

**DESK STUDY REPORT
FOR
VINE STREET,
GORTON**



REPORT STATUS SHEET

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APPENDIX A

DRAWINGS & FIGURES

- Site Location Plan, Dwg No AG3211-20-01
- Conceptual Site Model, Dwg No AG3211-20-02
- Topographic Land Survey, JLP Surveying, Dwg No S18-442
- Proposed Layout Drawing, Michael Stewart Architecture, Dwg No PL02 rev D

APPENDIX B

DESK STUDY DATA

- GroundSure Historical Maps
- GroundSure Enviro+Geo Insight Report
- Coal Authority Consultants Coal Mining Report

1.0 INTRODUCTION

An area of land adjacent to Vine Street, Gorton (the site) is being considered for redevelopment. The proposals for the site comprise the redevelopment of the existing site for a residential end use with associated car parking. Issue 2 of this report acknowledges the latest proposals for the site.

Applied Geology was appointed by Scott Hughes Design (the Engineer and Applied Geology's Client) to undertake a desk study/Phase I assessment in order to:

- Permit formulation of an opinion as to the potential for hazardous substances or conditions to exist on, at, or near the site at levels or in a situation likely to warrant mitigation or consideration appropriate to the intended end use proposed as stated above.
- Establish likely geological conditions and potential geotechnical constraints to aid safe and economic development design.
- support a future Planning Application.

The terms of reference/brief for the works were mutually developed between Scott Hughes Design and Applied Geology and are outlined in our proposal and estimate (ref: AG20-7444let001), dated 12th October 2020.

The scope of works undertaken by Applied Geology comprised:

- A site inspection and walkover survey.
- A review of the following desk study sources:
 - ❑ GroundSure – GeoInsight & EnviroInsight environmental databases.
 - ❑ GroundSure – MapInsight historical maps.
 - ❑ British Geological Survey (BGS) - published information & on-line borehole database.
 - ❑ Coal Authority Report (ref: 51002320896001).
 - ❑ Historical site investigation reports – provided by Client.
 - ❑ Manchester City Council Planning Portal.
- Assessment and reporting of the results of the works.

2.0 SITE DESCRIPTION AND PROPOSALS

2.1 General

The site is adjacent to Vine Street, Gorton, approximately 5.3km southeast of Manchester City centre. The Ordnance Survey grid reference for the centre of the site is 389261 396959 as shown on the Site Location Plan in Appendix A.

The site is roughly rectangular with dimensions of approximately 150m by 40m, with the western boundary tapering towards the west and covers circa 0.8ha. It is relatively flat topographically at 81m AOD, with a slight decline towards 80m AOD in the west. The western and northern boundaries slope steeply down towards a railway track at 72.5m AOD. A copy of the topographic survey drawing by JLP

Survey, drawing ref: S18-442, dated May 2018 is included in Appendix A for reference.

2.2 Walkover Survey

A site inspection/walkover was undertaken by Applied Geology on 1st December 2020. Access to the site was gained off Vine Street. At the time of the inspection, the site comprised a plot of vacant land with mounded material in the west. It is understood that unauthorised access had recently taken place at the site, resulting in deposition of the mounded material. The mounded material in the west measured 50m by 10m, tapering to 5m in width towards the east and generally 1.5-2m in height. The material comprised Made Ground (black clayey very gravelly sand. The gravel was angular to subangular, fine to coarse ceramic, glass, fabric, brick, concrete, metal, plastic, and wood). It was noted that large areas of the upper 0.05-0.1m had been scraped off the central southern portion of the site.

Alongside the mounded material was a roughly 6.5m by 4m excavation, approximately 3m in depth to the top of the water level, with an unknown depth below this. On the surface of the water a yellowish-brown oil was present and at ground level around the excavation. Following discussions with the on-site security, it is understood that an excavator breakdown had recently occurred (relating to the aforementioned unauthorised access). Therefore, it is possible that the substance observed is hydraulic oil from the excavated break down. It was noted that the quantity of mounded material does not appear to equal the amount of material removed from the excavation, therefore, it's not known where the excess material originated. Aerial imagery from 2020 shows mounded stockpiles within the south-central portion of the site, along with some fly tipping and patches of yellowish green-brown (potential oil contamination) colouration at the site surface.

Across the western tip of the site, beyond the mounded material, semi-mature beech trees and fly tipping (e.g., unlabelled clear plastic drums, plastic car parts, tyres, mattress and unknown bagged waste) were present at the surface. This area leads down a steep slope towards the adjacent railway line. Two raised manhole covers were present within the west, one of which had a broken cover with a metal access ladder – the base of which could not be seen and was estimated to be at least 5m in depth. No sound of running water was noted.

The northern boundary comprises a steep (roughly 60-70 degree) slope lined with semi-mature beech trees, with 2m high palisade fencing at the base, beyond which is a railway. At two main points on the slope, generally to the northwest, it was noted that significant fly tipping had occurred here too, including but not limited to: a large quantity of tyres, plastics, metals, fabrics, black bags of unknown household wastes, traffic cones, shopping trolleys, wood/pallets and a motorcycle.

The east of the site comprised a mix of semi-mature beech trees and what appeared to be 1-2m high western gorse shrubs. Immediately to the east was Vine Street, with mature beech trees.

The site was bounded to the south by a 1.8m high wooden fencing and to the southwest by 2m high palisade fencing, beyond which were residential housing and an industrial estate, respectively.



View across the northern central portion



View across the southern central portion



View towards the mounded material in the west



View of the oil contaminated excavation

It should be noted that Applied Geology does not provide arboricultural or specialist surveys for the detection of invasive plant species (such as Japanese Knotweed) or protected species of wildlife. The presence of Japanese Knotweed has been noted historically at the site. Therefore, it is recommended that a separate investigation/assessment by specialists is undertaken to confirm this.

2.3 Proposed Development

The proposals for the site comprise development of the existing land for residential end use comprising 25No houses (mix of terraced, detached, and semi-detached), with associated car parking and soft landscaping. The proposals are shown on the proposed site layout for outline planning, drawing ref: PL02 Rev D, by Michael Stewart Architecture, dated 8th December 2020, a copy of which is included in Appendix A.

3.0 DESK STUDY INFORMATION

3.1 Site History

The desk study findings are summarised below with the full Groundsure Report and selected Historical Ordnance Survey Maps included in Appendix B.

Map Date	On the Site	In the Vicinity of the Site
1848	The site is shown to comprise part of an open field.	The surrounding area generally comprises open fields with sporadic residential dwellings and industrial buildings (such as a Cotton Mill approx. 350m to the southwest). An east-west railway is shown to be present immediately to the north of the site.
1890/94	The site is now shown to comprise part of a railway line within the far west portion, orientated northwest southeast.	Iron and steel works are shown to be present approximately 175m to the west of the site. Residential development has

Map Date	On the Site	In the Vicinity of the Site
	The central west portion of the site is shown to also be part of the railway cutting. A signal box associated with the railway is present within the western tip of the site.	taken place from roughly 200m north. Ashton Canal – Stockport Branch is present 250m to the west. The Gorton Foundry and Gorton Locomotive Works are shown located from 500m west.
1905/09	No significant changes.	A 'Brick Works' is present immediately to the east and south, beyond the railway line. Residential development has taken place from 100m northeast, west, and south. The Gorton & Openshaw railway station is now present 100m west.
1916/22	The levels across the majority of the site, except the far east portion have been reduced to a similar level as the adjacent railway.	The 'Brick Works' to the south and east are no longer present and extensive residential development has taken place in all directions from roughly 100m. Vine Street is now present immediately east.
1933/34	No significant changes.	Three unlabelled square/rectangular buildings are now shown to be present approx. 50m to the southwest, beyond the railway line.
1949/56	Further earthworks, which appear to show further cutting, have taken place across the site.	An additional building is present approx. 50m southwest and is now labelled 'Packing Case Works'. Further residential development 100m south.
1957/68	The site appears to have been levelled, with two new unlabelled structures; a rectangular and square, are shown present within the west.	No significant changes.
1979/82	No significant changes.	Terraced housing 50m north has been redeveloped. The Ashton Canal (Stockport Branch) is no longer present, presumably infilled. The Gorton Foundry and Gorton Locomotive Works, 500m west, have been redeveloped to an industrial estate and market.
1985/91	No significant changes.	The residential properties immediately to the south of the site have been demolished.
2000/03	The railway line within the western portion of the site is no longer present (i.e., dismantled). The rectangular structure is no longer shown.	No significant changes.
2018	The central portion of the site is shown on aerial images to be used for the stockpiling of materials for the residential development immediately south.	Residential development takes place immediately south.
2020	Aerial imagery from 2020 shows mounded stockpiles within the southern central portion of the site, fly tipping, and patches of yellowish green-brown (potential oil contamination) at surface. During the walkover, it is noted that the western portion of the site now comprises stockpiled/mounded Made Ground materials and an open excavation.	No significant changes.

Summary

From the earliest map edition (1848), the site is shown to have been largely undeveloped and part of an open field, until a railway line is shown in the western portion from the 1890s. Cutting of the site appears to have taken place at several stages, associated with the development of the railway line and in the 1940/50s, likely relating to adjacent infrastructure/developments. Unknown structures were present during the 1950s, likely relating to the railway, and remaining until c.2000. Filling of the railway cutting is understood to have taken place following the dismantling of the railway in c.2000, which is also collaborated by available aerial imagery at this time.

From 1848, a railway line has been present immediately to the north of the site and the surrounding area largely comprised open fields and sporadic residential properties. Residential development in the general vicinity was being to develop in the 1890's, associated with the development of Gorton Foundry and Gorton Locomotive Works (and other industry), which were located roughly 500m to the west. A 'Brick Works' was present immediately east and 50m south in the early 1900's, and 'Works' have been present 50m southwest since the 1930's, Other than these, the surrounding area has largely comprised residential areas.

3.2 Anticipated Geology

Reference to the published 1:10,000 and 1:50,000 scale British Geological Survey (BGS) map, Sheet SJ89NE and '85' Manchester, and the BGS digital Geological Map of Great Britain, indicates that the site is underlain by Superficial strata comprising Glacial Till (typically firm to stiff sandy gravelly clay with cobbles and boulders). The Superficial Deposits are shown to be underlain by Permian aged Manchester Marls Formation. Made/Worked Ground is shown to be present on the site, associated with the historical railway line. Therefore, a variable and potentially significant thickness of Made Ground is expected to be present beneath the site. Further details of the anticipated geology are given in Section 3.12 of this report.

The BGS online archive was checked for records of relevant archived boreholes within or adjacent to the site and, no relevant data was available in close proximity to the site.

3.3 Mining History / Geological Cavities

The online Coal Authority Interactive Map Viewer indicates that site is located within a coal mining report area site is located within a coal mining reporting area. Reference to the Coal Authority Consultants Coal Mining Report (ref: 51002320896001, dated November 2020, included in Appendix B and the Coal Authority Interactive Map Viewer, however, indicate that the site does not lie within a development area risk area or within an area where probable historical underground coal mining has taken place.

