

Unite Students and Manchester Metropolitan University

Cambridge Hall, Manchester

Geotechnical and Geoenvironmental Desk Study

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Ove Arup and Partners Limited
6th Floor 3 Piccadilly Place
Manchester
M1 3BN
United Kingdom
arup.com

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Appendix A – Groundsure Report
Appendix B – Preliminary UXO Risk Assessment Report

Executive Summary

Ove Arup and Partners Ltd (Arup) has been commissioned by Unite Students and Manchester Metropolitan University to undertake a Geotechnical and Geoenvironmental Desk Study for the proposed development at Cambridge Halls of Residence, Cavendish Street, Manchester (the site).

Previous development on the site includes terraced residential buildings shown on the earliest historical map records (1848), timber yards, and a warehouse. A tramway operated through the site from the 1880s until it was dismantled in the 1940s. The warehouse and residential properties were demolished by the 1960s. The site was undeveloped in the 1980s, understood to be university playing fields. The most recent development, student accommodation, was constructed by the late 1990s and still remains on site today.

Based on geological mapping and historical ground investigation, ground conditions are expected to consist of made ground underlain by glacial sand and gravels followed by glacial till. Below these deposits, bedrock is encountered as a highly to moderately weathered sandstone around 6.8m to 9.9mbgl.

The made ground at the site is a potential source of contamination. Historical ground investigation conducted prior to the development of the student accommodation did not encounter any significant contamination and remediation was not required to enable the current development. Any residual risks associated with the site history will be assessed during ground investigation.

Obstructions have been reported in the historical ground investigation information for the site, where intact brick walls encountered at 2mbgl in the north of the site associated with the former residential development and a concrete slab at 4mbgl in the south of the site associated with the former warehouse development. The presence of potentially intact concrete slabs or other substructures may constrain the construction of foundations. It is anticipated that some enabling works, including obstruction removal, would have been conducted prior to development of the student accommodation building in the late 1990's however the extent of enabling works carried out is not known.

Three United Utilities sewers are present on site, aligned northeast to southwest, the most notable is a 1950mm diameter brick lined sewer located at an invert level of approximately 12mbgl in the centre of the site. The layout of new foundations will have to adhere to United Utilities wayleaves and foundations should be designed to not adversely load any of the sewers.

Based on extensive experience of nearby sites, the underlying sandstone will provide a suitable founding material for piled foundations and is the most likely solution for the proposed development. At this stage, it is considered likely that a bored cast in situ piling solution will be most appropriate with piles socketed into the underlying sandstone, dependent on the thickness of the weathered profile.

The Preliminary UXO Risk Assessment has assigned a 'High' Preliminary Risk Level and a Stage 2 Detailed UXO Risk Assessment is recommended prior to any intrusive works on the site.

Ground investigation will be required to confirm the stratigraphy and develop a better understanding of the geoenvironmental and geotechnical risks at the site and provide data for foundation design. Significant access constraints have been identified; this needs to be considered during the design of the ground investigation.

1. Introduction

1.1 Commission and scope

Ove Arup and Partners Ltd (Arup) has been commissioned by the Unite Students and Manchester Metropolitan University to undertake a Geotechnical and Geoenvironmental Desk Study to inform the Cambridge Hall development in Manchester.

The objective of the Geotechnical and Geoenvironmental Desk Study is to review available historical, geotechnical and geoenvironmental information pertaining to the site and the nearby surrounding area, highlighting any potential ground related risks to the proposed development. The Desk Study also aims to inform the scope and preliminary design of an intrusive ground investigation and identify any constraints relating to the ground investigation. It is intended that this document can also be submitted to the Manchester City Council to support the planning application.

1.2 Sources of information

The following sources of data and information has been reviewed as part of this desk study:

- Groundsure Geo and Enviro Insight reports (July 2024) [1][2];
- Groundsure Map Insights report (July 2024) [3];
- British Geological Survey (BGS) geological mapping and adjacent borehole records available via the online GeoIndex viewer [4];
- Igne Preliminary Unexploded Ordinance Risk Assessment report (July 2024) [5];
- Department of Environment (DoE) Industry profiles (published in 1995) [6];

Details of the sources used are indicated in subsequent sections and are provided in the references section. Supporting information has been included in the appendices where appropriate.

