 1.20	0.10 1.20 2.40	Inspection Pit Window Sample																

Remarks

Hammer drill from 0.00m to 0.10m.
SPT refusal at 2.40m.

Termination Depth: 2.40m

AGS

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used: **Dando Terrier Rig**

Contractor: **Arcadis**

Logged By: **Annabelle Randall**

Checked By: **JP**

Dynamic Sample Borehole Log

WS1106

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
London Borough of Barking and Dagenham	**10046791**	**14.00**	**02/06/2021**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Be First Regeneration Ltd.	**550237.00**	**186131.95**	**02/06/2021**	**Sheet 1 of 1**

SAMPLES		TESTS		PROGRESS		STRATA				
Type + Depth	Type + Depth	Results	Water Depth	Date & Time	Casing & Water Depth	Description	Legend	Depth (Thickness)	Level	Install/ Backfill
(D1) 0.10-0.20 (ES2) 0.20-0.30 (B3) 0.30-1.20 (ES4) 0.40-0.50	PID (1) 0.10	<1ppm				MADE GROUND: black angular fine and medium GRAVEL of bituminous material. [Asphalt].		0.05 0.10 (0.20)	13.95 13.90	
	PID (2) 0.50	<1ppm				MADE GROUND: medium strong light grey CONCRETE with mixed aggregates of angular to rounded gravel.		0.30	13.70	
	PID (3) 1.00	<1ppm				MADE GROUND: soft dark brown CLAY.				
	SPT(S) 1.20	N=7 (2,2/1,2,2,2)				MADE GROUND: Very soft brownish orange slightly gravelly very sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse bituminous material.		(1.20)		
	PID (4) 1.50	<1ppm				Bluish grey mottled brownish orange slightly gravelly clayey SAND. Sand is medium to coarse. Gravel is angular coarse flint.		1.50	12.50	
	SPT(S) 2.00 PID (5) 2.00	N=9 (1,1/2,2,2,3) <1ppm						(1.10)		
	PID (6) 2.50	<1ppm				Loose orange medium to coarse SAND.		2.60	11.40	
(D5) 3.20-3.30	SPT(S) 3.00 PID (7) 3.00	N=11 (1,2/3,4,2,2) <1ppm						(1.40)		
	PID (8) 3.50	<1ppm								
	SPT(S) 4.00	N=50 (7,8/12,12,13,13)						4.00	10.00	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time (mins)	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00 0.10 1.20	0.10 1.20 4.00	Inspection Pit Window Sample																

Remarks

Hammer drill from 0.00m to 0.10m.
Refusal on SPT at 4.00m.

Termination Depth: 4.00m

AGS

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used: **Dando Terrier Rig**

Contractor: **Arcadis**

Logged By: **Annabelle Randall**

Checked By: **JP**

APPENDIX F

Standard Procedure

E0 General Principles

This ground investigation was undertaken in general accordance with the principles of BS EN 1997-1 [1] and BS EN 1997-2 [2] and the advice given in BS5930:2015 [3], which, provides complimentary guidance on the application of the primary standards. Where the requirements of the ground investigation specification differ from these primary standards, the investigation methodology was adapted as required and specific notes regarding methods and techniques employed were made in the appropriate report sections.

E1 Buried Services

Service clearance was undertaken in accordance with Arcadis' *Safety, Health and Environment (SHE) Standard – Avoidance of Sub-Surface Hazards and Structures Standard.* This document details the methods and safe working practices used to undertake excavations safely. Prior to breaking ground, services plans were consulted, and the area scanned using a Cable Avoidance Tool (CAT) with detected signals marked on the ground. For all investigation positions, other than for machine excavated trial pits, hand excavated inspection pits are completed to 1.20 m bgl prior to the use of drilling and boring plant.

E2 Sampling Requirements

The selection of sample types and sampling techniques has been chosen to take account of the soil fabric, size and quality of sample required based on whether the soils mass properties or the intact material properties of the ground are to be determined in subsequent laboratory tests. BS EN ISO 22475-1[4] describes three generic sample groups that are:

a. Sampling by drilling. Generally, a disturbed sample recovered from the drilling tool or digging equipment, typically meeting Class 3 to Class 5 requirements, with the recovered material being stored in bulk bags or sealed jar or tub containers.
b. Sampling by sampler. Typically referred to as open tube or drive sampling in which a tube with a sharp cutting edge is driven into the ground either by static thrust or dynamically driven to give a relatively undisturbed sample of Class 1 or Class 2 but may result in a Class 3 sample.
c. Block sampling. Cylindrical large diameter samples or cuboid hand-cut samples usually relatively undisturbed Class 1 and Class 2.

The open-tube sampling equipment used on the site was of a type and design that conformed to BS EN ISO 22475-1. For the purpose of this ground investigation block sampling was not required.

Generally, samples were assessed on site and any unexpected deterioration in sample quality was reported to the ground engineer by the lead drilling technician.

Sufficient and representative samples were taken to allow the geo-mechanical properties of the ground to be adequately characterised and to enable the sequence of soil strata to be described by an engineering geologist or geotechnical engineer.

Where samples have been taken for chemical tests the drilling method attempted to adopt dry drilling over the sampling range that generally was achieved by the use of drill casing to separate and isolate the upper soil layers and exclude groundwater. Cross-contamination was further reduced by regular cleaning of sampling tools. Sample integrity was maintained by sealing samples immediately on collection and storing the samples in a temperature controlled cool box. Samples were despatched from the site at the end of the shift on which they were collected or as required in the project specification. Details of best practice storage, preservation and decontamination measures undertaken are given below:

Task	Soil	Groundwater	Ground Gas
Storage	Glass jars and vials supplied by the laboratory were used for the	Glass vials supplied by the laboratory were used for the collection of	1.4L Canisters supplied by the laboratory.

	collection of soil samples to be analysed for volatile compounds. Plastic one-litre tubs were used to collect soil samples for metals analysis.	samples to be analysed for volatile compounds. Samples to be analysed for lower volatility compounds were stored in laboratory prepared glass bottles.	
Preservation	Filling of sample containers as far as practicable to minimise headspace and low storage temperature to minimise the potential for volatilisation and biodegradation of petroleum hydrocarbon compounds prior to analysis.		Not required.
Decontamination	Disposable gloves were worn and changed between sample collection to prevent cross-contamination.	Groundwater samples were collected using dedicated disposable tubing / bailers, that were changed between monitoring well locations in order to prevent cross-contamination.	Disposable gloves were worn and changed between sample collection to prevent cross contamination.
Transport	Samples stored in dedicated sample boxes provided by the laboratory. Sample details and analytical requests were recorded on the laboratory chain of custody form included with samples, prior to dispatching to laboratory for analysis. Samples were dispatched to the laboratory on the day of sampling.		

E3 Sample Description

Sample description was undertaken by the Arcadis site geologist in accordance with BS 5930: 2015. The descriptions of the individual samples were used to identify the sequence of strata at the exploratory hole location and from which representative exploratory hole logs were drawn.

E4 *In situ* Testing

In situ geotechnical tests were undertaken taking account of the investigation scope and requirement to attain the appropriate parameters required in the geotechnical design. The tests were undertaken in accordance with the requirements of the relevant parts of BS EN ISO 22476 [5, 6, 7] and other methods as follows:

Dynamic probing

Dynamic probes were undertaken in general accordance with BS EN ISO 22476-2, BS EN 1997-2 and the national annex to BS EN 1997. The tests were generally made using the super-heavy DPSH-B configuration of the apparatus, however, it should be noted that the basis for selection of the type of dynamic probe should be a consideration of the driving energy in relation to the type of ground conditions anticipated at the site.

Where adequate correlation with borehole data is available an interpretation of the estimated soil type may be made, however, it should be noted that probing can give unreliable results in mixed soils.

E5 Data Transfer Format

The data collated during the ground investigation has been organised and managed using the “AGS data format” that allows data transfer between different disciplines and organisations in accordance with BS 8574 [10].

E6 References

1. BS EN 1997-1. 2004. Eurocode 7: Geotechnical Design. Part 1 General Rules. British Standards Institution, 2013 (revised text).
2. BS EN 1997-2. 2007. Eurocode 7: Geotechnical Design. Part 2 Ground Investigation and testing. British Standards Institution, 2010 (revised text).
3. BS 5930: 2020. Code of practice for ground investigation. British Standards Institution.
4. BS EN ISO 22475-1. Geotechnical investigation and testing – Sampling methods and groundwater measurements – Part 1 Technical principles for execution.
5. BS EN ISO 22476-1:2015. Geotechnical investigation and testing – Field testing – Part 1: Electrical cone and piezocone test. British Standards Institution
6. BS EN ISO 22476-2. Geotechnical investigation and testing – Field testing – Part 2: Dynamic Probing. British Standards Institution
7. BS EN ISO 22476-3 2005. Geotechnical investigation and testing – Field testing – Part 3: Standard penetration test. British Standards Institution
8. BS 1377-9. 1990. Methods of test for soils for civil engineering purposes. Part 9: In-situ tests. British Standards Institution.
9. TRL. 2004. Dynamic cone penetrometer tests and analysis. TRL Technical Report PR IN 277-04. Transport Research Laboratory, Crowthorne, England.
10. BS 8574. Code of practice for the management of geotechnical data for ground engineering projects.