There are no coal seams shown to sub-crop close to the surface beneath or within close proximity to the site. There are no recorded mine entries shown within 100m of the site boundary (nearest recorded approximately 2.1km to the west). In view of the above, the site is not considered at risk of surface instability due to historical underground coal workings.

Data provided within the GroundSure Report indicates that there are no recorded natural cavities within 500m of the site boundary and also that the site is not located in an area of recorded non-coal mining activities.

The nearest BritPits recorded site was located 90m to the east, at Abbey Hey Brick Works, a clay pit which has now ceased operations.

3.4 Natural Ground Stability Hazards

The GroundSure Report has classified the risk of various natural ground stability hazards, depending on the anticipated ground conditions on site.

The risk of ground dissolution of soluble rocks, shrink-swell of clays, running sand, collapsible deposits, landslides, and compressible rocks is considered to be negligible to very low.

3.5 Radon

The site is not indicated to be within a Radon Affected Area as defined by the Health Protection Organisation as less than 1% of the properties in the area are above the Action Level. As such, radon protection measures are not necessary for new developments at the site (BR211:2015).

3.6 Hydrology

There are no surface watercourses within 250m of the site. There are seven surface water abstractions within 2km of the site, the nearest active license is located 1.7km to the northwest, relating to 'general cooling' from the Ashton Canal.

There are no licensed discharges consents within 500m of the site.

The Environment Agency indicates that the site lies outside of any floodplains. The Risk of Flooding from Rivers and the Sea (RoFRaS Rating) is considered to be very low. The surface water flood risk (i.e., land naturally vulnerable to surface water ponding or flooding following extreme rainfall events) within the west and southwest tip of the site is modelled to be potentially greater than 1.0m depth (based on a 1 in 30-year rainfall event).

It should be noted that this report is not intended to be a full hydrological study and if a flood risk assessment is needed, additional analysis by other is recommended to confirm this aspect of the development.

3.7 Hydrogeology

The superficial aquifer designation maps indicate the Glacial Till to be a Secondary (undifferentiated) Aquifer. The bedrock aquifer designation maps indicate that the Manchester Marls Formation is a Secondary 'B' Aquifer.

There are no groundwater abstraction licenses or Source Protection Zones within 500m of the site boundary.

3.8 Ecology

Information from the ecological datasets included within the GroundSure Report indicate that the site does not lie within 500m of any ecologically sensitive areas.

If a full assessment of Environmental or Ecological aspects are required, it is recommended that other specialists are consulted.

3.9 Environmental Searches

Information from the environmental datasets included within the GroundSure Report indicates that there are no active/historical Environment Agency or Local Authority landfills within 500m of the site. There are four historical/recent closed waste sites. The recently closed waste site is located 253m to the west of the site, relating to a material recycling facility, closing in September 2000.

Information accessed from the Manchester city council Planning Portal includes approved applications in August 1997 and March 2000 (Application refs: 048674/FO/CENTL2/95 & 058161/FO/NORTH2/99) by British Rail Property Board & Railtrack Plc for the infilling of the former railway cutting with inert material to upper embankment level to provide area for redevelopment. No details regarding the infilling material or validations are included. It is noted that the March 2000 application is labelled 'Former railway cutting and sub-station'. Therefore, the sub-station may relate to the unlabelled structure identified in the northwest of the site during the historical mapping.

There are no records of Part A (1) or IPC Authorised Activities within 500m of the site boundary. Four Part A (2)/B Activities within 500m of the site, the nearest being 17m southwest of the site, relating to the respraying of road vehicles (historical permit).

Nine Environment Agency Recorded Pollution Incidents are shown within 500m of the site, the nearest located on site, relating to construction and demolition materials and wastes, dated 2001, recorded as a category 3 (minor) impact to land.

3.10 Current Industrial Land Uses

The following table summarises the contemporary Trade Directory (of potentially contaminative businesses and industrial features) entries within 250m of the site.

Category	Distance from site boundary	Principal Potential Contaminants
Infrastructure and Facilities, Repair and Servicing, Public Transport, Stations and Infrastructure	4m S, 41m SW, 92m W, 132m W, 237m NE, 239m E	Solvents, Heavy Metals, Petroleum Hydrocarbons, VOCs, Asbestos, Polychlorinated Biphenyls (age dependent)

3.11 Unexploded Ordnance (UXO) Risk

Available online information (Zetica Interactive Map) suggests that the site lies within an area of moderate risk from UXO. As such, it is recommended that a preliminary UXO risk assessment is undertaken prior to any further intrusive works at the site. The risk from UXO was not referenced in any of the historic reports for the site.

3.12 Historical Ground Investigations

Numerous historic ground investigations have been undertaken on the site, including the following:

- Basic Site Investigation Report by Cooper Associates, report ref: 3927br2, dated December 2006.
- Phase I & Phase II Geo-Environmental Site Investigation by Resource & Environmental Consultants (REC) Ltd, report ref: 44766p1r0, dated March 2013.

The following report has been produced for the adjacent plot to the south:

- Remediation & Enabling Works Strategy, by E3P, report ref: 10-019-R3, dated March 2017.

The reports by Coopers Associates, REC Ltd, and E3P were accessed online from the Manchester city council planning portal. All the pertinent details of the above reports are summarised below.

Basic Site Investigation Report by Cooper Associates, report ref: 3927br2, dated December 2006.

This report provides information for a proposed development comprising 62 No houses (mix of semi-detached and detached) with a new access road, landscaping, and car parking. The site predominantly covered the eastern portion of the current site only and a wider area to the south. The provided information suggests that the site boundary did not include the area of the historical railway. The summary below includes all locations.

Intrusive site investigation was undertaken by Coopers in January 2006 and comprised 9 No trial pits to depths of between 2.3m and 3.3m below ground level (bgl) and 11 No cable percussive boreholes (drilled by Geotechnics Ltd in March 2006) to depths of between 3.0m and 20.0m bgl. This report also references 5 No cable percussive boreholes undertaken by TBV Stanger in September 1994 to depths of between 2.15m and 10.0m bgl.

Made Ground was encountered from ground level to depths of between 4.8m and 10.2m bgl and generally comprised black clayey gravelly sand, with occasional cohesive lenses (reworked Glacial Till). The gravel comprised fine to coarse angular to subrounded brick, concrete, clinker, ash, slag, plastic, metal, timber, with frequent cobbles and boulders of concrete. Concrete obstructions were noted present throughout. A hydrocarbon odour was generally noted throughout the top 2m of the Made Ground, and at depths of 8.7m and 9.15m at one cable percussive borehole location.

The Made Ground was underlain by granular Glaciofluvial Deposits, which were in turn underlain by cohesive Glacial Till. The Glaciofluvial Deposits, generally comprising medium dense orangish brown slightly silty gravelly sand, were encountered from depths of between 3.4m and 10.2m, to depths of between 8.8m and 13.1m bgl. The Glacial Till generally comprised firm to very stiff brown slightly gravelly sandy clay, was encountered beneath the Glaciofluvial Deposits and were

proven to a maximum depth of 20m bgl. Solid strata of the Manchester Marls Formation were not encountered.

Groundwater seepages (as perched water) were noted during the trial pits between 1.3m and 2.8m bgl. Water strikes were encountered within the cable percussive boreholes at between 1.8m and 15.4m bgl. It is noted that most of the deeper groundwater strikes were encountered within the deeper sands (interpreted as natural). Groundwater monitoring over 9 months recorded deeper groundwater levels between 6m and 10m bgl.

The results of chemical testing undertaken on samples of the shallow Made Ground soil were screened against a residential with plant uptake end use. Only two relatively low elevations of benzo[a]pyrene were recorded against screening values applicable at the time, with the likely source being coal derived. No samples were taken where hydrocarbon odours were noted, with the recommendation of further testing. In addition to the benzo[a]pyrene, one elevation of arsenic (at 22mg/kg) was also noted within the shallow Made Ground. The presence of asbestos was not tested for.

Chemical testing of the groundwater was undertaken on a number of samples recorded slightly elevated concentrations of copper (up to 100µg/l) and benzo[a]pyrene (up to 7.1µg/l). No measurable hydrocarbons were recorded in any of the samples tested.

Gas monitoring was carried out on ten occasions over a 9-month period in standpipes installed between depths of 4m and 16m bgl (including dual-installations), which included three periods of low pressure. The results of the gas monitoring recorded methane up to a maximum concentration of 57.7% and carbon dioxide concentrations of up to 11.8%. Maximum flow rates were reported to be between 0.3l/hr and 0.8l/hr. It was therefore recommended that the site is classified as Characteristic Situation 3. Coopers noted that previous gas investigations in 1990, 1994, and 2000 by others had also recorded elevated concentrations of methane and carbon dioxide beneath the site. However, no further details of these historic investigations can be found within the Cooper Associates report or elsewhere.

The Human Health risk assessment recommended the implementation of a 600mm thick inert cover layer in private gardens, considering the lack of clean topsoil at the site. Controlled Waters were deemed not to be at risk from contamination.

A piled foundation with ground beams were generally recommended, owing to the presence of deep Made Ground. Piles in excess of 15m in length were anticipated, founded in the underlying glacial sands or clay. Pre-boring of the piles were deemed necessary due to the presence of obstructions within the Made Ground. Suspended floor slabs were recommended in all areas of the site.

With regard to buried concrete, a Design Sulphate Class of DS-1 and ACEC of AC-1s was generally recommended for the Made Ground and natural strata.

The Cooper Associates report concluded with the advice for further trial pitting and soil sampling for the potential presence of hydrocarbons and PAHs in the shallow Made Ground soils. In addition, it is noted that further gas monitoring may be required.

Phase I & Phase II Geo-Environmental Site Investigation by Resource & Environmental Consultants (REC) Ltd, report ref: 44766p1r0, dated March 2013.

This report provides information for a proposed development comprising a 46-bed hospital, incorporating 12 extra care rehabilitation apartments with associated soft landscaping and car parking. The site boundary was that of the current study and at the time of the investigation comprised a relatively flat plot of grassed land with a mix of immature and semi-mature trees, shrubs, and Japanese knotweed (noted along the centre and eastern boundary). The REC Ltd report also reviews the previous work by Cooper Associates.

Intrusive site investigation was undertaken by REC Ltd in January and March 2013 and comprised 20 No trial pits to depths of between 0.8m and 3.8m bgl, 4 No cable percussive boreholes to depths of between 0.5m and 7.5m bgl, and a single rotary borehole hole to 10.5m bgl.

Made Ground was encountered from ground level to depths of between 2.9m and 10.5m bgl, proven in BH101 and RBH101 only, and generally comprised dark brown clayey gravelly sand and dark brown gravelly sandy clay. The gravel comprised fine to coarse angular to subrounded brick, concrete, clinker, ash, fabric, plastic, metal, timber, with frequent cobbles and boulders of concrete. Concrete obstructions were noted present throughout.

The Made Ground was underlain by granular Glaciofluvial Deposits. The Glaciofluvial Deposits generally comprised medium dense orangish brown silty sand. Solid strata of the Manchester Marls Formation were not encountered.