1.3 Report structure

This report has the following structure:

- Section 2: Provides a description of the site in its current condition;
- Section 3: Documents the known site history and the geological and geoenvironmental setting;
- Section 4: Provides a summary of the key geoenvironmental constraints identified in relation to the proposed development;
- Section 5: Provides a summary of the key geotechnical constraints identified in relation to the proposed development;
- Section 6: Presents the geotechnical and geoenvironmental risk register; and
- Section 7: Presents conclusions of this assessment and recommendations for ground investigation.

1.4 Use and limitations of the report

This report was prepared by Arup on behalf of Unite Students and Manchester Metropolitan University (the Client) for Cambridge Hall, Manchester. It considers our client's instructions and requirements and addresses their priorities at the time. This report is not intended for, and should not be relied on by, any third party and no responsibility is undertaken to any third party in relation to it.

All reasonable skill, care and diligence have been exercised within the timescale available and in accordance with the technical requirements of the brief. Notwithstanding the efforts made by the professional team in preparing the report it is possible that other ground contamination or conditions as yet undetected may exist and consequently reliance on this report must be limited accordingly.

2. Site description

2.1 Site location and extent

The site is situated south of Manchester City Centre and approximately 100m south of the A57(M) Mancunian Way. The site is bounded to the north by Manchester Metropolitan University Faculty of Business and Law, to the west by the A5067 Road and Higher Cambridge Street, to the east by Lower and Higher Chatham Street and to the south by Boundary Street W.

The site is rectangular in shape covering an estimated 0.82ha and is centred on National Grid Reference SJ 84157 96972. Most of the site houses a student accommodation building with three distinct courtyard areas and Cavendish Street runs through the centre of the site.