APPENDIX G

Monitoring Results

Gas Monitoring Data																					
BH ID	Date	Time	Barometric pressure (mbar)	Relative borehole pressure (mbar)	Peak flow (litres / hour)	Steady flow (litres / hour)	Record Time	O2 %	CH4%	CO2%	CO	H2S	O2% MIN	CH4% MAX	CO2% MAX	CO MAX	H2S MAX	DTW Raw	DTB Raw	Dip point description	Comments	Weather
WS1103	2021-06-22	09:34:00	1020	0.23	0.1	-0.1	Final:	14.6	0	5	0	0	14.6	0	5	4	0	1.2	1.73	Ground Level	After development well became dry. Purge 2l. dtb is same.	Cloudy/ Raining
WS1104	2021-06-22	09:33:00	1019	-20.69	-2.5	0.6	Final:	18.9	0	1.4	1	0	18.9	0	1.4	1	0	0.9	2.4	Ground Level	8 mins to settle flow, gas reading failed 3x. Good condition. After development well became dry. Purge volume 3litre, dtb is same	Cloudy/ Raining
WS1106	2021-06-22	09:33:00	1020	28.88	3.8	0.3	Final:	20.3	0	1	9	0	20.2	0	1.1	9	0	1.1	2.29	Ground Level	Gas pump failed, after development well became dry. purged 2l, dtb is same.	Cloudy/ Raining

APPENDIX H

Geotechnical Data

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.4 and 5

Client:	Arcadis Consulting (UK) Ltd	Client Reference:	10046791
Client Address:	HCL House, St Mellon's Business Park, Cardiff, CF3 OEY	Job Number:	21-82838
		Date Sampled:	03/06/2021
		Date Received:	14/06/2021
Contact:	Ross Scammell	Date Tested:	29/06/2021
Site Address:	LBBD Wheel Farm Drive	Sampled By:	Client - A. Rendall

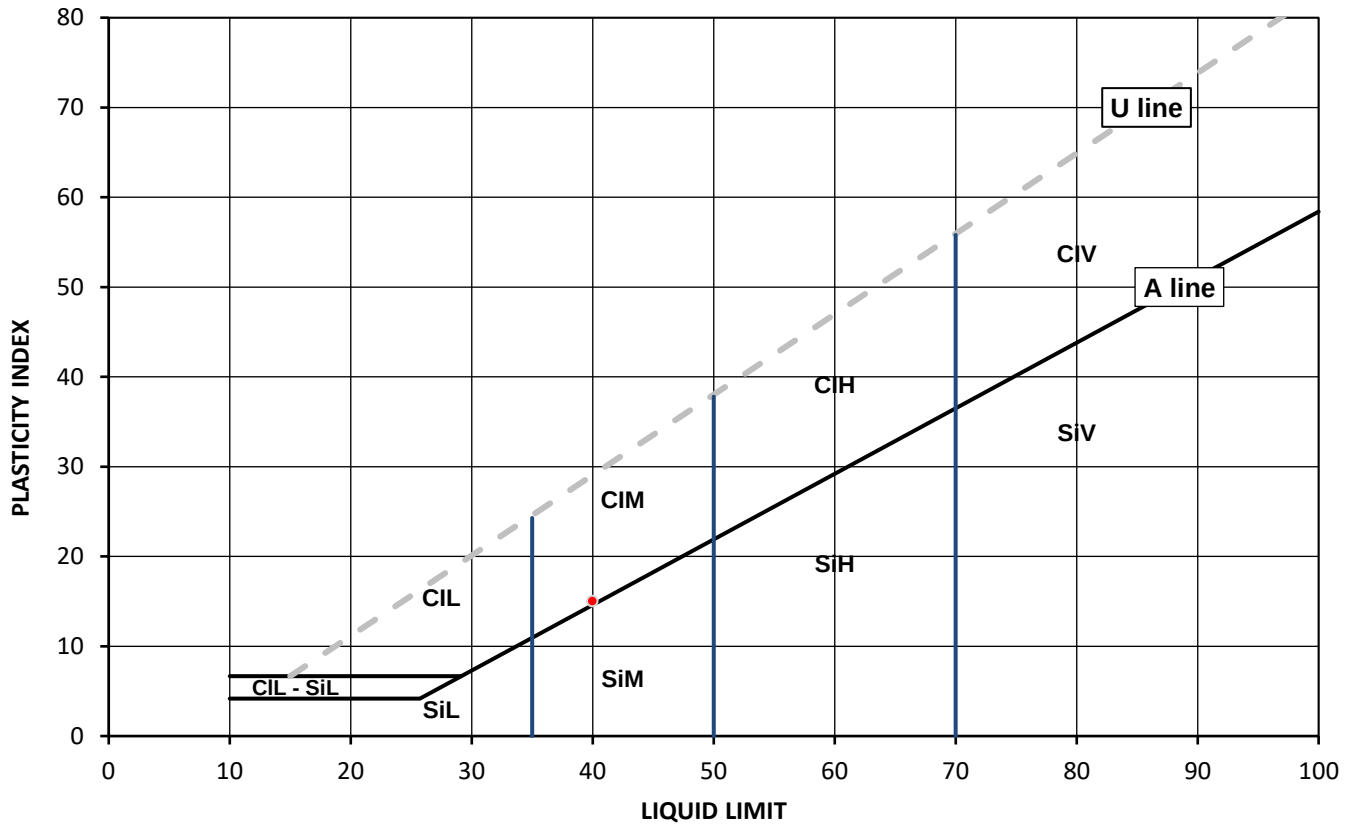
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1913914	Depth Top [m]:	0.40
Hole No.:	WS1104	Depth Base [m]:	1.20
Sample Reference:	Not Given	Sample Type:	B
Soil Description:	Brown gravelly clayey SAND		

Sample Preparation: Tested after washing to remove >425um

As Received Moisture Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	% Passing 425µm BS Test Sieve
12	40	25	15	58



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 08/07/2021

GF 232.10

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.4 and 5

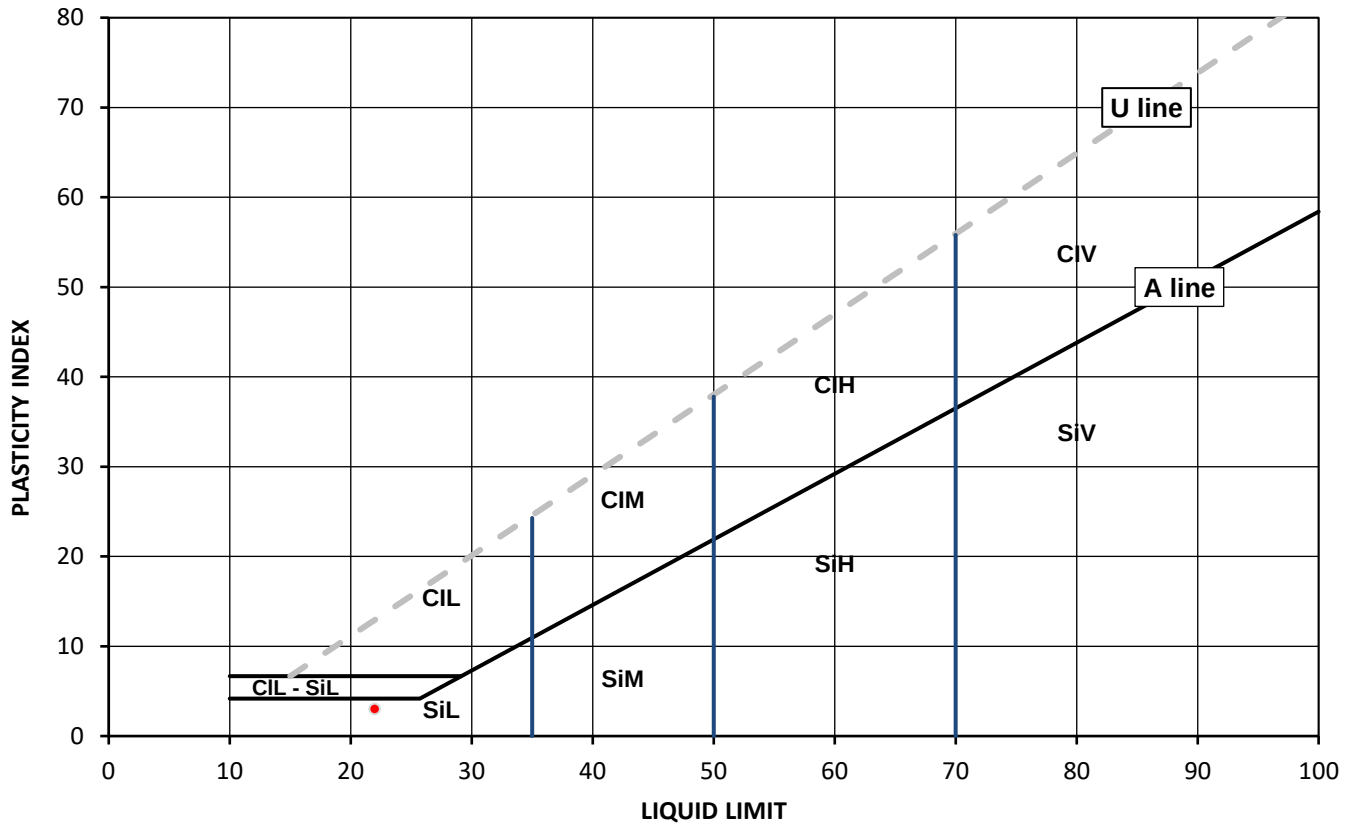
Client:	Arcadis Consulting (UK) Ltd	Client Reference:	10046791
Client Address:	HCL House, St Mellon's Business Park, Cardiff, CF3 OEY	Job Number:	21-82838
		Date Sampled:	03/06/2021
		Date Received:	14/06/2021
Contact:	Ross Scammell	Date Tested:	28/06/2021
Site Address:	LBBD Wheel Farm Drive	Sampled By:	Client - A. Rendall