Groundwater seepages (as perched water) were noted during the trial pits between 0.5m and 1.7m bgl. No water strikes were noted within the cable percussive boreholes. Groundwater monitoring within BH101 and RBH101 recorded groundwater levels between 7.14m and 9.57m bgl.

The results of chemical testing undertaken on samples of the shallow Made Ground soil were screened against a residential end use. Widespread elevations of PAHs (benzo[a]pyrene up to 17mg/kg and naphthalene up to 23mg/kg) and TPHs (C₂₁ – C₃₅ up to 30,000mg/kg) were encountered throughout the shallow Made Ground. The presence of chrysotile was noted within two samples; however, no quantification was provided.

No further groundwater testing was considered necessary following Cooper Associates' assessment.

Gas monitoring was carried out on two occasions in standpipes installed between depths of 0.5m and 10.5m bgl, both during periods of falling pressure. The results of the gas monitoring recorded methane up to a maximum concentration of 7.8%, and carbon dioxide concentrations of up to 0.5%. Maximum flow rates were reported to be between 0.1l/hr and 0.2l/hr. It was therefore recommended that the site is classified as Characteristic Situation 3 primarily based on the previous findings by Cooper Associates.

The Human Health risk assessment recommended the implementation of a 600mm thick inert cover layer in private gardens, considering the lack of clean topsoil at the site. The REC Ltd report recommended a soil vapour survey to quantify the

naphthalene vapour concentrations in respect of indoor inhalation pathways or, in lieu of this, a hydrocarbon membrane is installed.

A piled foundation or ground improvement were generally recommended as possible foundation solutions. However, owing to the presence of deep Made Ground with frequent obstructions, the REC Ltd report concludes that following enablement works to remove obstructions, ground improvement of the Made Ground would be the most practical foundation solution.

With regard to buried concrete, REC Ltd recommended a Design Sulphate Class of DS-1 and ACEC of AC-1s for the Made Ground and natural strata.

The REC Ltd report concludes with a recommendation for further investigation of the naphthalene elevation at the site with regards to indoor inhalation pathways. In addition, it is recommended that further gas monitoring be undertaken.

Remediation & Enabling Works Strategy, by E3P, report ref: 10-019-R3, dated March 2017.

This report provides information for a proposed development immediately adjacent to the south comprising 46 No low rise residential dwellings with associated access roads, parking, and landscaping. This report deals with the implementation of the remedial works for the development, however, the contamination and ground gas from the previous phase 2 ground investigation work is referenced, although not found to be available on the Planning Portal (Phase II Geo-Environmental Site Investigation, report ref: 10-019-R2, dated May 2014).

Made Ground was encountered up to depths of 9.0m bgl, generally comprised black clayey gravelly sand and black gravelly sandy clay. The gravel comprised fine to coarse angular to subrounded brick, concrete, clinker and plastic, with frequent cobbles and boulders of concrete. Obstructions were noted present throughout. Hydrocarbon and 'sweet' odours were noted at several locations.

Japanese Knotweed was identified in the central eastern portion of the site.

Perched groundwater was noted during the ground investigation works at between 0.8m and 2.5m bgl, and c.9.5m bgl in deeper rotary boreholes.

A Human Health risk assessment identified the presence of elevated concentrations of heavy metals, non-volatile PAHs, and trace asbestos fibres within the shallow Made Ground. Although no values are presented, it was deemed that the shallow Made Ground posed a risk to end-users. In addition, a localised naphthalene and TPH C₁₀ – C₁₆ 'hotspot' was identified at one location (0.3m in the south of the site), with the impacted area removed to mitigate any potential risk.

No significant risk to Controlled Waters was identified from groundwater samples collected from installed standpipes at the site.

Gas monitoring was carried out on seven occasions in six shallow standpipes (installed to depths of between 1.8m and 3.0m bgl). The results of the seven gas monitoring visits recorded methane up to a maximum concentration of 0.1%, and carbon dioxide concentrations of up to 5.0%. Flow rates were reported as a minimum flow of -6.55lhr. It was therefore recommended, based on two visits, that

the site can be classified as Characteristic Situation 2 or NHBC Amber 1. The gas monitoring results are summarised in a separate addendum report (report ref: 10-019-1c, dated March 2017). In a later letter report by E3P (ref: 10-019-L3, dated October 2019) it is noted that as the residential properties were developed with precast concrete (block and beam), which included the use of a subfloor void, then the gas risk was re-classified as NHBC Green based on the GSV's. Regardless of this, a gas membrane was installed at each plot.

The Human Health risk assessment recommended the implementation of a 600mm thick inert cover layer (450mm subsoil and 150mm topsoil) in areas of private gardens and 300mm inert cover in proposed areas of public open space to ensure the Human Health source-pathway-receptor linkage is broken to the end user.

The foundation solution comprised a programme of reprocessing and re-engineering of the upper 3m of Made Ground at each plot, proposed road, and driveways, to create a suitable platform to allow for raft foundations. All fill materials were subject to an earthwork's specification and in-situ testing programme to ensure suitability.

Further Historical Site Investigation Reports

These historical reports were provided to Applied Geology by the Client for information only and no reliance can be made on the contents.

Historical Investigation 1

The report provides supplementary information for a proposed development comprising a care home and assisted living apartments following on from the historical REC Ltd report. In particular, the report seeks to further assess the additional sampling requirements.

Intrusive site investigation was undertaken in July 2013 and comprised 3 No window sample boreholes to depths of between 1.6m and 3.15m bgl and 5 No machine excavated trial pits to depths of between 2.7m and 3.2m bgl. The window sample boreholes were located in areas where high ground gas was previously identified by Cooper Associates and the trial pits to obtain near surface samples. In addition, bulk gas and vapour analysis was undertaken in two of the window boreholes and BH08 (from Cooper Associates ground investigation).

Made Ground was encountered at all locations and generally comprised dark brown clayey sandy gravel. The gravel comprised fine to coarse angular to subrounded brick, concrete, clinker, tarmac, ash, clinker, glass, metal, plastic, with frequent cobbles and boulders of concrete. Concrete obstructions were noted present throughout. A hydrocarbon odour was generally noted throughout at each trial pit location, with PID concentrations recorded between less than detection (i.e., <0.1ppm) and 3.8ppm. Neither the natural glacial soils nor Manchester Marls Formation were encountered.

No groundwater was noted during the shallow ground investigation works. Groundwater monitoring recorded perched groundwater at 1.4m bgl at a single location.

The results of chemical testing undertaken on samples of the shallow Made Ground soil were screened against a residential without plant uptake end use. As per previous investigations, widespread elevations of PAHs (benzo[a]pyrene up to 25mg/kg and naphthalene up to 36mg/kg) and TPHs (total TPH up to 1,500mg/kg) were encountered throughout the shallow Made Ground. No further asbestos was detected.

No further groundwater testing was considered necessary following Cooper Associates' assessment.

Gas monitoring was carried out on two occasions in shallow standpipes. The results of the gas monitoring recorded methane up to a maximum concentration of 3.9%, and carbon dioxide concentrations of up to 6.2%. Flow rates were reported to be between less than 0.1l/hr. Bulk analysis of the installs identified maximum methane of 62ppm (0.0062%v/v) and carbon dioxide of 6.47%v/v. Carbon isotope analysis identified methane and carbon dioxide as biogenic in nature. Based on GSV's from the two visits, the gas risk was calculated to be Characteristic Situation 2. However, as a precaution, based on the REC Ltd results, it was recommended that the site is classified as Characteristic Situation 3 as per previous investigations.

The Human Health risk assessment recommended the implementation of a 450mm thick inert cover layer with a 100mm thick capillary break layer (i.e., MOT type 1 material), considering the lack of clean topsoil at the site. A Remediation Strategy report (ref: CL1148-03, dated August 2013) was completed for the site to ensure the Human Health source-pathway-receptor linkage is broken to the end user.

This report refers to the REC Ltd report for geotechnical aspects of the site.

Historical Investigation 2

This report provides information for a proposed development comprising a care home and twelve bungalows with a central hub, car parking, communal gardens, and landscaping. The report appears to act as a standalone report and doesn't incorporate the results of the previous investigations.

Intrusive site investigation was undertaken in August and September 2016 and comprised 3No cable percussive boreholes to depths of up to 10.2m bgl, 9No window sample boreholes up to a maximum depth of 4.0m bgl, and 6No machine excavated trial pits to a maximum depth of 0.9m bgl.

Made Ground was encountered at all locations up to depths of 8.5m and 9.0m bgl, generally comprised black clayey gravelly sand and black gravelly sandy clay. The gravel comprised fine to coarse angular to subrounded brick, concrete, clinker, tarmac, ash, clinker, glass, metal, plastic, with frequent cobbles and boulders of concrete. Obstructions were noted present throughout. Hydrocarbon and 'sweet' odours were noted at several locations.

The Made Ground was underlain by granular Glaciofluvial Deposits, proven to 9.45m and 10.2m bgl. The Glaciofluvial Deposits generally comprised medium dense yellowish brown mottled black clayey sand. Solid strata of the Manchester Marls Formation were not encountered.

Perched groundwater was noted during the shallow ground investigation works at 0.2m bgl in a single trial pit, and 8.5m and 9.0m bgl in the cable percussive boreholes. Groundwater monitoring recorded perched groundwater at 1.43m bgl in the shallow window sample installs and at 8.77m bgl in a deeper cable percussive installation.

The results of chemical testing undertaken on samples of the shallow Made Ground soil were screened against a residential without plant uptake end use. Elevations of PAHs (benzo[a]pyrene up to 41mg/kg), TPHs (C₂₁ – C₃₅ up to 7,000mg/kg), and a single exceedance of lead (2,11mg/kg) were encountered throughout the shallow Made Ground. No asbestos was detected.

No further groundwater testing was considered necessary, with the Conceptual Site Model rating the risk to Controlled Waters as very low.

Gas monitoring was carried out on two occasions in four shallow standpipes and two deeper standpipes. It is noted that four more visits are due, however, this are to be reported separately (and have not been made available to Applied Geology). The results of the two gas monitoring visits recorded methane up to a maximum concentration of 6.0%, and carbon dioxide concentrations of up to 3.4%. Flow rates were reported as a minimum flow of -4.0lhr. It was therefore recommended, based on two visits, that the site can be classified as Characteristic Situation 2 or NHBC Amber 2.

The Human Health risk assessment recommended the implementation of a 600mm thick inert cover layer to ensure the Human Health source-pathway-receptor linkage is broken to the end user. In addition, a hydrocarbon resistant membrane was recommended for all new developments to reduce the risk of vapour inhalation.

A piled foundation or ground improvement were generally recommended as possible foundation solutions. However, owing to the presence of deep Made Ground with frequent obstructions, this report concludes that following enablement works to remove obstructions, ground improvement of the Made Ground would be the most practical foundation solution. It is considered appropriate that suspended ground floor slabs be used.