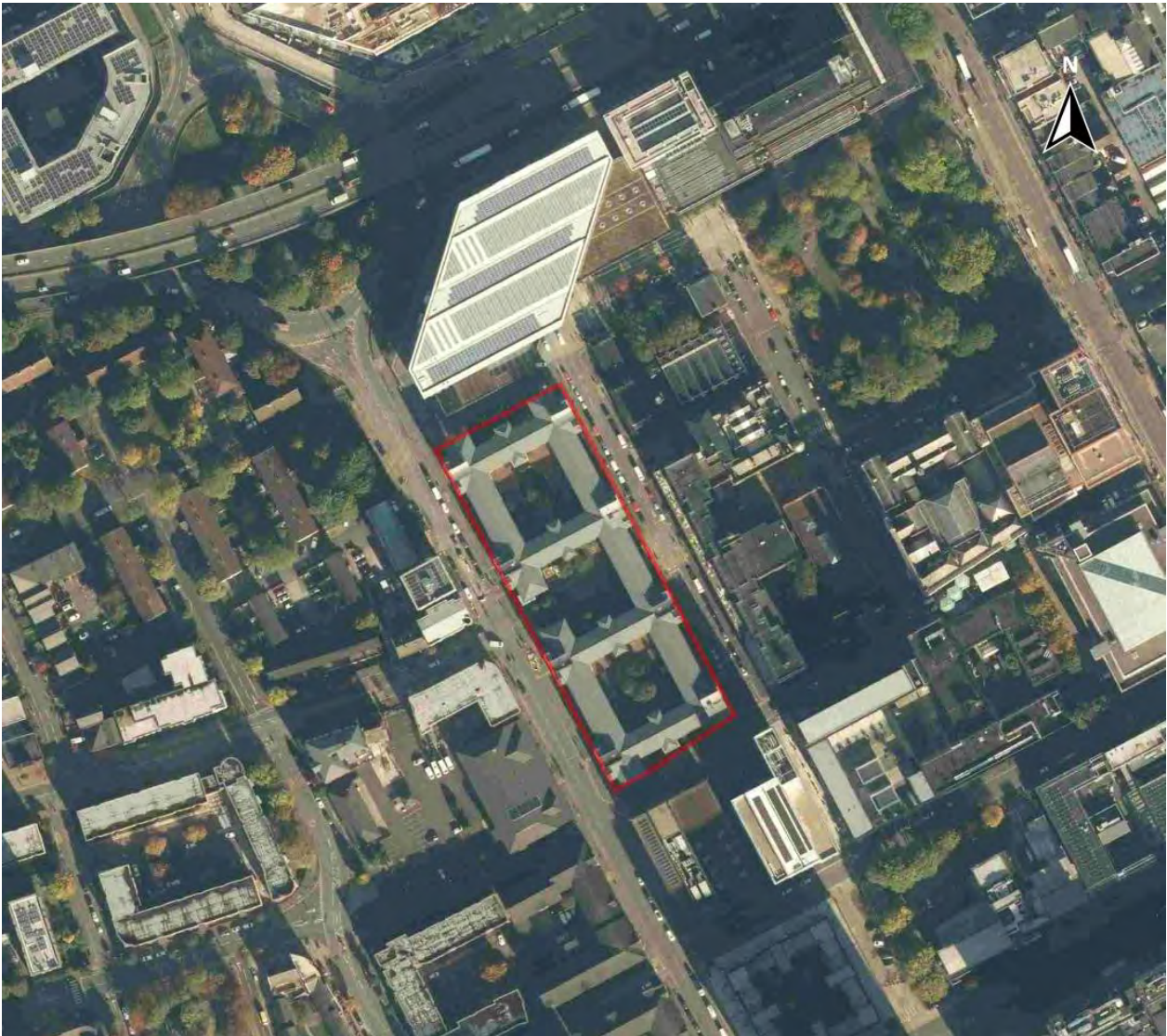


Figure 1: Site location

2.2 Topography

The topography of the site has been interpreted from Ordnance Survey Terrain 50 DTM data. The site is relatively flat and ranges between 36mOD to 37mOD.

2.3 Utilities and drainage

Following client discussions with United Utilities and information received [10], a large brick sewer is known to run through the centre of the site, additionally there is a foul sewer on a parallel alignment. Further north, another sewer passes beneath the existing building. The location of the sewers is shown in Figure 2.



Figure 2 United Utilities assets present on site

The nearest manhole chamber from available United Utilities information reports that the invert level of the manhole chamber is 24.38mOD and the cover level is 36.64mOD for the deeper 1950mm brick lined Victorian sewer. The sewer has 10.31m of cover and the invert level is 12.26m below ground level from the nearest manhole information, the invert and cover levels on the site itself may be slightly different.

The shallower 300mm x 400mm diameter sewer in the north has a cover level of 36.55mOD and an invert level of 33.01mOD from the nearest manhole information. The sewer has 3.14m of cover and the invert level is 3.54m below ground level from the nearest manhole information, the invert and cover levels on the site itself may be slightly different.

No information on cover or depths is held for the 600mm x 750mm United Utilities sewer.

2.4 Proposed development

The proposed development comprises demolition of the existing halls of residence and erection of two buildings of 30 and 24 storeys above ground, plus basement and rooftop plant levels, comprising purpose-built student accommodation with internal and external rooftop communal amenity space (Sui Generis). Ground floor usage will be commercial and community space (Flexible Use Classes E, F1 or F2). The development also includes hard and soft landscaping and associated highway works.