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1913915	Depth Top [m]:	2.30
Hole No.:	WS1104	Depth Base [m]:	2.40
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Greyish brown gravelly clayey SAND		
Sample Preparation:	Tested after >425um removed by hand		

As Received Moisture Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	% Passing 425µm BS Test Sieve
11	22	19	3	53



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 08/07/2021

GF 232.10

SUMMARY REPORT

Summary of Classification Test Results

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Tested in Accordance with:

Moisture Content by BS 1377-2: 1990: Clause 3.2; Water Content by BS EN 17892-1: 2014; Atterberg by BS 1377-2: 1990: Clause 4.3 (4 Point Test), Clause 4.4 (1 Point Test) and 5; PD by BS 1377-2: 1990: Clause 8.2

Client: Arcadis Consulting (UK) Ltd

Client Address: HCL House, St Mellon's Business Park, Cardiff, CF3 OEY

Contact: Ross Scammell

Site Address: LBBD Wheel Farm Drive

Client Reference: 10046791
Job Number: 21-82838
Date Sampled: 03/06/2021
Date Received: 14/06/2021
Date Tested: 28/06 - 29/06/2021
Sampled By: Client - A. Rendall

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	Moisture Content [W]	Water Content [W]	Atterberg				Density			Total Porosity#		
		Reference	Depth Top m	Depth Base m	Type			%	%	% Passing 425um %	WL %	Wp %	Ip %	bulk Mg/m3	dry Mg/m3	PD Mg/m3	%		
1913914	WS1104	Not Given	0.40	1.20	B	Brown gravelly clayey SAND	Atterberg 1 Point	12		58	40	25	15						
1913915	WS1104	Not Given	2.30	2.40	D	Greyish brown gravelly clayey SAND	Atterberg 1 Point	11		53	22	19	3						

Note: # Non accredited; NP - Non plastic

Comments:

Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

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Date Reported: 08/07/2021

GF 234.12

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Client: Arcadis Consulting (UK) Ltd
Client Address: HCL House, St Mellon's Business Park, Cardiff, CF3 OEY
Contact: Ross Scammell
Site Address: LBBD Wheel Farm Drive

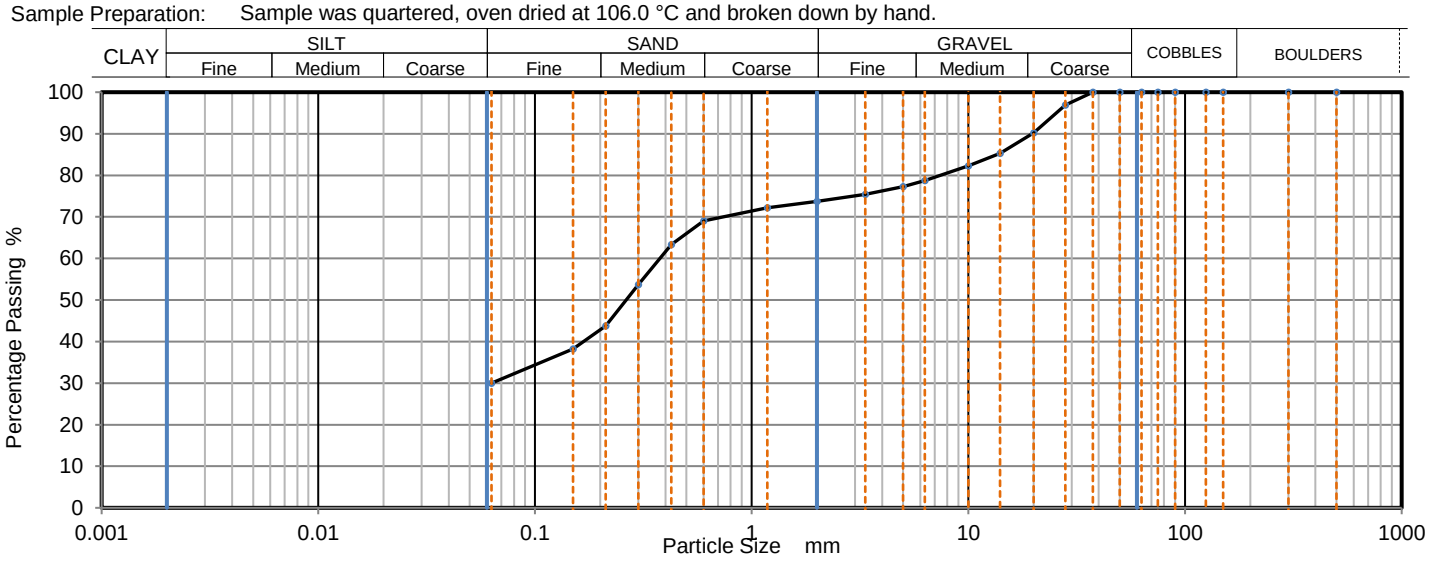
Client Reference: 10046791
Job Number: 21-82838
Date Sampled: 03/06/2021
Date Received: 14/06/2021
Date Tested: 29/06/2021
Sampled By: Client - A. Rendall

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 1913914
Hole No.: WS1104
Sample Reference: Not Given
Sample Description: Brown gravelly clayey SAND
Sample Preparation: Sample was quartered, oven dried at 106.0 °C and broken down by hand.

Depth Top [m]: 0.40
Depth Base [m]: 1.20
Sample Type: B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	90		
14	85		
10	82		
6.3	79		
5	77		
3.35	75		
2	74		
1.18	72		
0.6	69		
0.425	63		
0.3	54		
0.212	44		
0.15	38		
0.063	30		

Sample Proportions	% dry mass
Very coarse	0
Gravel	26
Sand	43
Fines <0.063mm	30

Grading Analysis		
D100	mm	37.5
D60	mm	0.377
D30	mm	
D10	mm	
Uniformity Coefficient		> 6
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 08/07/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

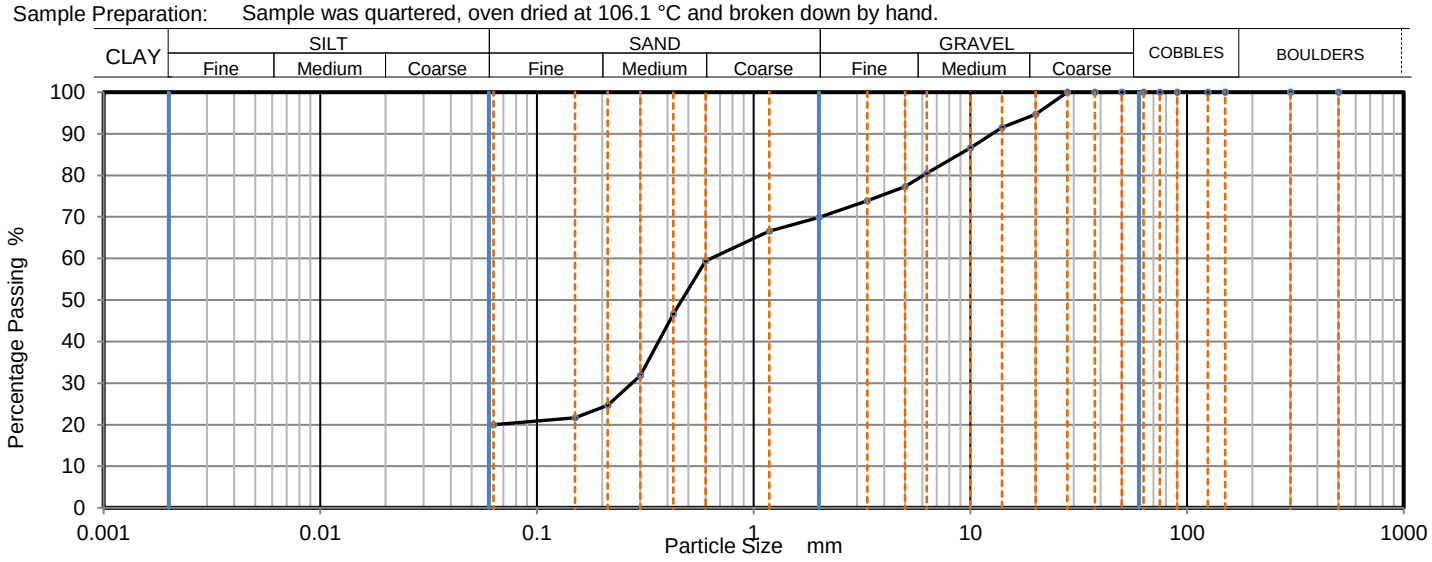
4041

Client:	Arcadis Consulting (UK) Ltd	Client Reference:	10046791
Client Address:	HCL House, St Mellon's Business Park, Cardiff, CF3 OEY	Job Number:	21-82838
		Date Sampled:	03/06/2021
		Date Received:	14/06/2021
Contact:	Ross Scammell	Date Tested:	29/06/2021
Site Address:	LBBD Wheel Farm Drive	Sampled By:	Client - A. Rendall

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1913912	Depth Top [m]:	0.50
Hole No.:	WS1103	Depth Base [m]:	1.20
Sample Reference:	Not Given	Sample Type:	B
Sample Description:	Brown clayey very gravelly SAND		
Sample Preparation:	Sample was quartered, oven dried at 106.1 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	95		
14	92		
10	87		
6.3	81		
5	77		
3.35	74		
2	70		
1.18	67		
0.6	59		
0.425	47		
0.3	32		
0.212	25		
0.15	22		
0.063	20		