With regard to buried concrete, a Design Sulphate Class of DS-1 and ACEC of AC-1 was recommended for the Made Ground and natural strata.

4.0 CONCEPTUAL SITE MODEL

4.1 Diagrammatical Illustration

The Conceptual Model for the site, showing the main elements of the surface and subsurface conditions and including the potential contaminant sources, pathways and receptors identified from the desk study information is presented in Appendix A as Drawing No AG3211-20-02. The potential sources, pathways and receptors are defined in the following sections:

4.2 Sources

On-site

- Made Ground associated with the former railway or historical filling/material storage has previously been shown to contain elevated concentrations of contaminants such as heavy metals, asbestos, petroleum hydrocarbons, oils, and polycyclic aromatic hydrocarbons (PAHs).
- Deep Made Ground has been shown to be a source of hazardous ground gases, primarily carbon dioxide and methane. Naphthalene has been previously identified in the Made Ground. VOCs may also be present from petroleum hydrocarbons, solvents etc.

Off-site

- Made Ground associated with the adjacent industrial land uses (to the west/southwest) or brick works (to the east/south) and other parts of the infilled railway embankment may contain mobile contaminants such as metals, hydrocarbons, phenols, and solvents which may pose a risk to Human Health and/or Controlled Waters, and/or could be a source of ground gas/vapours.

4.3 Pathways

Inhalation, Ingestion, Dermal Contact

- End users could be at risk from inhalation, ingestion, and dermal contact pathways if elevated concentrations of contaminants are present in sufficient concentrations.

Migration via Leaching

- Mobile or leachable contaminants within any Made Ground may migrate laterally and vertically via granular horizons into the Secondary Aquifers of the granular Glacial Till and Manchester Marls Formation.

Direct Contact

No direct contact pathway has been identified during previous site investigations.

4.4 Receptors

- End users (Human Health).
- The Secondary Aquifers are potentially receptors to any mobile contamination (Controlled Waters).
- Buried concrete, in respect of elevated concentrations of sulphates in the ground, if present. (Building Materials).

- Water supply pipes could be affected by hydrocarbon or solvent contamination, should any be present (Building Materials).

4.5 Source-Pathway-Receptor Linkage and Assessed Risks

The Conceptual Site Model is summarised in the table below along with the assessed risks.

Source	Pathway	Receptor	Risk*
Potential contaminants within Made Ground (heavy metal, asbestos, hydrocarbons/oils, PAHs) associated with the current and historical site usage (i.e., infilling of land).	Inhalation, ingestion, dermal contact.	End users	High
	Migration and Leaching	Secondary Aquifers	Low
	Direct Contact	Water supply pipes	Low
Ground gas from Made Ground – both on site and off site sources (methane, carbon dioxide, VOCs)	Migration into buildings and any excavations	End users	High

*** Definition of Risk Categories**

Negligible - Contaminants that might have unacceptable impact on key receptors, are unlikely to be present, or, no pathway is envisaged.

Low Risk: Contaminants may be present but are unlikely to be at levels to have unacceptable impact on key receptors, or pathways are likely to be minimal.

Medium Risk: Contaminants are probably present and might have an unacceptable impact on key receptors. Pathways may also be present therefore remedial measures may be necessary to reduce the risks.

High Risk – Contaminants probably or certainly present and pathways are probably also present. Therefore, contaminants are likely to have an unacceptable impact on key receptors and remedial measures are likely to be necessary to reduce the risks to acceptable levels.

5.0 DISCUSSION

5.1 Geo-environmental Issues

The desk study has indicated the potential for soil contamination and ground gas to be present at the site, generally associated with the historical site usage and infilling of railway cutting and other earthworks and historical land use in the immediate vicinity (i.e., wider landfill area, including former brick works). Although the risk is largely characterised by historic investigations, more recent stockpiling of material (as noted in 2018 from aerial images) and more recent tipping of waste on the site (as noted during the site walkover) should be investigated. The shallow Made Ground soils should also be investigated for the recent oil contamination observed.

The risk to Controlled Waters (Secondary Aquifers) will depend on the presence, nature and concentrations of any mobile contaminants within soil and groundwater beneath the site. However, given the likely presence of cohesive Glacial Till at depth and the previous investigations which have not established a risk, we envisage extensive remedial actions are unlikely to be necessary to protect groundwater. Some actions may be needed if (in particular) sources of hydrocarbons are identified in shallow soil or perched groundwater (as noted by the walkover) the ground investigation or subsequently during development.

Made Ground, on and off site, has been shown to be generating some ground gases. Historic reports have recommended Characteristic Situation 2 or 3 and NHBC Amber 2 classifications for the site. Therefore, it is recommended that the proposed development incorporate NHBC Amber 2, sub-floor ventilated voids, and a hydrocarbon resistant membrane at each plot.

5.2 Geotechnical Issues

A deeper foundation solution is likely to be utilised to support any new loads associated with the proposed development, with piling or ground improvement anticipated to be suitable options. A programme of enabling works, comprising the removal of obstructions, vegetation and drainage runs etc, will be required to prepare the site for piling or ground improvement operations.

The proximity and stability of the railway embankment will need to be taken into account and this may affect building locations and piling methodologies. Although no instability of the embankment was noted during the recent site walkover, a full slope stability assessment should be made. Monitoring of the embankment during construction may also be required.

Suspended slabs are likely to be required.

Re-engineering of the near surface Made Ground soils will probably be required to reduce settlements in areas of hardstanding (i.e., roads, paths and driveways). This could be done in conjunction with the preparation of working platforms at each plot/group of plots.

Considering the deep variable Made Ground, soakaway drainage is not recommended, therefore, discharge to main drainage system will be required. Runoff in wet weather conditions, both during and post-construction, will need to be controlled to prevent the weakening/erosion of the railway embankment.

Based on the previous reports, a Design Sulphate Class of DS-1 and ACEC of AC-1 is considered likely for any buried concrete at the site.

5.3 Recommendations

At this stage, it is recommended that a ground investigation comprising machine excavated trial pits is undertaken to confirm the initial conceptual model and to assess the near surface Made Ground soils. It is recommended that further cable percussive boreholes to c.20m bgl are undertaken to prove the base of the Made Ground in other areas and to derive parameters for a potential piled foundation design.

Considering the date of the historical reports and recent changes on site and off site, further ground gas monitoring is likely to be required, with both shallow and deep standpipe installations recommended. A series of driven continuous sampling boreholes may allow for shallow installations, if required. Discussions with the Local Authority may be anticipated to agree the required scope and subsequent gas risk assessment.

Engineering laboratory testing including soil classification and BRE Special Digest 1 concrete classification tests should be carried out to aid foundation design.

Chemical testing to include a suite of heavy metals, polycyclic aromatic hydrocarbons, VOCs, TPH, pH, asbestos screen and soil organic matter should be carried out on selected soil recovered during the ground investigation and the results assessed against relevant screening criteria.

Groundwater samples should be obtained (both from shallow soils for the recent oil contamination and deeper if present within response zone of standpipes) and tested for potential contaminants (or leachate testing of Made Ground soils if no groundwater). Additional specific investigation may be warranted based on visual and olfactory evidence during fieldwork. It is likely that a remediation strategy will be required to comply with likely future Planning Conditions.

It is assumed that the fly tipping would be dealt with during site enablement and clearance works. Although the site now has security guards, the site is still accessible by the public. Further security measures such as fencing/hoarding should be considered to reduce the risk of further incidents and possible sources of further contamination from being brought onto site. The contaminated excavation to the west should be dealt with as soon as practicable and backfilled and the broken manhole cover should be replaced, both for security and potential health and safety risks to members of the public.

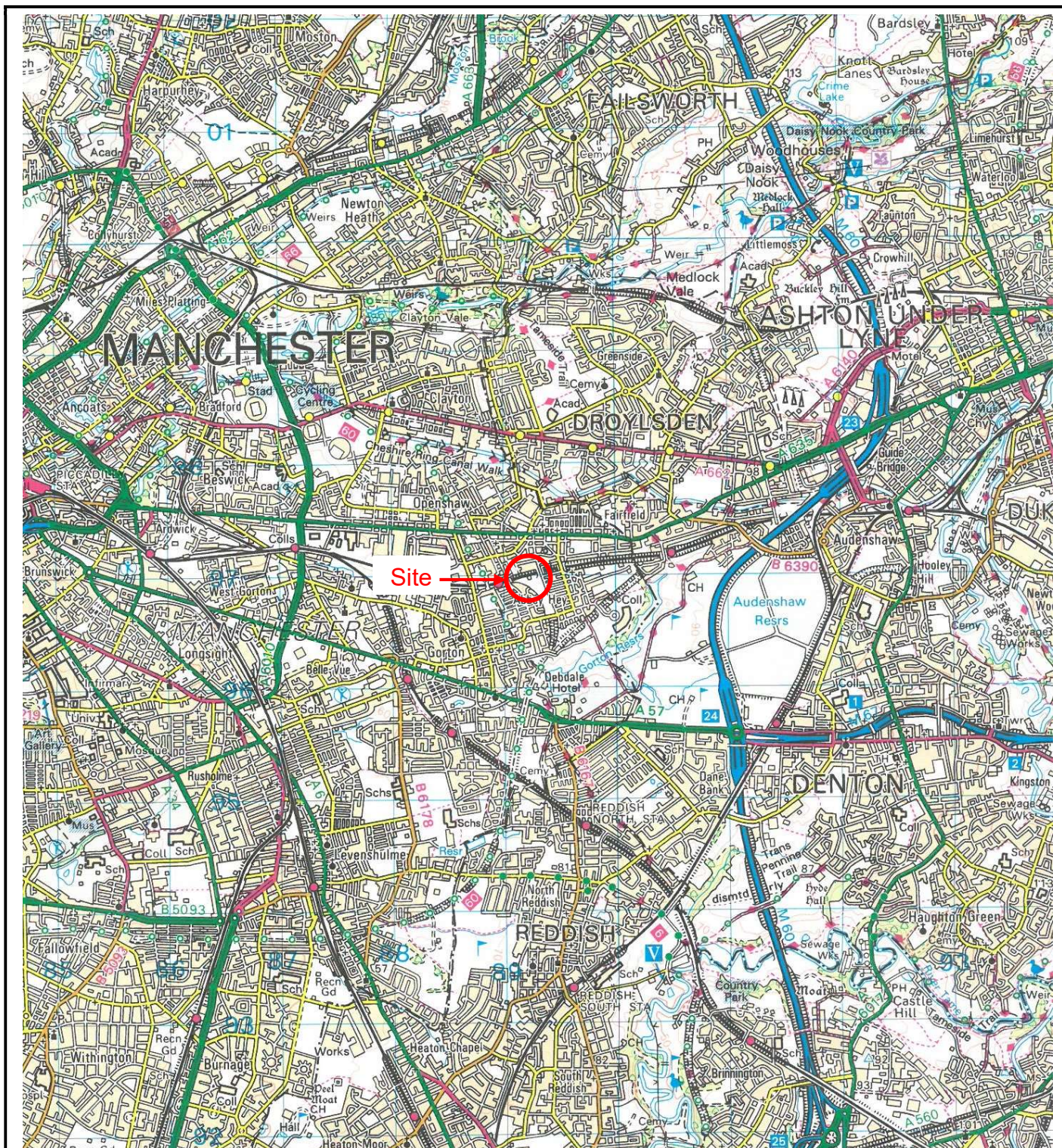
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GENERAL NOTES