Figure 3 Indicative layout of proposed development

3. Site history and environmental setting

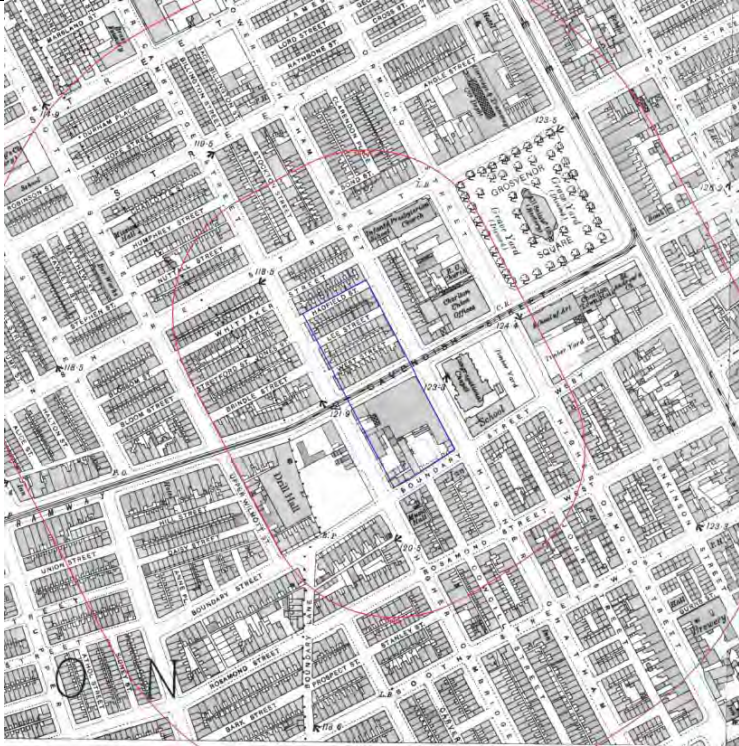
3.1 Site history

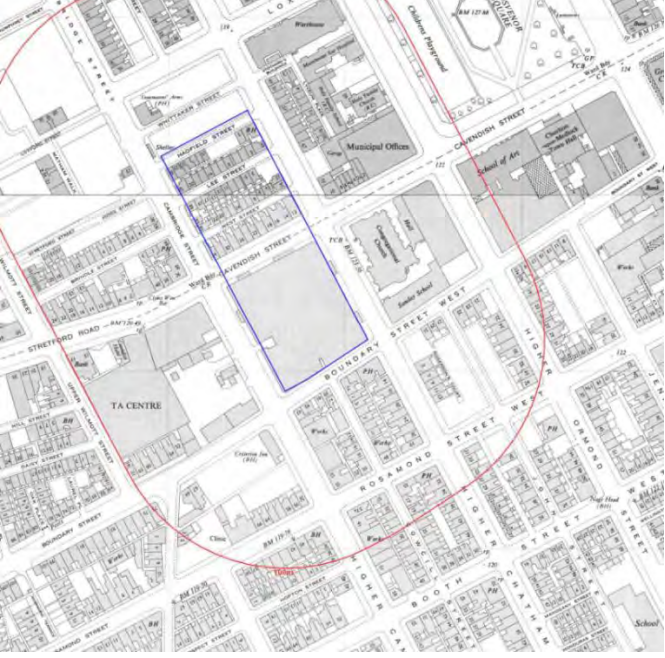
The history of the site has been summarised below based on historical mapping and aerial photography (from Groundsure and Google Earth Pro). The following information has been reviewed:

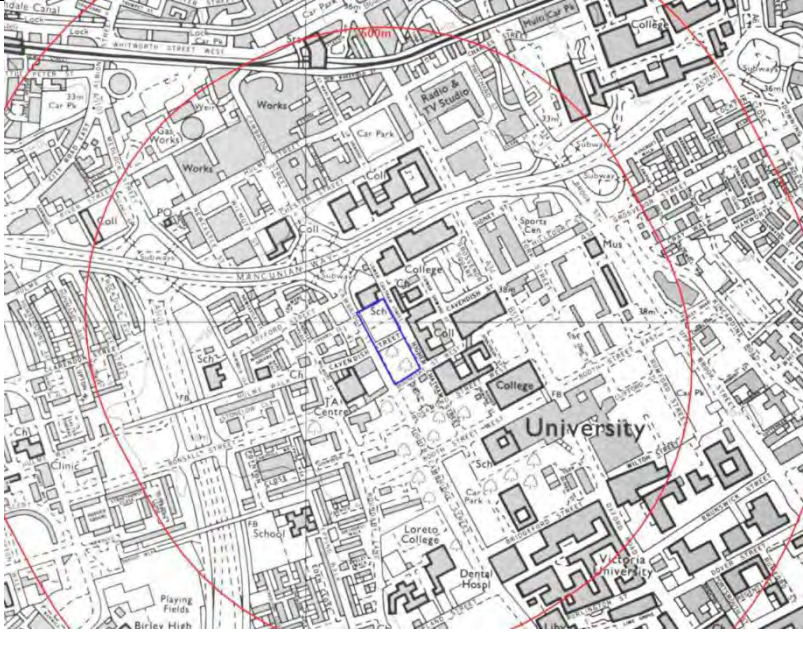
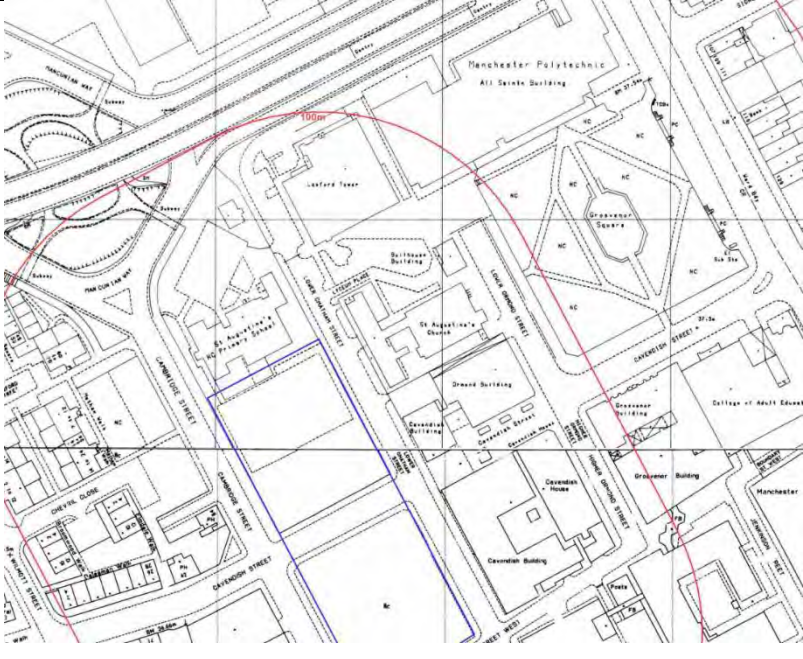
- Published Ordnance Survey (OS) mapping dating from 1848 to 2024 obtained from Groundsure [3];
- Town Plans of England and Wales / Scotland viewed on the National Library of Scotland website [7];
- Google Earth imagery dating from 2000 to 2021;