Sample Proportions	% dry mass
Very coarse	0
Gravel	30
Sand	50
Fines <0.063mm	20

Grading Analysis		
D100	mm	28
D60	mm	0.634
D30	mm	0.274
D10	mm	
Uniformity Coefficient		> 10
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 08/07/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

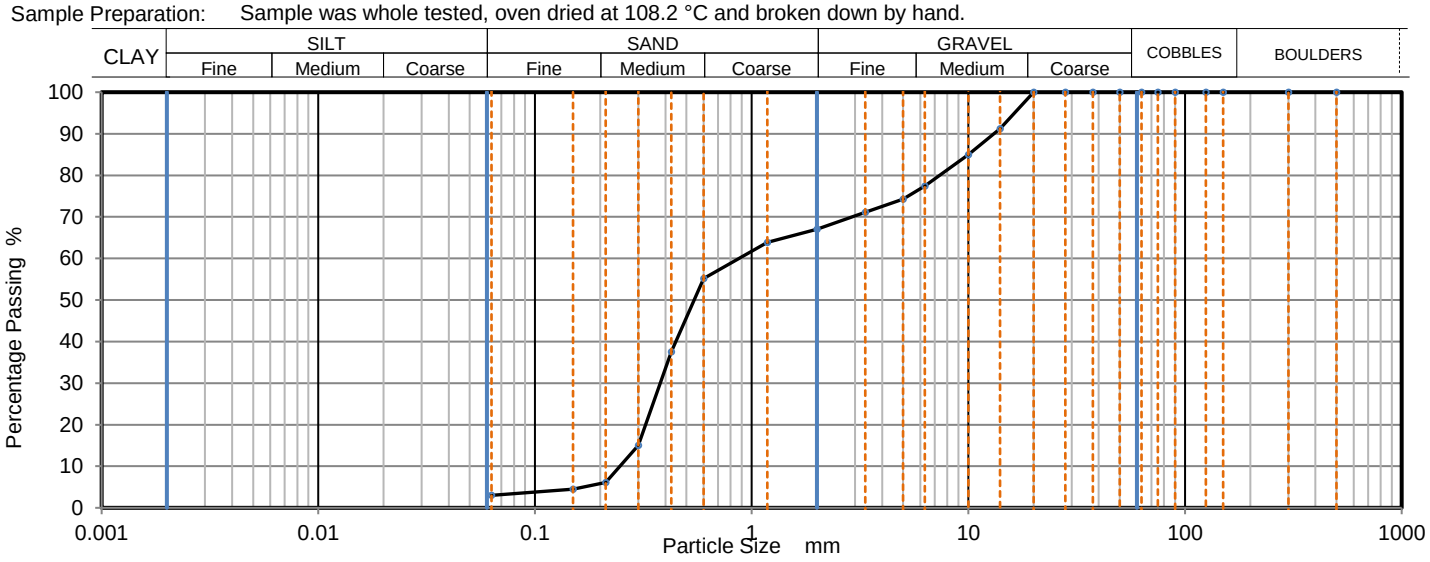
4041

Client:	Arcadis Consulting (UK) Ltd	Client Reference:	10046791
Client Address:	HCL House, St Mellon's Business Park, Cardiff, CF3 OEY	Job Number:	21-82838
		Date Sampled:	03/06/2021
		Date Received:	14/06/2021
Contact:	Ross Scammell	Date Tested:	28/06/2021
Site Address:	LBBD Wheel Farm Drive	Sampled By:	Client - A. Rendall

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1913913	Depth Top [m]:	1.60
Hole No.:	WS1103	Depth Base [m]:	1.70
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Brown slightly clayey very gravelly SAND		
Sample Preparation:	Sample was whole tested, oven dried at 108.2 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	91		
10	85		
6.3	77		
5	74		
3.35	71		
2	67		
1.18	64		
0.6	55		
0.425	38		
0.3	15		
0.212	6		
0.15	5		
0.063	4		

Sample Proportions	% dry mass
Very coarse	0
Gravel	33
Sand	63
Fines <0.063mm	4

Grading Analysis		
D100	mm	20
D60	mm	0.873
D30	mm	0.378
D10	mm	0.247
Uniformity Coefficient		3.5
Curvature Coefficient		0.66

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 08/07/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

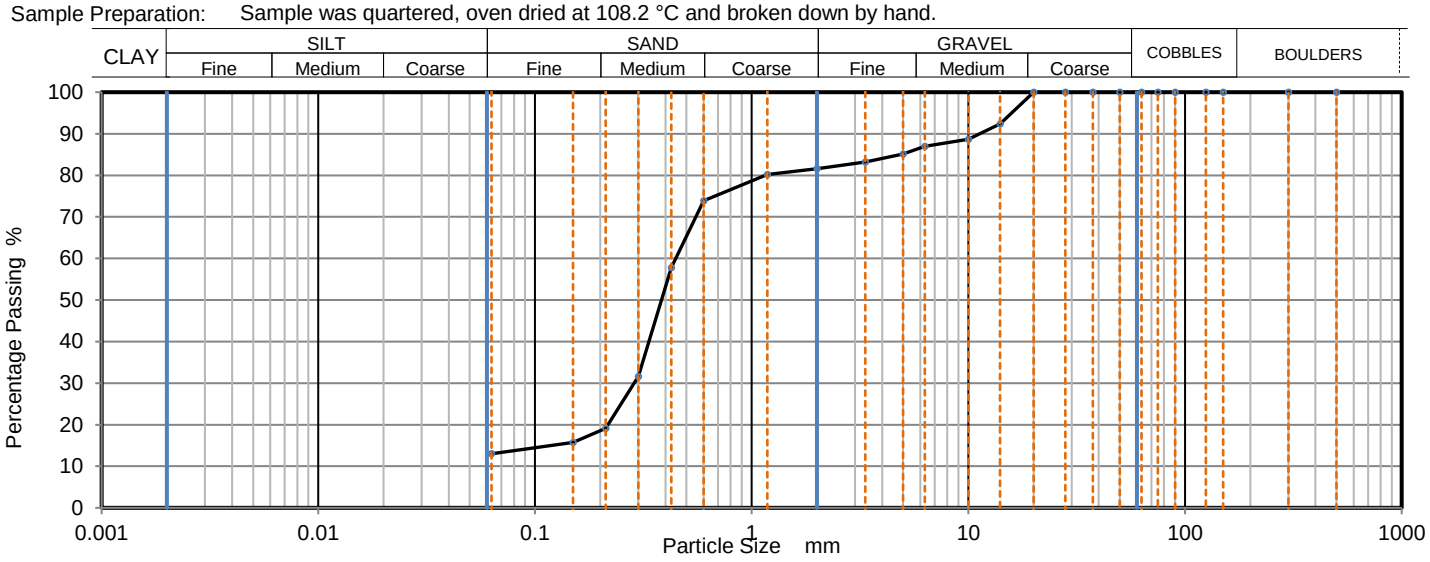
4041

Client:	Arcadis Consulting (UK) Ltd	Client Reference:	10046791
Client Address:	HCL House, St Mellon's Business Park, Cardiff, CF3 OEY	Job Number:	21-82838
		Date Sampled:	03/06/2021
		Date Received:	14/06/2021
Contact:	Ross Scammell	Date Tested:	28/06/2021
Site Address:	LBBD Wheel Farm Drive	Sampled By:	Client - A. Rendall

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1913915	Depth Top [m]:	2.30
Hole No.:	WS1104	Depth Base [m]:	2.40
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Greyish brown gravelly clayey SAND		
Sample Preparation:	Sample was quartered, oven dried at 108.2 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	92		
10	89		
6.3	87		
5	85		
3.35	83		
2	82		
1.18	80		
0.6	74		
0.425	58		
0.3	32		
0.212	19		
0.15	16		
0.063	14		

Sample Proportions	% dry mass
Very coarse	0
Gravel	18
Sand	68
Fines <0.063mm	14

Grading Analysis		
D100	mm	20
D60	mm	0.446
D30	mm	0.287
D10	mm	
Uniformity Coefficient		> 7.1
Curvature Coefficient		