- A) The assessment made in this report is based on the site terrain and ground conditions revealed by the various field investigations undertaken and also any other relevant data for the site including previous site investigation reports (if available) and desk study data. There may be special conditions appertaining to the site, however, which have not been revealed by the investigation and which have not, therefore, been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available. It must be recognised that many of the Environmental Searches obtained during the course of the desk study are often lengthy. Applied Geology have, where appropriate and in the interests of simplicity, only reproduced the summary of the searches within the report. A full copy of all the search data is held at the Applied Geology office and is available for inspection if required.
- B) Where any data supplied by the Client or other external source, including that from previous site investigations, has been used it has been assumed that the information is correct. No responsibility can be accepted by Applied Geology for inaccuracies within this data.
- C) Whilst the report may express an opinion on possible configurations of strata between or beyond the exploratory locations, or on the possible presence of features based on either visual, verbal or published evidence this is for guidance only and no liability can be accepted for the accuracy.
- D) Comments on groundwater (and landfill gas) conditions are based on observations made during the course of the present and past investigations or with reference to published data unless otherwise stated. It should be noted, however, that groundwater (and landfill gas) levels vary due to seasonal (or atmospheric conditions) or other effects.
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- I) Unless specifically stated, the investigation has not taken into account the possible effects of mineral extraction.
- J) The economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, depends on very many factors in addition to geotechnical considerations and hence its evaluation is outside the scope of this report.
- K) Applied Geology operates as a Consultancy and does not operate its own laboratory for soil testing, this work being sub contracted to known and respected, generally UKAS accredited, laboratories. Applied Geology can therefore not be held responsible for the testing carried out.

APPENDIX A



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JS

Checked By:

CS

Paper Size:

A4

Scale:

1:50,000

Date:

01.12.2020

NGR:

389261 396959

Title:

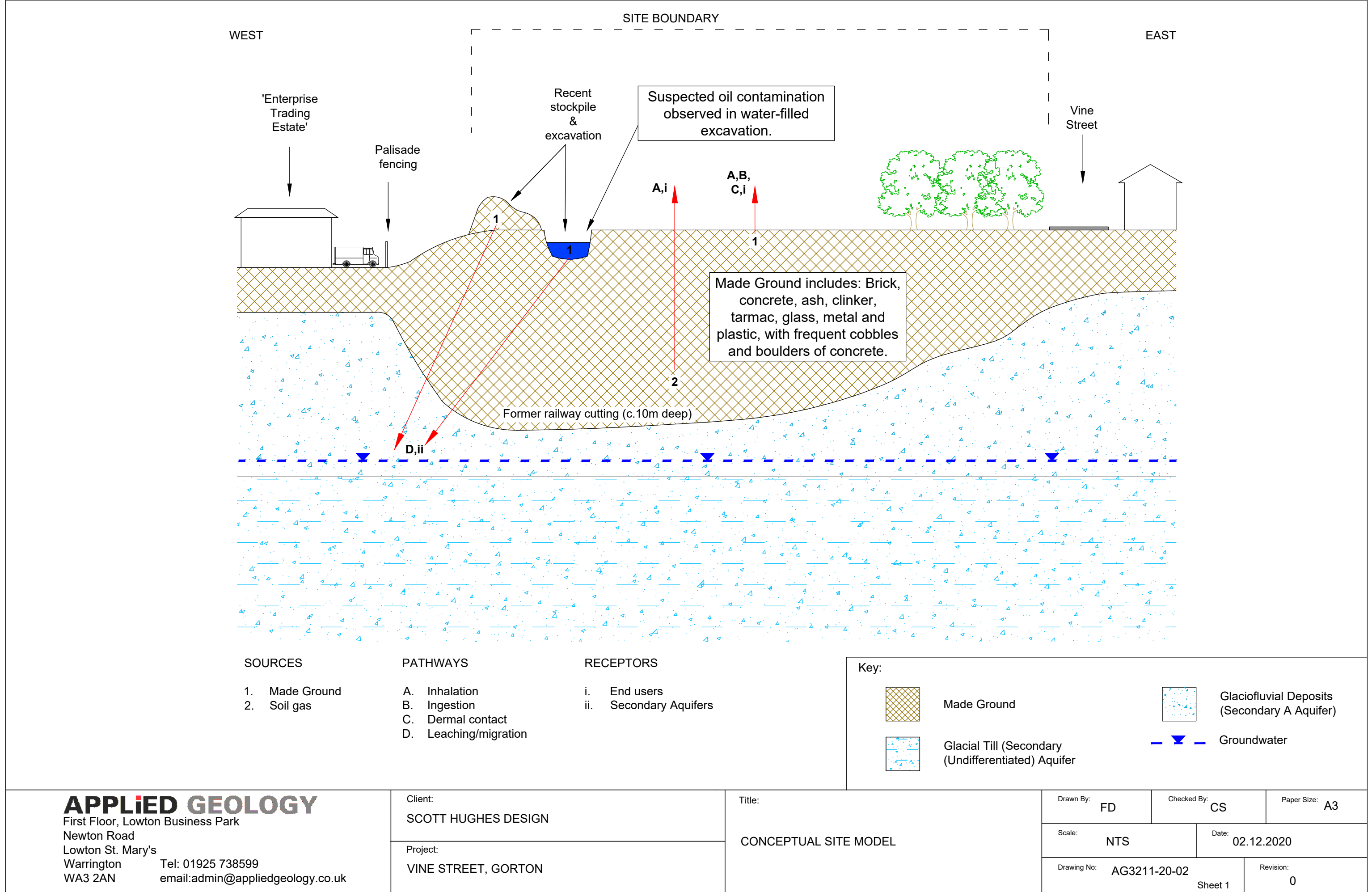
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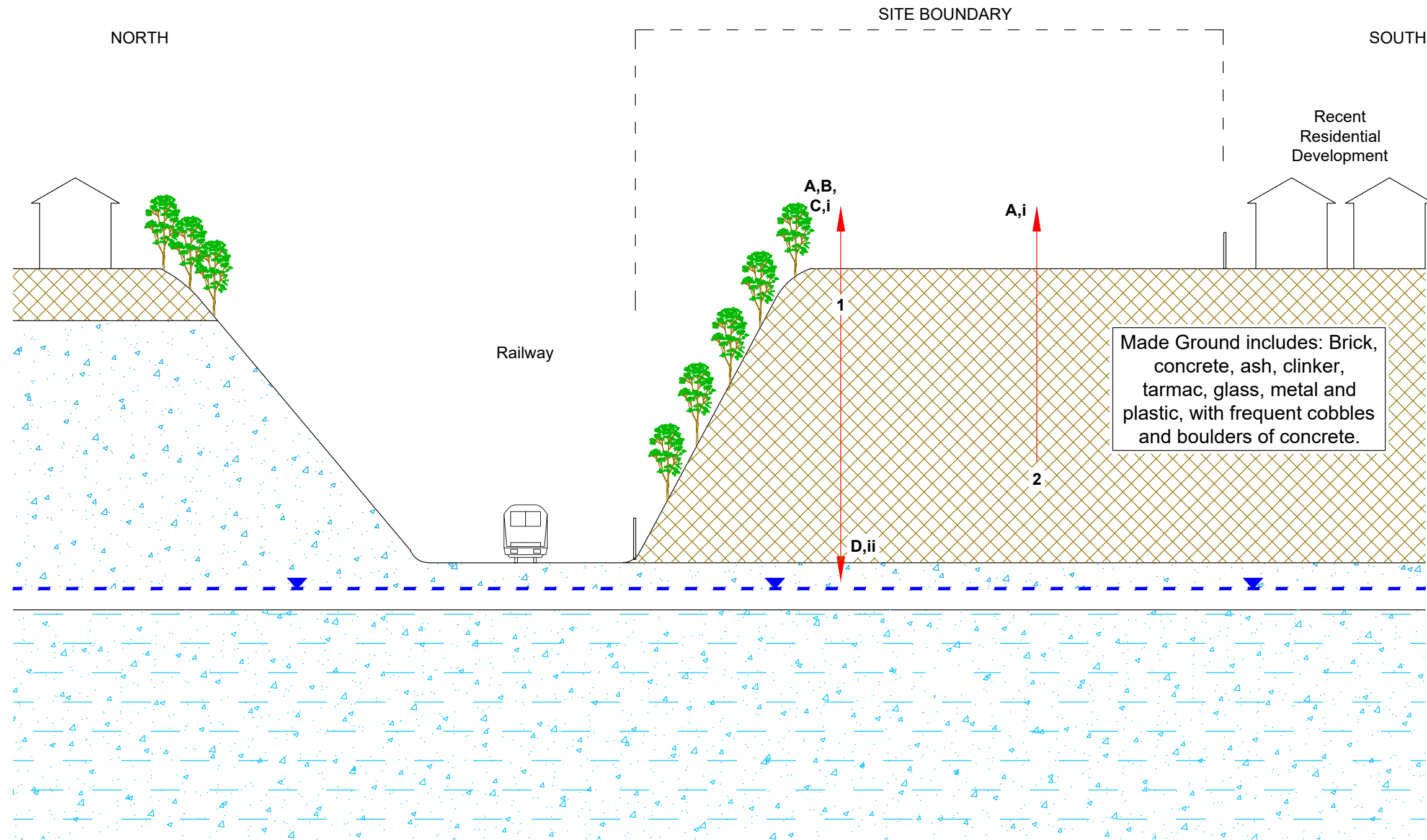
Drawing No:

AG3211-20-01

Revision:

0





SOURCES

1. Made Ground
2. Soil gas

PATHWAYS

- A. Inhalation
- B. Ingestion
- C. Dermal contact
- D. Leaching/migration

RECEPTORS

- i. End users
- ii. Secondary Aquifers

Key:



Made Ground



Glacial Till (Secondary (Undifferentiated) Aquifer)



Glaciofluvial Deposits (Secondary A Aquifer)

Groundwater

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Project:
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Title:

CONCEPTUAL SITE MODEL

Drawn By: JS

Checked By: CS

Paper Size: A3

Scale: NTS

Date: 08.12.2020

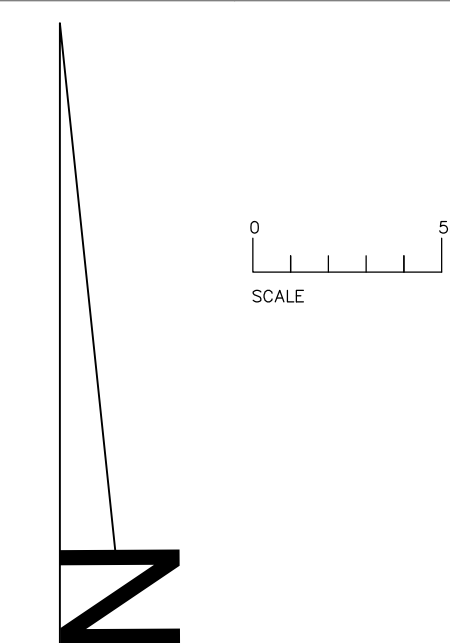
Drawing No: AG3211-20-02

Sheet 2

Revision: 0

-
- Network Rail Access
- 10m safety zone from boundary
- 80m contour
- Site boundary
- Developable area
- Indicative floor and ground levels within plus or minus 500mm

car parking	
2 bedroom house	100%
3 bedroom house	100%
4 bedroom house	200%



APPENDIX B

County Series 1:10,560 scale

VEGETATION



Fir Wood



Deciduous Wood



Mixed Wood



Brushwood



Orchard



Reeds



Rough Pasture



Furze



Marsh



Osiers

ROADS



Railway over Road



Road over Railway



Road over River or Canal



Level Crossing



Railway over River



Road over Stream



Road over Stream



Sunken Road



Raised Road

RAILWAYS



Double Lines of Railway



Single Lines of Railway and Tramway

GENERAL FEATURES



Gravel Pit



Sand Pit



Quarry



Shingle



Other Pits



Antiquities, Site of



Arrow, showing direction of flow of water

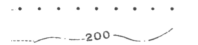


Trigonometrical Station

BOUNDARIES



County Boundary



Parish Boundary



Contours



Parliamentary Division Boundary



Union Boundary



Rural District Boundary

National Grid 1:10,000 scale

HEIGHTS (METRES)

Values are given in metres above mean sea level at Newlyn.

Surface heights determined by ground survey 163m
air survey 164m

Bench marks and their values are shown on large scale maps, and bench mark lists containing fuller and possibly later levelling information are obtainable from the Director General, Ordnance Survey.

Contours are at 5 metres vertical interval.

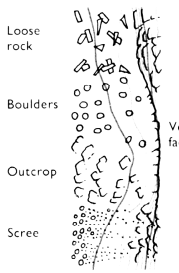
ROCK FEATURES

Loose rock

Boulders

Outcrop

Scree



CONVERSION SCALE

Metres - Feet

2000 Metres 6500 Feet

6000

5000

1500

4000

ABBREVIATIONS

BP,BS Boundary Post or Stone
Ch Church
CH Club House
F Sta Fire Station
FB Foot Bridge
Fn Fountain
GP Guide Post
MP,MS Mile Post or Stone
P Pole or Post
Pol Sta Police Station

PO Post Office
PC Public Convenience
PH Public House
S Stone
Spr Spring
TCB Telephone Call Box
TCP Telephone Call Post
TH Town Hall
W Well
Y Youth hostel

ROADS

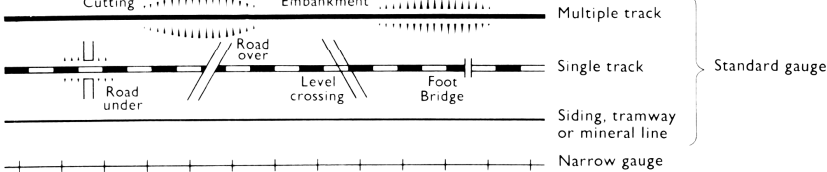
Road

Track

Where unfenced shown by pecked lines.

Path

RAILWAYS



GENERAL FEATURES

Antiquity, (site of)

Boulders

Building

Pylon

Pole

Glasshouse

Triangulation station

Lake, loch or pond

Sloping masonry

= Chalk pit, clay pit or quarry

= Gravel pit

= Sand pit

Refuse or slag heap

Direction of flow of water

Shingle

Sand

VEGETATION

Bracken, rough grassland

Scrub

Heath

Marsh

Saltings

Reeds

Coppice

Orchard

Coniferous trees

Non-coniferous trees

In some areas bracken () and rough grassland () are shown separately.



GroundSure

Historical Map Pack Legend

County Series & National Grid 1:10,560 scale

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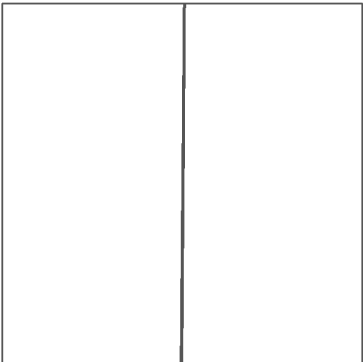
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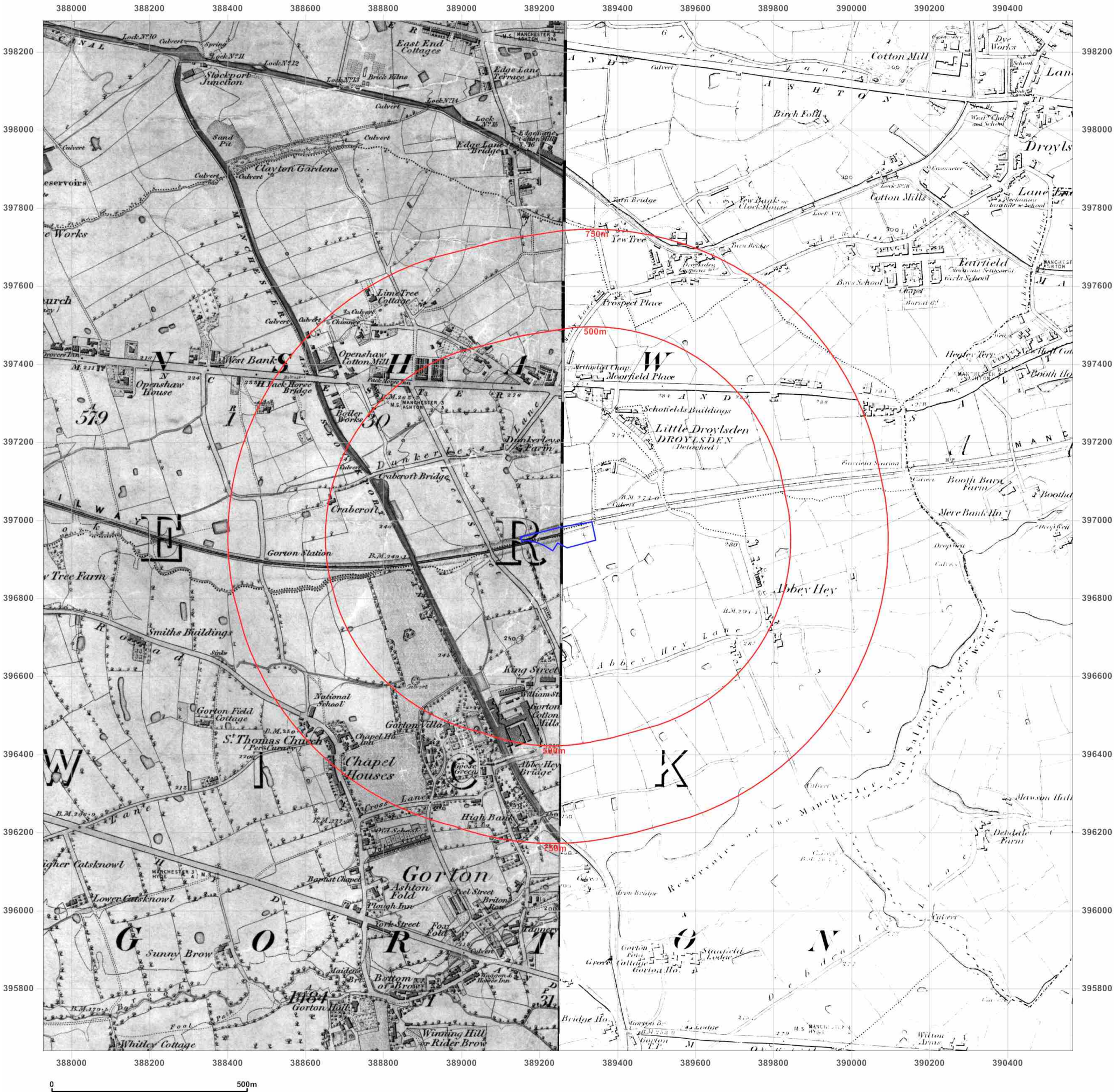