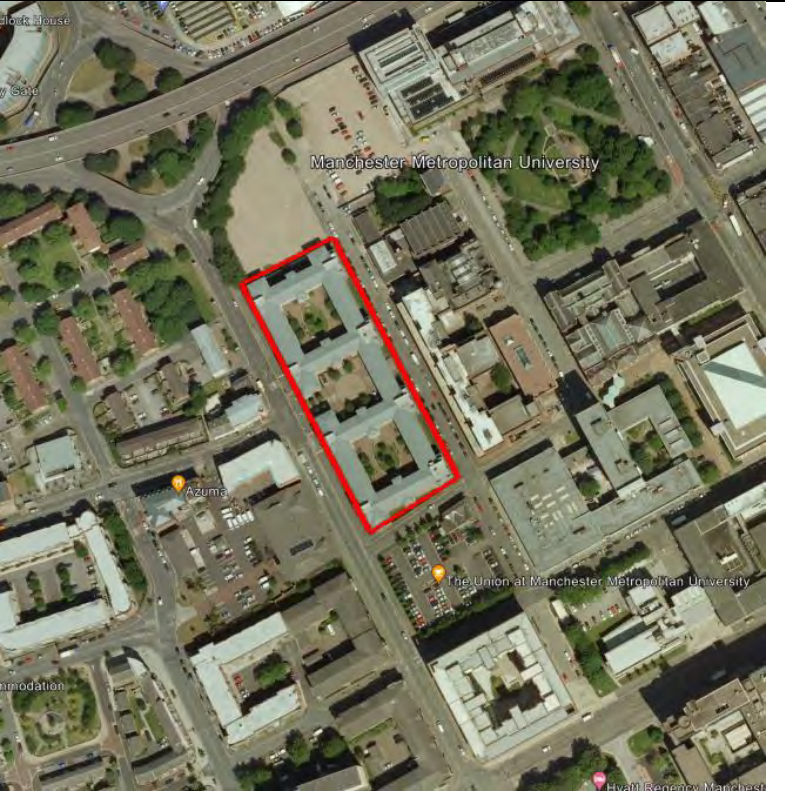
Table 1: Summary of site history

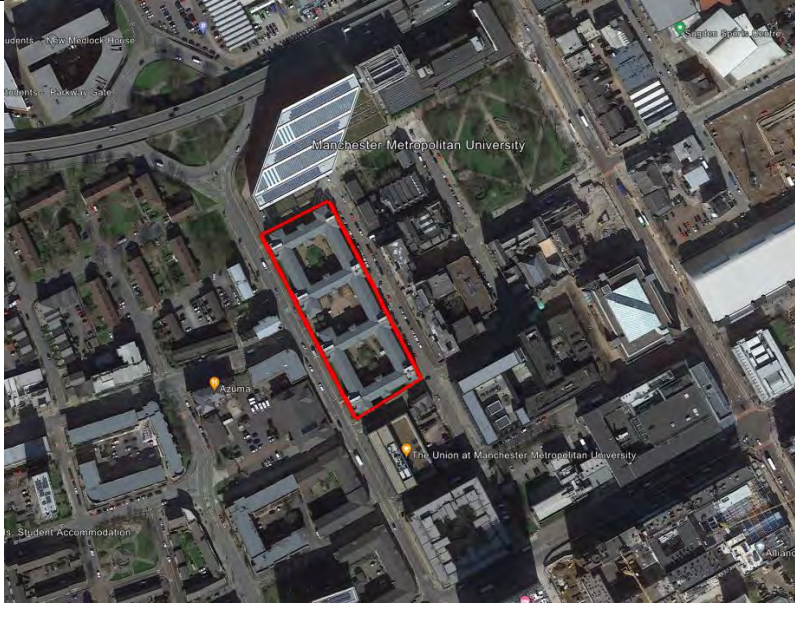
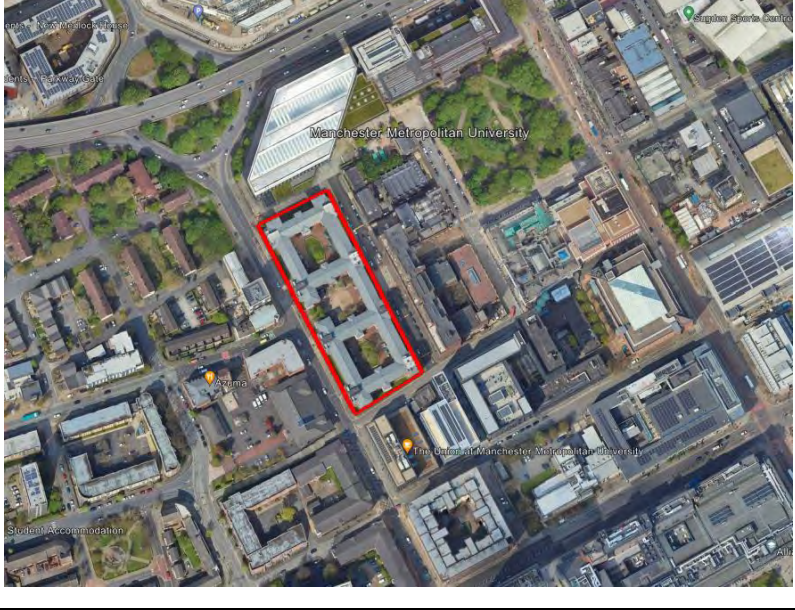
Year	Map/aerial image extract	Observations
1848 County Series 1:10,560		The site consists of terraced residential buildings. The surrounding land is in a residential area.
1851 Scale Town Plan 1:1,056		The northern half of the site consists of terraced residential buildings. In the south, a park, timber yards and some terraced residential buildings are present. The site is split by Cavendish Street. Four pumps are present within the site. There are more timber, stone and slate yards to the west of the site, a brewery and storehouse to the south, and a college and church to the east.

1889-93 County Series 1:2,500		Additional residential buildings have been built in the northern section of the site. A tramway goes through the middle of the site along Cavendish Street. A Carriage & Tramway Depot is located 150m northeast of the site. The southern section of the site is occupied by a large unspecified building. Directly east of the site is a school, chapel and timber yard, with offices on the opposite side of Cavendish Street. A drill hall is shown to the west of the site.
1908 County Series 1:2,500		There has been a change in the footprint for the unspecified building situated in the south of the site. There is no significant change for the remainder of the site.

1951-55 National Grid 1:1,250		Some of the terraced buildings located in the north of the site are no longer present.
1961- 1962 National Grid 1: 1,250		The warehouse present in the south of the site has been demolished, which is now shown as a vacant plot of land.
1965-70 National Grid 1:1,250		Most of the terraced residential buildings present in the north of the site have been demolished. St Augustine's RC Primary School is present north and adjacent to the site. Mancunian Way has been built 100m north of the site, with subways underneath.