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 08/07/2021

GF 100.20

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

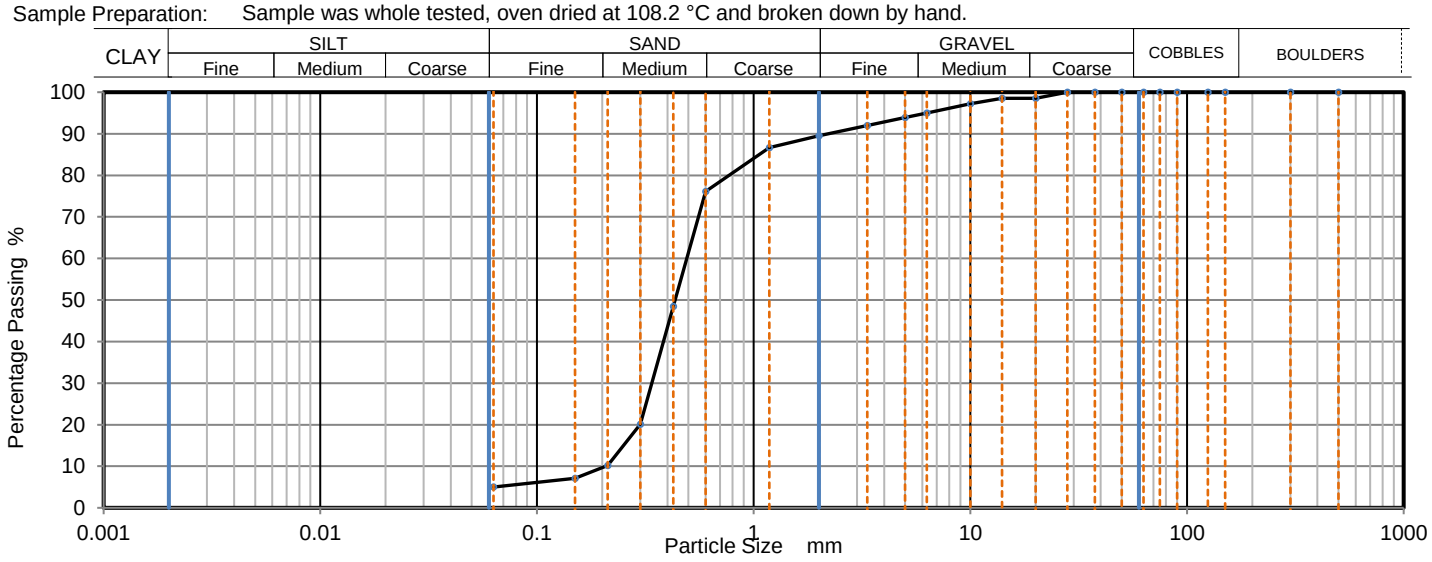
4041

Client:	Arcadis Consulting (UK) Ltd	Client Reference:	10046791
Client Address:	HCL House, St Mellon's Business Park, Cardiff, CF3 OEY	Job Number:	21-82838
		Date Sampled:	03/06/2021
		Date Received:	14/06/2021
Contact:	Ross Scammell	Date Tested:	28/06/2021
Site Address:	LBBD Wheel Farm Drive	Sampled By:	Client - A. Rendall

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1913916	Depth Top [m]:	3.20
Hole No.:	WS1106	Depth Base [m]:	3.30
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Brown slightly clayey gravelly SAND		
Sample Preparation:	Sample was whole tested, oven dried at 108.2 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	99		
14	99		
10	97		
6.3	95		
5	94		
3.35	92		
2	90		
1.18	87		
0.6	76		
0.425	49		
0.3	20		
0.212	10		
0.15	7		
0.063	5		

Sample Proportions	% dry mass
Very coarse	0
Gravel	11
Sand	84
Fines <0.063mm	5

Grading Analysis		
D100	mm	28
D60	mm	0.491
D30	mm	0.339
D10	mm	0.208
Uniformity Coefficient		2.4
Curvature Coefficient		1.1

Uniformity Coefficient and Coefficient of Curvature calculated in accordance with BS EN ISO 14688-2: 2004 + A1: 2013

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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Signed:

Szczepan Bielatowicz
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 08/07/2021

GF 100.20

Ross Scammell
Arcadis Consulting (UK) Ltd
HCL House
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Cardiff
CF3 OEY

t: 029 2092 6873

e: ross.scammell@arcadis.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 21-82842

Project / Site name:	LBBD Wheel Farm Drive	**Samples received on:**	12/06/2021
Your job number:	10046791	**Samples instructed on/ Analysis started on:**	12/06/2021
Your order number:	14051905	**Analysis completed by:**	02/07/2021
Report Issue Number:	1	**Report issued on:**	02/07/2021
Samples Analysed:	3 soil samples		

Signed: Karolina Marek

Karolina Marek
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 21-82842
Project / Site name: LBBD Wheel Farm Drive

Lab Sample Number				1913923	1913924	1913925
Sample Reference				WS1104	WS1106	WS1106
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.40-1.20	0.10-0.20	0.30-1.20
Date Sampled				03/06/2021	03/06/2021	03/06/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	8.7	8.0	11
Total mass of sample received	kg	0.001	NONE	1.0	0.50	2.0
General Inorganics						
pH - Automated	pH Units	N/A	MCERTS	7.8	10.6	7.9
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.014	0.16	0.032

U/S = Unsuitable Sample I/S = Insufficient Sample

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number : 21-82842
Project / Site name: LBBD Wheel Farm Drive

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1913923	WS1104	None Supplied	0.40-1.20	Brown sandy clay with gravel and vegetation.
1913924	WS1106	None Supplied	0.10-0.20	Brown sandy clay with gravel.
1913925	WS1106	None Supplied	0.30-1.20	Light brown clay and sand with gravel.

Analytical Report Number : 21-82842
Project / Site name: LBBD Wheel Farm Drive

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

APPENDIX I

Geo-environmental Data

Ross Scammell
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St Mellon's Business Park
Cardiff
CF3 OEY

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WD18 8YS

t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 21-79398

Project / Site name:	LBBD Wheel Farm Drive	**Samples received on:**	03/06/2021
Your job number:	10046791	**Samples instructed on/ Analysis started on:**	07/06/2021
Your order number:	14051905	**Analysis completed by:**	14/06/2021
Report Issue Number:	1	**Report issued on:**	14/06/2021
Samples Analysed:	5 soil samples		

Signed: Karolina Marek

Karolina Marek
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 21-79398
Project / Site name: LBBD Wheel Farm Drive

Lab Sample Number				1893869	1893870	1893871	1893872	1893873
Sample Reference				WS1103	WS1103	WS1104	WS1106	WS1106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30-0.40	0.60-0.70	0.50-0.60	0.20-0.30	0.40-0.50
Date Sampled				02/06/2021	02/06/2021	02/06/2021	02/06/2021	02/06/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	9.6	4.9	9.9	11	14
Total mass of sample received	kg	0.001	NONE	1.1	1.3	1.0	1.2	1.2
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	-	Not-detected	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.7	7.4	7.8	8.6	7.5
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.10	0.013	0.017	0.098	0.0084
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.9	-	-	0.9	-
Phenols by GC-MS								
Phenol	mg/kg	0.2	NONE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
2,4-Dichlorophenol	mg/kg	0.3	NONE	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	NONE	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
2-Chlorophenol	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
2-Methylphenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
2-Nitrophenol	mg/kg	0.3	NONE	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
4-Chloro-3-methylphenol	mg/kg	0.1	ISO 17025	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
4-Methylphenol	mg/kg	0.2	NONE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Total Phenols								
Total Phenols (GC-MS)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	1.2	1.0	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	3.2	3.1	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	3.9	3.2	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	36	29	0.36	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	8.9	7.2	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	52	43	0.68	0.59	< 0.05
Pyrene	mg/kg	0.05	MCERTS	39	32	0.78	0.61	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	27	22	0.41	0.37	< 0.05
Chrysene	mg/kg	0.05	MCERTS	23	21	0.57	0.29	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	24	16	0.74	0.35	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	9.2	8.1	0.35	0.14	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	20	15	0.52	0.23	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	12	8.9	0.32	0.24	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	3.7	3.0	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	10	8.3	0.46	0.27	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	273	221	5.19	3.09	< 0.80

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Analytical Report Number: 21-79398
Project / Site name: LBBD Wheel Farm Drive

Lab Sample Number				1893869	1893870	1893871	1893872	1893873
Sample Reference				WS1103	WS1103	WS1104	WS1106	WS1106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30-0.40	0.60-0.70	0.50-0.60	0.20-0.30	0.40-0.50
Date Sampled				02/06/2021	02/06/2021	02/06/2021	02/06/2021	02/06/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	9.6	16	12	14
Boron (water soluble)	mg/kg	0.2	MCERTS	1.5	0.5	0.6	0.4	0.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	25	18	33	27	38
Copper (aqua regia extractable)	mg/kg	1	MCERTS	29	6.1	10	26	13
Lead (aqua regia extractable)	mg/kg	1	MCERTS	72	12	13	100	16
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	18	13	16	14	28
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	82	24	35	70	51
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	-	-	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	-	-	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	-	-	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	-	-	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	-	-	< 1.0	< 1.0
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	-	-	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	-	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	-	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	-	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	-	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	-	-	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	-	-	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	-	-	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	-	-	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	-	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	-	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	-	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	9.2	-	-	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	140	-	-	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	260	-	-	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	410	-	-	10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample

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Analytical Report Number : 21-79398
Project / Site name: LBBD Wheel Farm Drive

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1893869	WS1103	None Supplied	0.30-0.40	Brown loam and clay with gravel.
1893870	WS1103	None Supplied	0.60-0.70	Brown sandy loam with gravel.
1893871	WS1104	None Supplied	0.50-0.60	Brown clay and sand with gravel and vegetation.
1893872	WS1106	None Supplied	0.20-0.30	Brown clay and loam with gravel.
1893873	WS1106	None Supplied	0.40-0.50	Brown clay and loam with gravel.

Analytical Report Number : 21-79398
Project / Site name: LBBD Wheel Farm Drive

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Phenols, speciated, in soil, by GCMS	Determination of speciated phenols in soil by extraction in dichloromethane and hexane followed by GC-MS.	In-house method based on USEPA 8270	L064-PL	D	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Analytical Report Number : 21-79398
Project / Site name: LBBD Wheel Farm Drive

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

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Analytical Report Number : 21-83547-2B

Replaces Analytical Report Number: 21-83547, issue no. 1
Report format change.