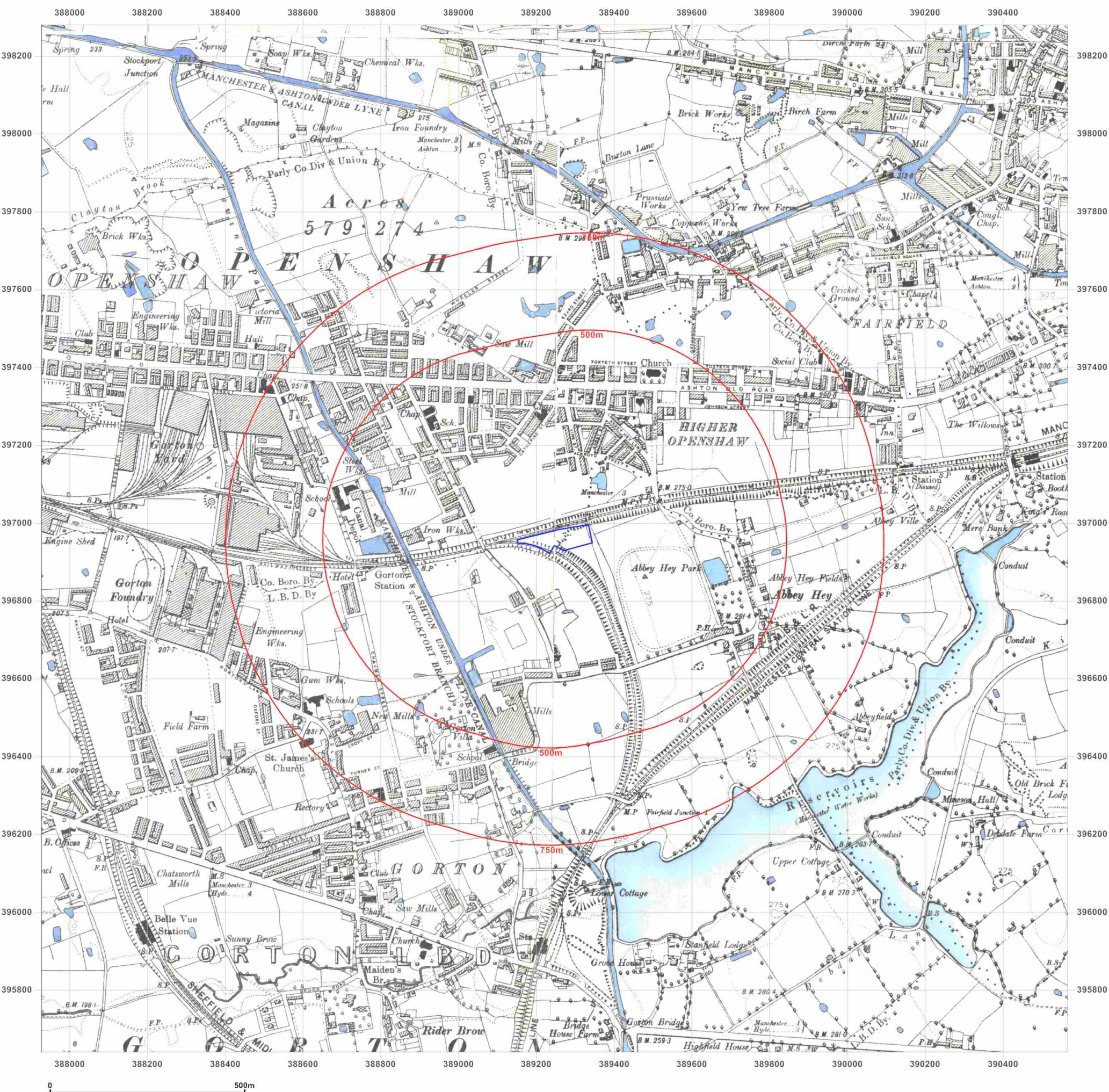
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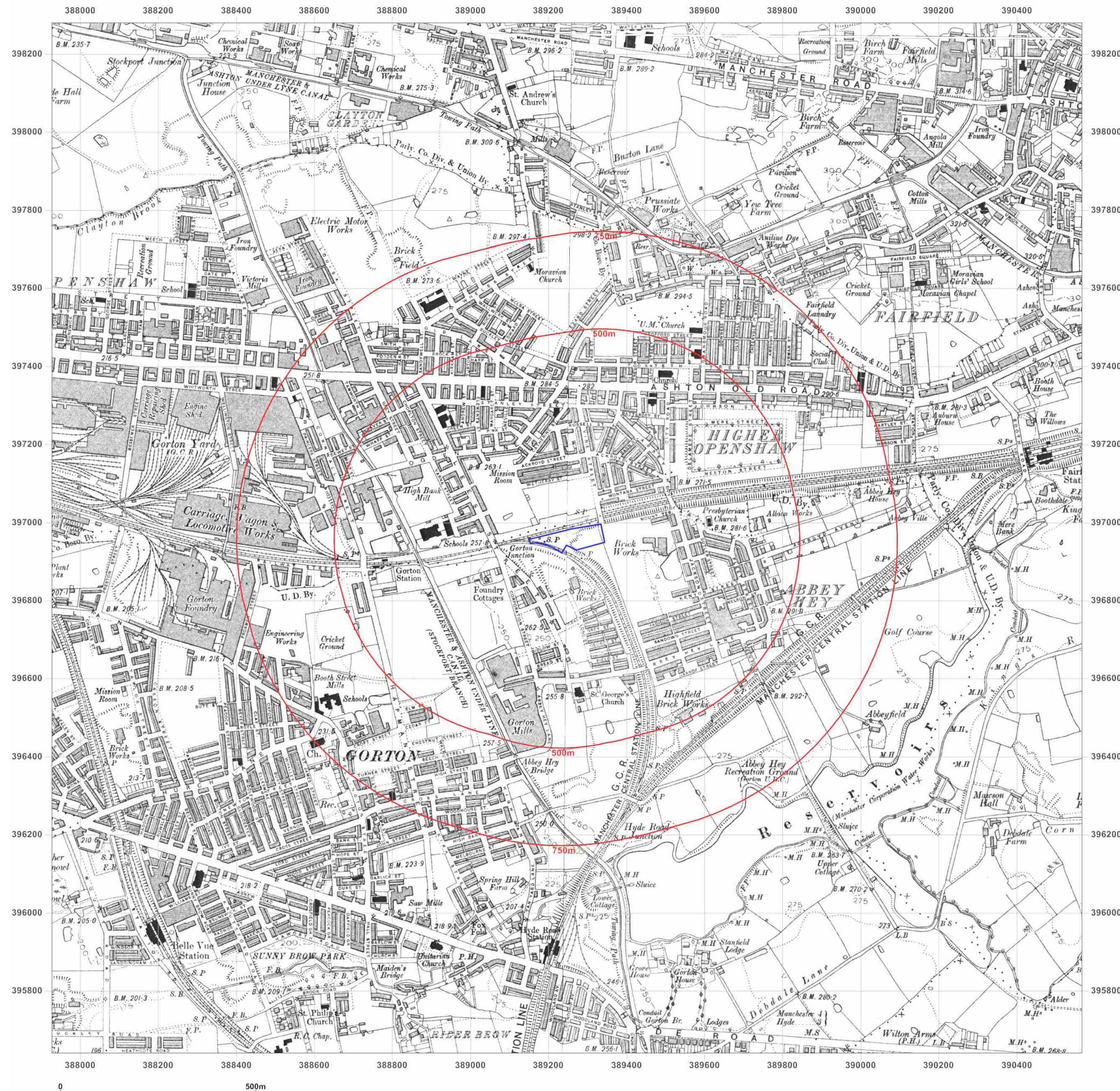


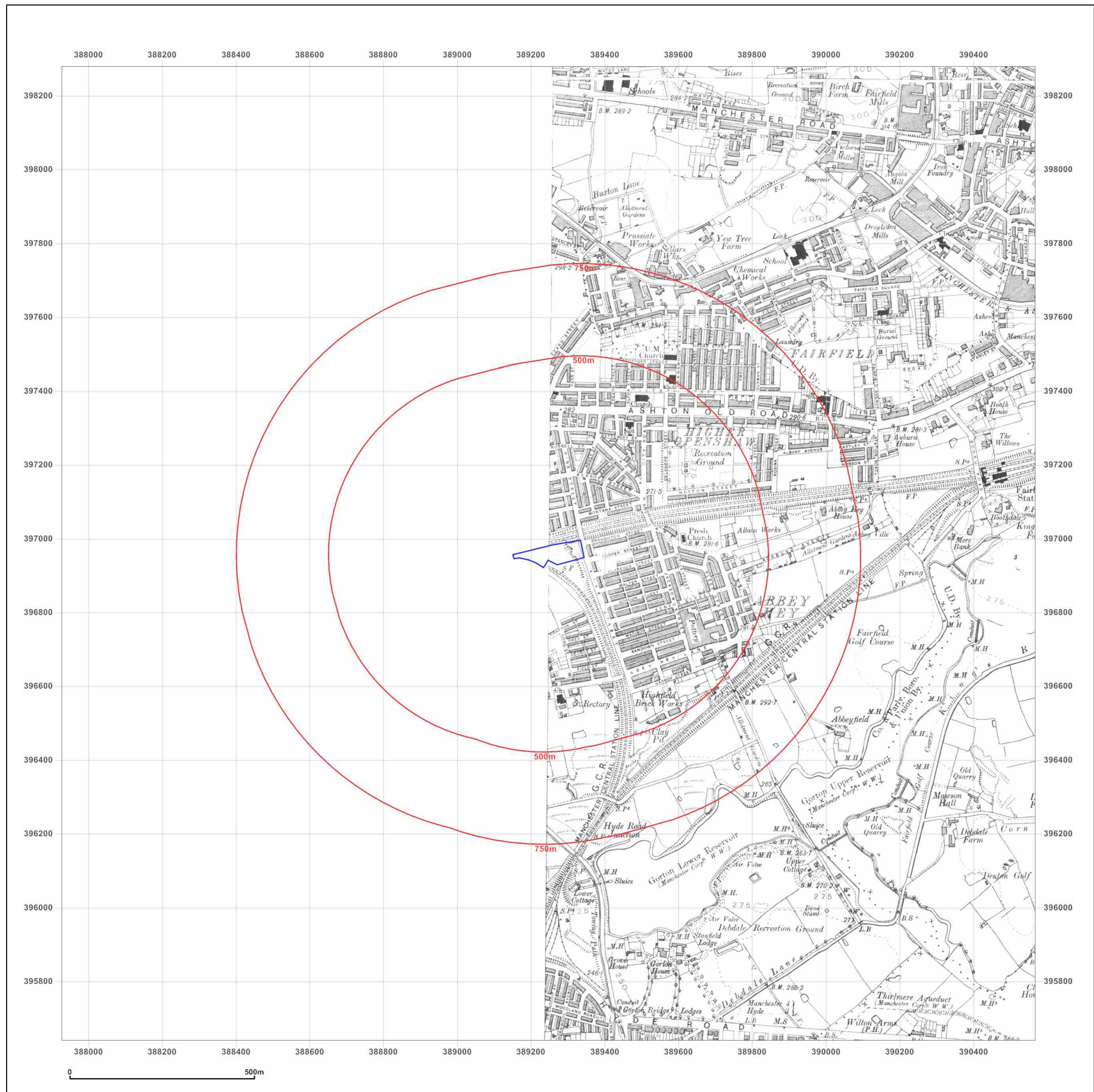
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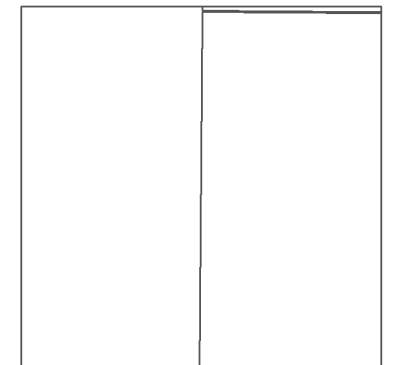
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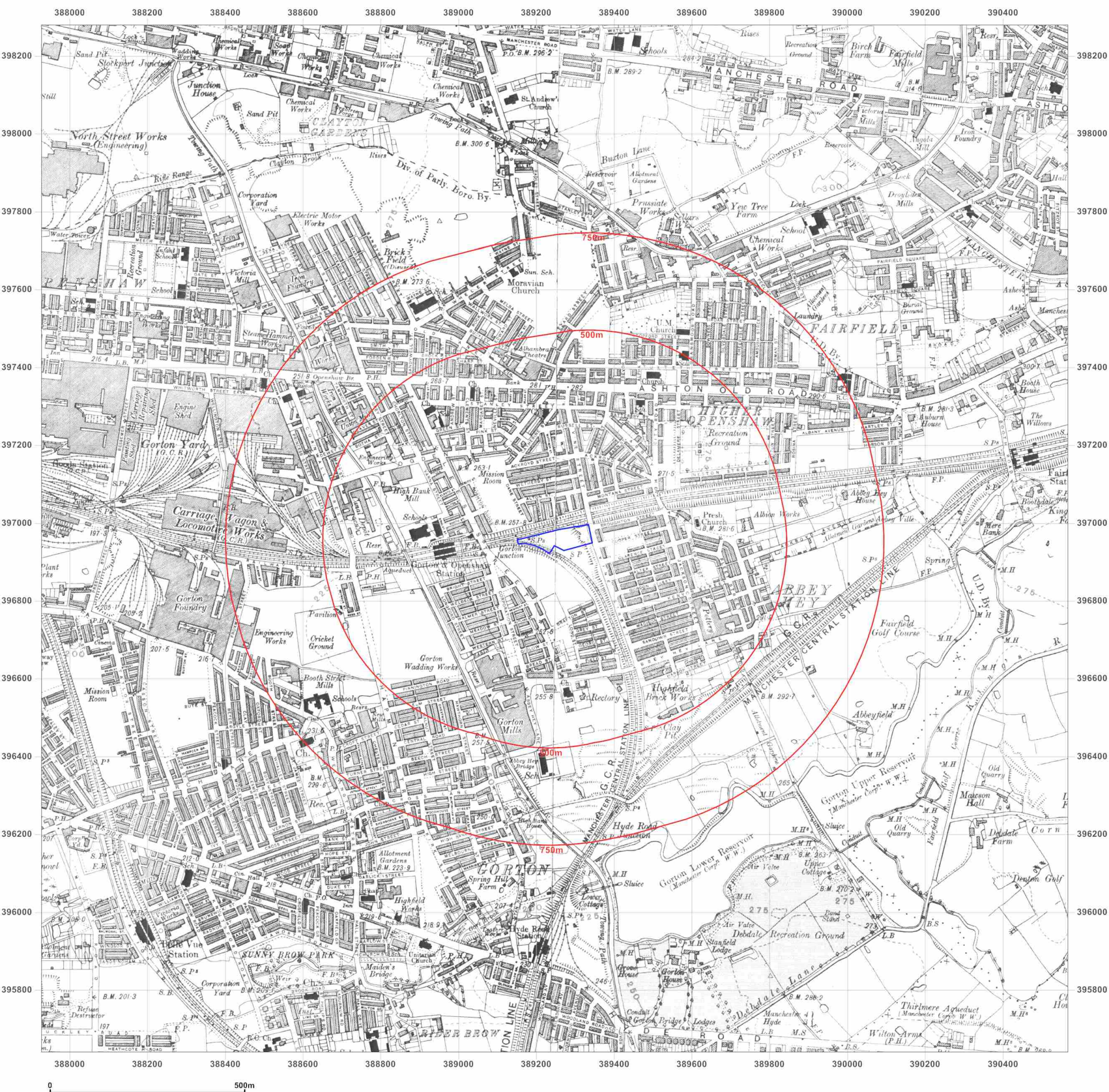