1981-85 National Grid 1:10,000		Both north and south of the site are shown to be vacant, understood to be playing fields. Trees are annotated in the southern area of the site. Manchester Metropolitan University buildings are shown in the surrounding area.
1987-92 National Grid 1:1,250		No significant changes are observed on site. An electricity substation is present approximately 200m east of the site. Various buildings have been built around the site, namely the Loxford Tower and Manchester Polytechnic (Manchester Metropolitan University)

2000 Google Earth Imagery		Cambridge Hall student accommodation has been built. Cavendish Street is no longer shown, the alignment through the site is still accessed by pedestrians and cyclists. There is an open car park directly south of the site.
2009 Google Earth Imagery		St Augustine's RC Primary School has been demolished. Loxford Tower has been demolished and an open car park is now present on site.

2017 Google Earth Imagery		Manchester Metropolitan University Business School has been constructed directly north of the site. The area south of the site that was formerly a car park has been developed into Manchester Metropolitan University buildings.
2023 Google Earth Imagery		No significant change.

3.1.1 Summary

The 1848 Ordnance Survey map showed the north of the site being occupied by terraced residential buildings. By 1851, timber yards are shown in the south of the site and in the early 1900s, a large warehouse was built in the south of the site. A tramway operated through the site from the 1880s until it was dismantled in 1940s. The warehouse and residential properties were demolished by 1960s. The site was undeveloped in the 1980s, understood to be university playing fields. By the year 2000, a student accommodation building occupied the site with no further change being observed on the site to date. The surrounding area has seen electric substations, car parks, schools, a garage, and a hospital.

3.2 Geology

The following sources of information have been reviewed:

- British Geological Survey (BGS) GeoIndex online viewer [4];
- Groundsure GeoInsight report [1];
- BGS Solid and Drift Map Sheet SJ89NW [8];

3.2.1 Made ground

Given the history of the site, which includes the presence of multiple buildings dating back to the earliest mapping and their subsequent demolition, made ground is anticipated to be present.

3.2.2 Superficial deposits

Available BGS mapping shows the site to be underlain by superficial Glaciofluvial Sheet Deposits of sand and gravel. The older 1976 1:10,000 map indicates gravel to be thin and patchy over boulder clay (Glacial Till).

3.2.3 Solid geology

Bedrock at the site is sandstone of the Chester Pebble Beds Formation of the Sherwood Sandstone Group. The stratigraphically older Manchester Marls Formation is mapped 200m east of the site, close to the West Manchester Fault.

3.3 Historical ground investigation data

3.3.1 BGS borehole records

The BGS online borehole database provides access to scans of borehole logs for historical ground investigations across the UK. A summary of nearby records is shown below.

Table 2: Summary of nearby borehole records.

Borehole ID	Location	Year	Comment
SJ89NW4180	100m NE	2008	Geothermal borehole drilled to 92m. It encountered 1m of made ground, 6m of superficial materials (including 4m of alluvium) and a very weathered bedrock at a depth of 7mbgl. Marl underlies the sandstone strata and is encountered at a depth around 36mbgl. Groundwater was encountered at approximately 9mbgl.
SJ89NW4197	100m N	2009	This borehole encountered 2m of made ground, 9.7m of superficial materials (sand and gravel overlying clay). Weathered sandstone was encountered at a depth of 11.7mbgl. Marl underlies the sandstone strata and is encountered at a depth around 36.5mbgl. Groundwater was encountered at approximately 8.51mbgl.
SJ89NW4196	60m N	2009	This borehole encountered 2.6m of made ground, 11.3m of superficial materials (sand, gravel and clay). Weathered sandstone was encountered at a depth of 13.9mbgl. Marl underlies the sandstone strata and starts to be encountered at a depth of 32mbgl. Groundwater was encountered at approximately 14.32mbgl.

3.3.2 Arup local knowledge

Arup has local knowledge of the area, having undertaken several desk studies and ground investigations at neighbouring sites. The plan of nearby Arup sites is shown in Figure 4.