Project / Site name:	LBBD Wheel Farm Drive	**Samples received on:**	25/06/2021
Your job number:	10046791	**Samples instructed on/ Analysis started on:**	25/06/2021
Your order number:		**Analysis completed by:**	09/07/2021
Report Issue Number:	2	**Report issued on:**	09/07/2021
Samples Analysed:	3 water samples		

Signed:

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 21-83547-2B
Project / Site name: LBBD Wheel Farm Drive

Lab Sample Number				1918189	1918190	1918191
Sample Reference				WS1103	WS1106	WS1104
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.50	2.00	1.75
Date Sampled				24/06/2021	24/06/2021	24/06/2021
Time Taken				1320	1330	1345
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
General Inorganics						
pH	pH Units	N/A	ISO 17025	6.8	7.2	7.3
Total Cyanide	µg/l	10	ISO 17025	28	< 10	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10
Sulphate as SO4	mg/l	0.045	ISO 17025	10.1	87.1	46.6
Alkalinity as CaCO3	mg/l	3	ISO 17025	120	220	190
Phenols by HPLC						
Catechol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5
Resorcinol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5
Ethylphenol & Dimethylphenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5
Cresols	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5
Naphthols	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5
Isopropylphenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5
Phenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5
Trimethylphenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5
Total Phenols						
Total Phenols (HPLC)	µg/l	3.5	NONE	< 3.5	< 3.5	< 3.5
Speciated PAHs						
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Total PAH						
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16

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Analytical Report Number: 21-83547-2B
Project / Site name: LBBD Wheel Farm Drive

Lab Sample Number				1918189	1918190	1918191
Sample Reference				WS1103	WS1106	WS1104
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.50	2.00	1.75
Date Sampled				24/06/2021	24/06/2021	24/06/2021
Time Taken				1320	1330	1345
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Heavy Metals / Metalloids						
Boron (dissolved)	µg/l	10	ISO 17025	50	69	76
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0
Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.38	0.45	0.57
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.03	0.05	< 0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.9	1.4	1.2
Copper (dissolved)	µg/l	0.5	ISO 17025	2.9	6.2	6.0
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	3.6	12	4.5
Selenium (dissolved)	µg/l	0.6	ISO 17025	2.7	< 0.6	0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	4.4	6.9	4.5
Monoaromatics & Oxygenates						
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons						
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample

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Analytical Report Number : 21-83547-2B
Project / Site name: LBBD Wheel Farm Drive

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
Phenols, speciated, in water, by HPLC	Determination of speciated phenols by HPLC.	In house method based on Blue Book Method.	L030-PL	W	NONE
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Free cyanide in water	Determination of free cyanide by distillation followed by colorimetry.Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Sulphate in water	Determination of sulphate in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW, PrW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025
Alkalinity in Water (by discreet analyser)	Determination of Alkalinity by discreet analyser (colorimetry). Accredited matrices: SW, PW, GW.	In house method based on MEWAM & USEPA Method 310.2.	L082-PL	W	ISO 17025

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Sample Deviation Report

Analytical Report Number : 21-83547
Project / Site name: LBBD

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
WS1103	None Supplied	W	1918189	c	pH at 20oC in water (automated)	L099-PL	c
WS1104	None Supplied	W	1918191	c	pH at 20oC in water (automated)	L099-PL	c
WS1106	None Supplied	W	1918190	c	pH at 20oC in water (automated)	L099-PL	c

Table 1												
Comparison of CoC in Soil with GAC												
				Sample ID	WS1103	WS1103	WS1104	WS1104	WS1106	WS1106	WS1106	WS1106
				Sample Depth	0.30-0.40	0.60-0.70	0.50-0.60	0.40-1.20	0.10-0.20	0.20-0.30	0.40-0.50	0.30-1.20
				Sample Date	02/06/2021	02/06/2021	02/06/2021	02/06/2021	02/06/2021	02/06/2021	02/06/2021	02/06/2021
				Residential With Plant Uptake								
Chem_Group	**ChemName**	**output unit**	**EQL**	**GAC (mg/kg)**								
Metals	Arsenic (aqua regia extractable)	mg/kg	1	37	12	9.6	16	-	-	12	14	-
	Boron (water soluble)	mg/kg	0.2		1.5	0.5	0.6	-	-	0.4	0.5	-
	Cadmium (aqua regia extractable)	mg/kg	0.2	11	< 0.2	< 0.2	< 0.2	-	-	< 0.2	< 0.2	-
	Chromium (hexavalent)	mg/kg	4	6	< 4.0	< 4.0	< 4.0	-	-	< 4.0	< 4.0	-
	Chromium (aqua regia extractable)	mg/kg	1	910	25	18	33	-	-	27	38	-
	Copper (aqua regia extractable)	mg/kg	1	2400	29	6.1	10	-	-	26	13	-
	Lead (aqua regia extractable)	mg/kg	1	220	72	12	13	-	-	100	16	-
	Mercury (aqua regia extractable)	mg/kg	0.3	1.2	< 0.3	< 0.3	< 0.3	-	-	< 0.3	< 0.3	-
	Nickel (aqua regia extractable)	mg/kg	1	130	18	13	16	-	-	14	28	-
	Selenium (aqua regia extractable)	mg/kg	1	250	< 1.0	< 1.0	< 1.0	-	-	< 1.0	< 1.0	-
	Zinc (aqua regia extractable)	mg/kg	1	3700	82	24	35	-	-	70	51	-
Asbestos	Asbestos in Soil	Type	N/A	-	Not-detected	-	-	-	-	Not-detected	Not-detected	-
Inorganics	pH - Automated	pH Units	N/A	-	7.7	7.4	7.8	7.8	10.6	8.6	7.5	7.9
	Total Cyanide	mg/kg	1	-	< 1.0	< 1.0	< 1.0	-	-	< 1.0	< 1.0	-
	Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	-	0.10	0.013	0.017	0.014	0.16	0.098	0.0084	0.032
	Total Organic Carbon (TOC)	%	0.1	-	1.9	-	-	-	-	0.9	-	-
	Stone Content	%	0.1	-	-	-	-	< 0.1	< 0.1	-	-	< 0.1
	Moisture Content	%	0.01	-	-	-	-	8.7	8	-	-	11
	Total mass of sample received	kg	0.001	-	-	-	-	1.0	0.5	-	-	2
Phenols	Phenol	mg/kg	0.2	280	< 0.2	< 0.2	< 0.2	-	-	< 0.2	< 0.2	-
	2,4,5-Trichlorophenol	mg/kg	0.2	-	< 0.2	< 0.2	< 0.2	-	-	< 0.2	< 0.2	-
	2,4,6-Trichlorophenol	mg/kg	0.1	-	< 0.1	< 0.1	< 0.1	-	-	< 0.1	< 0.1	-
	2,4-Dichlorophenol	mg/kg	0.3	-	< 0.3	< 0.3	< 0.3	-	-	< 0.3	< 0.3	-
	2,4-Dimethylphenol	mg/kg	0.3	-	< 0.3	< 0.3	< 0.3	-	-	< 0.3	< 0.3	-
	2-Chlorophenol	mg/kg	0.1	-	< 0.1	< 0.1	< 0.1	-	-	< 0.1	< 0.1	-
	2-Methylphenol	mg/kg	0.3	-	< 0.3	< 0.3	< 0.3	-	-	< 0.3	< 0.3	-
	2-Nitrophenol	mg/kg	0.3	-	< 0.3	< 0.3	< 0.3	-	-	< 0.3	< 0.3	-
	4-Chloro-3-methylphenol	mg/kg	0.1	-	< 0.1	< 0.1	< 0.1	-	-	< 0.1	< 0.1	-
	4-Methylphenol	mg/kg	0.2	-	< 0.2	< 0.2	< 0.2	-	-	< 0.2	< 0.2	-
	Total Phenols (GC-MS)	mg/kg	1	-	< 1.0	< 1.0	< 1.0	-	-	< 1.0	< 1.0	-
PAH 16	Naphthalene	mg/kg	0.05	2.3 [f]	< 0.05	< 0.05	< 0.05	-	-	< 0.05	< 0.05	-
	Acenaphthylene	mg/kg	0.05	170	1.2	1.0	< 0.05	-	-	< 0.05	< 0.05	-
	Acenaphthene	mg/kg	0.05	210	3.2	3.1	< 0.05	-	-	< 0.05	< 0.05	-
	Fluorene	mg/kg	0.05	170	3.9	3.2	< 0.05	-	-	< 0.05	< 0.05	-
	Phenanthrene	mg/kg	0.05	95	36	29	0.36	-	-	< 0.05	< 0.05	-
	Anthracene	mg/kg	0.05	2400	8.9	7.2	< 0.05	-	-	< 0.05	< 0.05	-
	Fluoranthene	mg/kg	0.05	280	52	43	0.68	-	-	0.59	< 0.05	-
	Pyrene	mg/kg	0.05	620	39	32	0.78	-	-	0.61	< 0.05	-
	Benzo(a)anthracene	mg/kg	0.05	7.2	27	22	0.41	-	-	0.37	< 0.05	-
	Chrysene	mg/kg	0.05	15	23	21	0.57	-	-	0.29	< 0.05	-
	Benzo(b)fluoranthene	mg/kg	0.05	2.6	24	16	0.74	-	-	0.35	< 0.05	-
	Benzo(k)fluoranthene	mg/kg	0.05	77	9.2	8.1	0.35	-	-	0.14	< 0.05	-
	Benzo(a)pyrene	mg/kg	0.05	2.2	20	15	0.52	-	-	0.23	< 0.05	-
	Indeno(1,2,3-cd)pyrene	mg/kg	0.05	27	12	8.9	0.32	-	-	0.24	< 0.05	-
	Dibenz(a,h)anthracene	mg/kg	0.05	0.24	3.7	3.0	< 0.05	-	-	< 0.05	< 0.05	-
	Benzo(ghi)perylene	mg/kg	0.05	32	10	8.3	0.46	-	-	0.27	< 0.05	-
	PAH 16 Total	mg/kg	0.8	-	273	221	5.19	-	-	3.09	< 0.80	-
TPH CWG	>C5-C6 Aliphatics	mg/kg	0.001	42	< 0.001	-	-	-	-	< 0.001	< 0.001	-
	>C6-C8 Aliphatics	mg/kg	0.001	100	< 0.001	-	-	-	-	< 0.001	< 0.001	-
	>C8-C10 Aliphatics	mg/kg	0.001	27	< 0.001	-	-	-	-	< 0.001	< 0.001	-
	>C10-C12 Aliphatics	mg/kg	1	130 (48) [vap]	< 1.0	-	-	-	-	< 1.0	< 1.0	-
	>C12-C16 Aliphatics	mg/kg	2	1100 (24) [sol]	< 2.0	-	-	-	-	< 2.0	< 2.0	-
	>C16-C21 Aliphatics	mg/kg	8	65000 (8.48) [f,sol]	< 8.0	-	-	-	-	< 8.0	< 8.0	-
	>C21-C35 Aliphatics	mg/kg	8	65000 (8.48) [f,sol]	< 8.0	-	-	-	-	< 8.0	< 8.0	-
	Total >C5-C35 Aliphatics	mg/kg	10	-	< 10	-	-	-	-	< 10	< 10	-
	>EC5-EC7 Aromatics	mg/kg	0.001	70	< 0.001	-	-	-	-	< 0.001	< 0.001	-
	>EC7-EC8 Aromatics	mg/kg	0.001	130	< 0.001	-	-	-	-	< 0.001	< 0.001	-
	>EC8-EC10 Aromatics	mg/kg	0.001	34	< 0.001	-	-	-	-	< 0.001	< 0.001	-
	>EC10-EC12 Aromatics	mg/kg	1	74	< 1.0	-	-	-	-	< 1.0	< 1.0	-
	>EC12-EC16 Aromatics	mg/kg	2	140	9.2	-	-	-	-	< 2.0	< 2.0	-
	>EC16-EC21 Aromatics	mg/kg	10	260 [f]	140	-	-	-	-	< 10	< 10	-
	>EC21-EC35 Aromatics	mg/kg	10	1100 [f]	260	-	-	-	-	< 10	< 10	-
	Total >EC5-EC35 Aromatics	mg/kg	10	-	410	-	-	-	-	10	< 10	-
BTEX	Benzene	mg/kg	1	0.087	< 1.0	-	-	-	-	< 1.0	< 1.0	-
	Toluene	mg/kg	1	130	< 1.0	-	-	-	-	< 1.0	< 1.0	-
	Ethylbenzene	mg/kg	1	47	< 1.0	-	-	-	-	< 1.0	< 1.0	-
	Xylene (m & p)	mg/kg	1	59	< 1.0	-	-	-	-	< 1.0	< 1.0	-
	Xylene (o)	mg/kg	1	60	< 1.0	-	-	-	-	< 1.0	< 1.0	-
Fuel oxygenates	MTBE	mg/kg	1		< 1.0	-	-	-	-	< 1.0	< 1.0	-