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Site Details:

Vine Street, Gorton

Client Ref: EMS_648066_859626
Report Ref: EMS-648066_859626
Grid Ref: 389246, 396959

Map Name: County Series

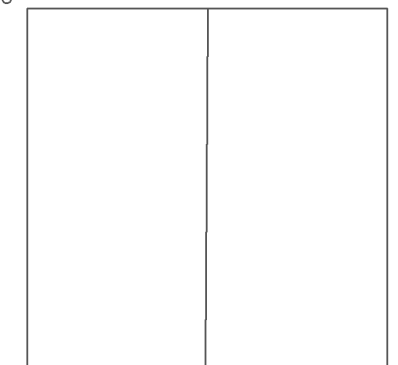
Map date: 1923

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1844
 Revised 1916
 Edition 1923
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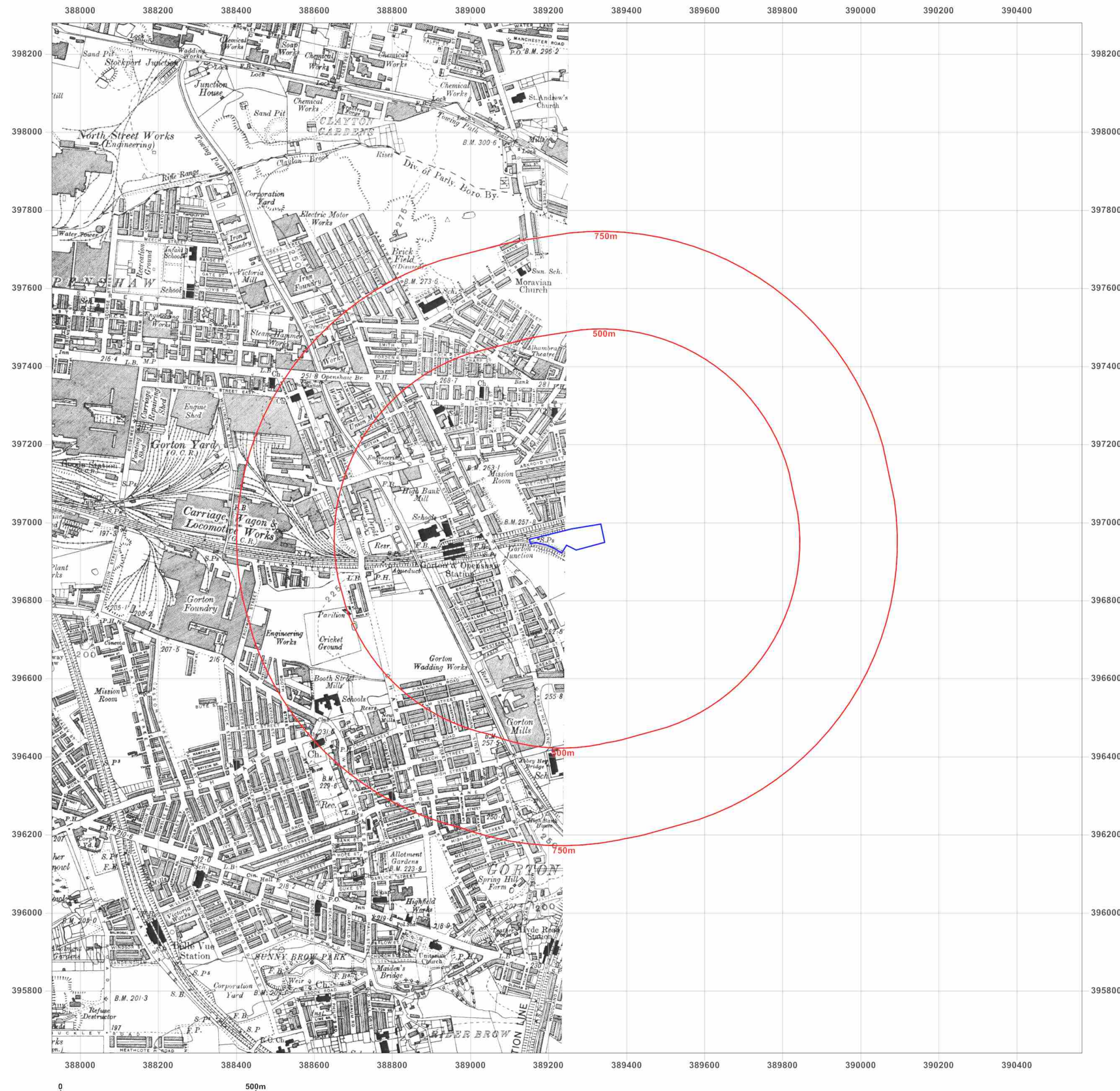


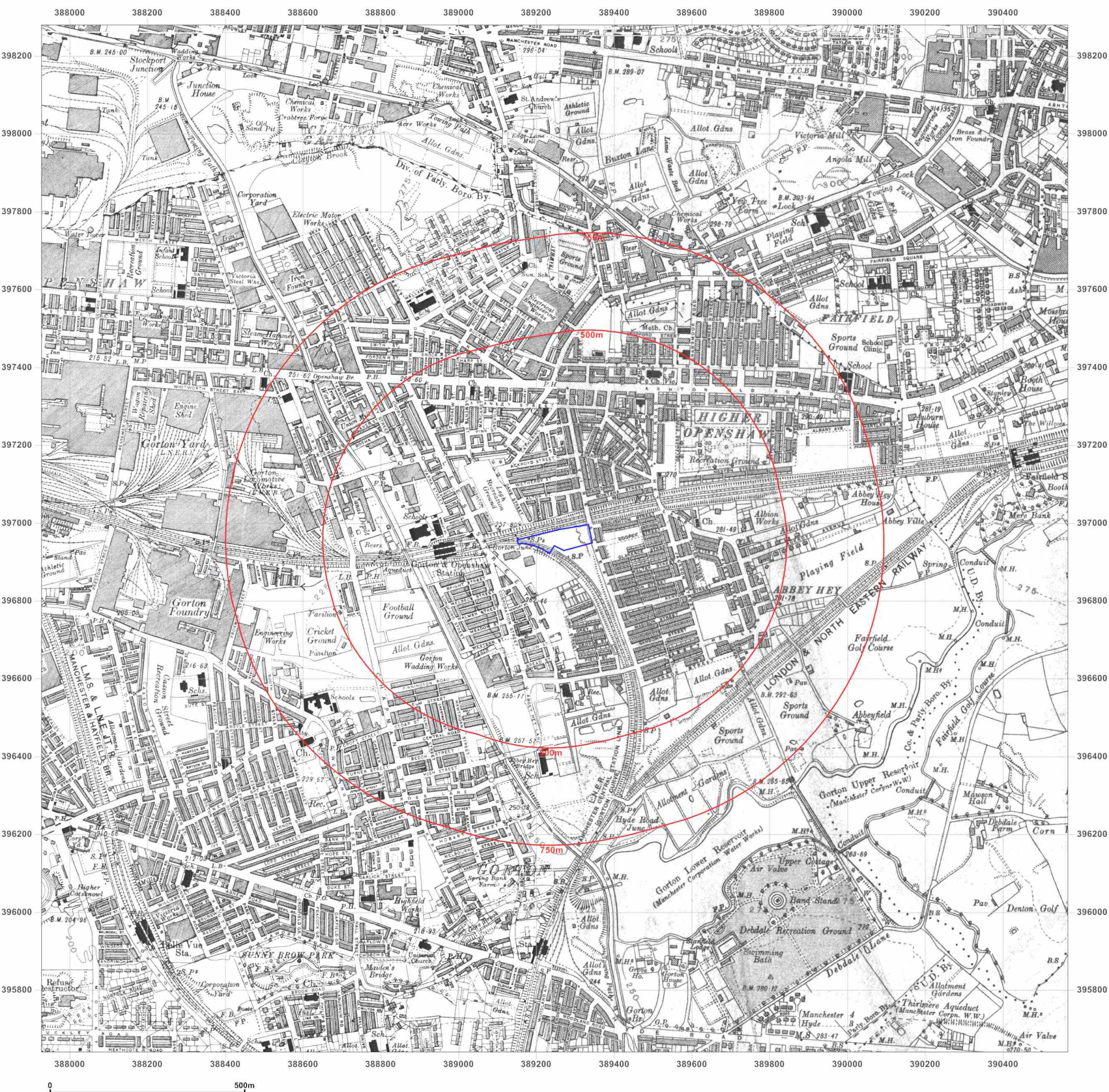
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Site Details:

Vine Street, Gorton

Client Ref: EMS_648066_859626
Report Ref: EMS-648066_859626
Grid Ref: 389246, 396959

Map Name: County Series

Map date: 1933-1934

Scale: 1:10,560

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