-	No water quality standard identified as suitable for deriving generic assessment criteria
<100	Concentation is below laboratory method detect limit
-	Sample not scheduled for analysis
100	Exceedance

Table 2							
Comparison of CoC in Groundwater with GAC							
				Sample ID	WS1103	WS1104	WS1106
				Sample Depth	1.50	1.75	2.00
				Sample Date	24/06/2021	24/06/2021	24/06/2021
				Water Resource Surface Water			
Chem_Group	**ChemName**	**output unit**	**EQL**	**GAC (µg/l)**			
Metals	Arsenic (dissolved)	µg/l	0.15	50	0.38	0.57	0.45
	Cadmium (dissolved)	µg/l	0.02	0.08 - 0.25	0.03	< 0.02	0.05
	Chromium (dissolved)	µg/l	0.2	4.7	0.9	1.2	1.4
	Copper (dissolved)	µg/l	0.5	1 [1]	2.9	6.0	6.2
	Lead (dissolved)	µg/l	0.2	1.2 [1]	< 0.2	< 0.2	< 0.2
	Mercury (dissolved)	µg/l	0.05	0.07	< 0.05	< 0.05	< 0.05
	Nickel (dissolved)	µg/l	0.5	4 [1]	3.6	4.5	12
	Selenium (dissolved)	µg/l	0.6	10	2.7	0.6	< 0.6
	Zinc (dissolved)	µg/l	0.5	12.1 [1,2]	4.4	4.5	6.9
	Boron (dissolved)	µg/l	10	2000	50	76	69
	Chromium (hexavalent)	µg/l	5	3.4	< 5.0	< 5.0	< 5.0
Inorganics	pH	pH Units	N/A	-	6.8	7.3	7.2
	Total Cyanide	µg/l	10	-	28	< 10	< 10
	Free Cyanide	µg/l	10	-	< 10	< 10	< 10
	Sulphate as SO4	mg/l	0.045	-	10.1	46.6	87.1
	Alkalinity as CaCO3	mg/l	3	-	120	190	220
Phenols	Catechol	µg/l	0.5	-	< 0.5	< 0.5	< 0.5
	Resorcinol	µg/l	0.5	-	< 0.5	< 0.5	< 0.5
	Ethylphenol & Dimethylphenol	µg/l	0.5	-	< 0.5	< 0.5	< 0.5
	Cresols	µg/l	0.5	-	< 0.5	< 0.5	< 0.5
	Naphthols	µg/l	0.5	-	< 0.5	< 0.5	< 0.5
	Isopropylphenol	µg/l	0.5	-	< 0.5	< 0.5	< 0.5
	Phenol	µg/l	0.5	7.7	< 0.5	< 0.5	< 0.5
	Trimethylphenol	µg/l	0.5	-	< 0.5	< 0.5	< 0.5
	Total Phenols (HPLC)	µg/l	3.5	-	< 3.5	< 3.5	< 3.5
PAH 16	Naphthalene	µg/l	0.01	2	< 0.01	< 0.01	< 0.01
	Acenaphthylene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Acenaphthene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Fluorene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Phenanthrene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Anthracene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Fluoranthene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Pyrene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Benzo(a)anthracene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Chrysene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Benzo(b)fluoranthene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Benzo(k)fluoranthene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Benzo(a)pyrene	µg/l	0.01	0.00017	< 0.01	< 0.01	< 0.01
	Indeno(1,2,3-cd)pyrene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Dibenz(a,h)anthracene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	Benzo(ghi)perylene	µg/l	0.01	-	< 0.01	< 0.01	< 0.01
	PAH 16 Total	µg/l	0.16	-	< 0.16	< 0.16	< 0.16
TPH CWG	>C5-C6 Aliphatics	µg/l	1	#	< 1.0	< 1.0	< 1.0
	>C6-C8 Aliphatics	µg/l	1	#	< 1.0	< 1.0	< 1.0
	>C8-C10 Aliphatics	µg/l	1	#	< 1.0	< 1.0	< 1.0
	>C10-C12 Aliphatics	µg/l	10	#	< 1.0	< 1.0	< 1.0
	>C12-C16 Aliphatics	µg/l	10	#	< 1.0	< 1.0	< 1.0
	>C16-C21 Aliphatics	µg/l	10	#	< 1.0	< 1.0	< 1.0
	>C21-C35 Aliphatics	µg/l	10	#	< 1.0	< 1.0	< 1.0
	Total >C5-C35 Aliphatics	µg/l	10	#	< 1.0	< 1.0	< 1.0
	>EC5-EC7 Aromatics	µg/l	1	10	< 1.0	< 1.0	< 1.0
	>EC7-EC8 Aromatics	µg/l	1	74	< 1.0	< 1.0	< 1.0
	>EC8-EC10 Aromatics	µg/l	1	#	< 1.0	< 1.0	< 1.0
	>EC10-EC12 Aromatics	µg/l	10	#	< 1.0	< 1.0	< 1.0
	>EC12-EC16 Aromatics	µg/l	10	#	< 1.0	< 1.0	< 1.0
	>EC16-EC21 Aromatics	µg/l	10	#	< 1.0	< 1.0	< 1.0
	>EC21-EC35 Aromatics	µg/l	10	#	< 1.0	< 1.0	< 1.0
	Total >EC5-EC35 Aromatics	µg/l	10	-	< 1.0	< 1.0	< 1.0
BTEX	Benzene	µg/l	1	10	< 1.0	< 1.0	< 1.0
	Toluene	µg/l	1	74	< 1.0	< 1.0	< 1.0
	Ethylbenzene	µg/l	1	20	< 1.0	< 1.0	< 1.0
	Xylene (m & p)	µg/l	1	30	< 1.0	< 1.0	< 1.0
	Xylene (o)	µg/l	1	30	< 1.0	< 1.0	< 1.0
Fuel oxygenates	MTBE	µg/l	1	15	< 1.0	< 1.0	< 1.0

-	No water quality standard identified as suitable for deriving generic assessment criteria
<100	Concentation is below laboratory method detect limit
-	Sample not scheduled for analysis
>SOL	Target acceptable risk not exceeded at theoretical solubility concentration
#	No GAC for individual TPH fractions given that the compliance criteria is for sum TPH
NR	No appropriate inhalation reference dose identified during review of toxicological data
-	No water quality standard identified as suitable for deriving generic assessment criteria
NVP	Contaminant has low vapour pressure in groundwater
U/S	Unsuitable Sample

APPENDIX J

Limitations

Study Limitations

IMPORTANT. This appendix should be read before reliance is placed on any of the information, opinions, advice, recommendations or conclusions contained in this report.

1 This report has been prepared by Arcadis (UK) Limited ('Arcadis'), with all reasonable skill, care and diligence within the terms of the Appointment and with the resources and manpower agreed with Be First Regeneration Limited (the 'Client'). Arcadis does not accept responsibility for any matters outside the agreed scope.

2 This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing. otherwise in writing. The contents of this report may not be used or relied upon by any person other than this party without the express written consent and authorisation of Arcadis.

3 Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. Arcadis is unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have unpublished, more stringent objectives. Further work may be required by these parties.

4 All work carried out in preparing this report has used, and is based on, Arcadis' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice, pending changes in legislation, of which Arcadis is aware, have been considered. Following delivery of the report, Arcadis has no obligation to advise the Client or any other party of such changes or their repercussions.

5 This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.

6 Whilst this report and the opinions made are correct to the best of Arcadis' belief, Arcadis cannot guarantee the accuracy or completeness of any information provided by third parties. provided by third parties. Arcadis has taken reasonable steps to ensure that the information sources used for this assessment provided accurate information and has therefore assumed this to be the case.

7 This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have been received.

8 This report refers, within the limitations stated, to the condition of the Site at the time of the inspection. No warranty is given as to the possibility of changes in the condition of the Site since the time of the investigation.

9 The content of this report represents the professional opinion of experienced environmental consultants. Arcadis does not provide specialist legal or other professional advice. The advice of other professionals may be required.

10 Where intrusive investigation techniques have been employed, they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. In some cases, the investigation is further limited by Site operations, underground obstructions and above ground structures. Unless otherwise stated, areas beyond the boundary of the Site have not been investigated.

11 If below ground intrusive investigations have been conducted as part of the scope, safe location of exploratory holes has been carried out with reference to the Arcadis ground disturbances procedure. No guarantee can be given that all services have been identified. Additional services, structures or other below ground obstructions, not indicated on the drawing, may be present on Site.

12 Unless otherwise stated the report provides no comment on the nature of building materials, operational integrity of the facility or on any regulatory compliance issues.

13 Unless otherwise stated, an inspection of the Site has not been undertaken and there may be conditions present at the Site which have not been identified within the scope of this assessment.

14 Unless otherwise stated, samples from the Site (soil, groundwater, building fabric or other samples) have not been obtained.

15 Arcadis has relied upon the accuracy of documents, oral information and other material and information provided by the Client and others, and Arcadis assumes no liability for the accuracy of such data, although in the event of apparent conflicts in information, Arcadis would highlight this and seek to resolve.

16 Unless otherwise stated, the scope of works has not included an environmental compliance review, health and safety compliance review, hazardous building materials assessment, interviews or contacting Local Authority, requests for information to the petroleum officer, sampling or analyses of soil, ground water, surface water, air or hazardous building materials or a chain of title review.

17 Unless otherwise stated, this assessment has considered the ongoing use of the Site and has not been prepared for the purposes of redevelopment which may act as a trigger for Site investigation and remediation works not needed for ongoing use

APPENDIX K

Risk Assessment Methodology

CONCEPTUAL SITE MODEL

General

The aim of the initial conceptual model and risk assessment is to provide a preliminary identification of the risks to controlled waters, proposed future site users and the surrounding area posed by any contamination present on site. The assessment is based on identification of 'contaminant linkages', i.e. contaminant-pathway-receptor relationships. This approach accords with the guidance that accompanies Part 2A of the Environmental Protection Act of 1990 where land is considered to be contaminated when 'significant harm' is occurring, or where there is the 'significant possibility of significant harm' or where significant pollution of controlled waters is being, or is likely to be caused. In such cases the contaminant linkage itself is defined as being 'significant'.

A source of contamination and a pathway to receptors must be present for there to be a risk. The preliminary risk assessment assesses the strength of the link between the source, the pathway and the receptor.

Source - Contaminant that has potential to cause harm to environmental receptors. In a wider sense, sources can include particular ground conditions, for example the existence of redundant footings, which have the potential to impact on development proposals.

Pathway - The route by which the source is brought into contact with the receptor. This can include the transport of contamination via groundwater, wind-blown dust, vapours, excavation and deposition etc.

Receptor - Human beings, other living organisms, physical systems and built structures that could be affected by the source. A receptor will only be affected if a pathway from the source to the receptor is present. Groundwater and surface water systems can be considered as receptors in their own right as their quality is regulated by the statutory bodies, as well as being pathways for contaminant migration to other receptors.

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ENVIRONMENTAL RISK ASSESSMENT

Qualitative Methodology

The risk assessment considers the potential sources, receptors and pathways identified in the Conceptual Site Model.

The environmental assessment has been undertaken with due regard to Contaminated Land Guidance Documents issued by the Department of the Environment Food and Rural Affairs (DEFRA). The Guidance requires a risk-based approach; with the potential environmental risk assessed qualitatively using the 'source-pathway-target' contaminant linkage concept contained in Part 2A of the Environment Protection Act. Unless specifically stated as relating to 'Contaminated Land' as defined in the Environmental Protection Act 1990 (as amended), references to 'contamination' and 'contaminants' relate in general terms to the presence of potentially hazardous substances, in, on or under the subject site.

Based on information presented in

- CIRIA C552 (2001) Contaminated Land Risk Assessment: A guide to good practice; and
- NHBC / EA/ CIEH (2008) R&D Publication 66: (Volume 1) Guidance for the Safe Development of Housing on Land Affected by Contamination
- DEFRA (2012) Environmental Protection Act 1990: Part 2A. Contaminated Land Statutory Guidance

Risk assessment considers the identified sources, the potential receptors and the pathways linking them together.

The designation of risk is based upon the consideration of both:

a. **the severity of the potential consequence -** this takes into account both the potential severity of the hazard and the sensitivity of the receptor
b. **the magnitude of probability** (i.e. likelihood) - this takes into account both the presence of the hazard and receptor and the integrity of the pathway

Severity (consequence) can be defined as the adverse effects (or harm) arising from a defined hazard, which impairs the quality of human health or the environment in the short or longer term. Definitions of different categories of severity are detailed in Table 1 below.

Probability can be defined as the chance of a particular event occurring in a given period of time. Definitions of different categories of probability are detailed in Table 2 below.

A contaminant linkage must first be established before tests for probability and consequence are applied. If there is no contaminant linkage then there is no potential risk.

Table 1 - Classification of Potential Consequence (Severity)

	Human Health	Controlled Water	Built Environment[1]	Ecosystems[2]
Severe	Short term (acute) risk to human health. Concentrations present likely to result in "significant harm" as defined by Part 2A.	Substantial pollution of sensitive water resources.	Catastrophic damage to buildings, structures or the environment, including building collapse.	Major damage to aquatic or other ecosystem, which is likely to result in a substantial adverse change or irreversible change in its functioning or harm to a species of special interest.
Medium	Chronic damage to human health. Concentrations present that could result in significant harm.	Pollution of sensitive water resources or small scale pollution of sensitive water resources	Significant damage to buildings, structures or the environment making it unsafe to occupy, or damage that may impair a scheduled ancient monument.	Significant damage to aquatic or other ecosystems or organism forming part of an ecosystem that could endanger the long term maintenance of a population at that location.
Mild	Slight short term health effects to humans. Exposure to human health unlikely to lead to significant harm.	Pollution to non-sensitive water resources	Minor damage to sensitive buildings, structures, services or the environment.	Minor or short lived damage to aquatic or other ecosystems.
Minor	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.)	Insubstantial pollution to non-sensitive water resources	Easily repairable effects of damage to buildings or structures	Harm (although not necessarily significant harm which may result in financial loss or expenditure to resolve e.g. loss of plants in a landscape scheme).

1. Property includes crops including timber, produce grown domestically (gardens or allotments for consumption), livestock, other owned or domesticated animals or wild animals which are subject to shooting or fishing rights. It also includes buildings, meaning any structure or erection, but does not include plant or machinery within a building or buried services.
2. Where ecological system effects relate to a Site of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Marine Nature Reserve (MNR), and areas of Special Protection for Birds, a "European site", or any habitat or site afforded protection under the Wildlife & Countryside Act 1981 and The Conservation of Habitats and Species Regulations 2010, i.e. candidate Special Areas of Conservation, potential Special Protection Areas and listed Ramsar sites.

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Table 2 Classification of Probability

(Only applies if there is a possibility of a contaminant linkage being present)

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

Table 3 Classification of Risk

Once the severity and probability have been classified for a contaminant linkage they can be compared to produce a risk category from very high risk to very low risk as shown in the matrix below.

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

Table 4 Risk Classification Descriptions

Table 4 below describes the risk classifications.

Risk Term	Description
Very High Risk	There is a high probability that significant harm could arise to a designated receptor from an identified hazard at the site without appropriate remedial action or there is evidence that significant harm to a designated receptor is already occurring.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remedial action. Remediation works may be necessary in the short-term and are likely over the longer term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However it is either relatively unlikely that any such harm would be severe or if any harm were to occur it is more likely that such harm would be relatively mild. Some remediation work may be required in the longer term.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely, at worst, that this harm if realised would normally be mild. Any subsequent remediation works are likely to be relatively limited.
Very Low Risk	It is a low possibility that harm could arise to a receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.

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