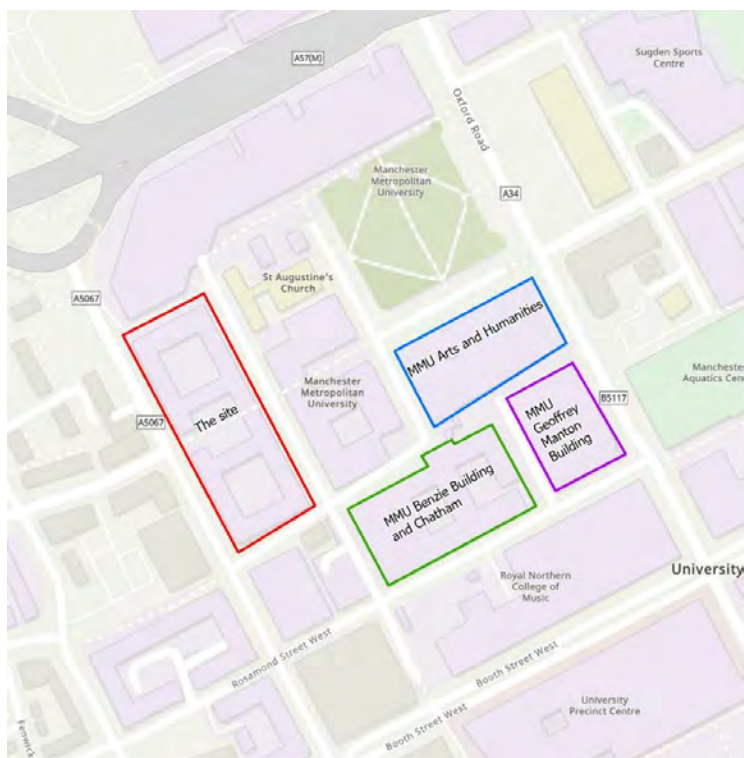


Figure 4 Arup nearby sites

MMU Halls of Residence (located within the site boundary)

Ground investigation conducted on the development site in 1993/1994 by Exploration Associates and LTG Ground Engineering for the existing buildings present comprised nine trial pits and three cable percussive boreholes ranging in depth from 8m to 11m. Made Ground was encountered to a depth of between 1m and 4m. This was described as demolition rubble mixed with reworked glacial material. This was underlain by Glacial Sands and Gravels which in turn overlie Glacial Till. The Glacial Sands and Gravels comprise medium dense granular deposits and the base of the Sands and Gravels is between 3m and 4m below ground level. The Till comprises stiff brown silty clay. Sandstone bedrock was encountered at depths between of 6.8m and 9.9m across the site. Ground water level was not recorded during the investigation.

MMU Benzie Building and Chatham Tower

Ground investigation conducted approximately 50m southeast of the site in 2010 by Ian Farmer Associates included three boreholes with rotary coring follow on, ten window samples and twelve trial pits. The ground investigation revealed a variable thickness of made ground (1.2m to 2.4m) across the site. This was underlain in places by a thin layer of Sands and Gravels (0.2m to 0.5m) over Glacial Till (0.8m to 3.6m). Sandstone bedrock was encountered at depths ranging from 3.4m to 4.6m below ground level. Generally, no visual or olfactory evidence of contamination was encountered within the bulk of the Made Ground or within the underlying strata. However, hotspots of hydrocarbons were noted to be present in the Made Ground in samples obtained adjacent to pipe work associated with a former oil tank in the basement to the Chatham Tower building. Groundwater was not encountered during the investigation and the installations remained dry during the monitoring period. Gas monitoring did not reveal elevated levels of ground gas on the site.

Geoffrey Manton Building

Ground investigation conducted approximately 150m southeast of the site in 1993 by Exploration Associates included five cable percussive boreholes with rotary coring follow on. The deepest borehole was 25m deep (base of hole 12.97mOD). Thirteen trial pits were also completed ranging in depth between 1.4m and 4.2m.

The boreholes and trial pits encountered Made Ground to a depth of between 1.15 to 2.6m bgl. This is underlain by fluvio-glacial sheet deposits, comprising medium dense sand and gravels, to depths between 2.8m and 3.3mbgl. The top of the sandstone bedrock was encountered between 3.2mbgl and 4.2mbgl across the site. Two boreholes proved the base of the sandstone as being between 20.7m (17.27mOD) and 19.5m (18.44mOD) below ground respectively. Beneath this is a weathered moderately weak siltstone. Gas and groundwater monitoring wells were installed in the boreholes on completion. The data from this indicates a groundwater level of 11m below ground level.

MMU Arts and Humanities

Ground investigation conducted approximately 150m east of the site in 2016/2017 by Resource and Environmental Consultants (REC) limited included windowless sampling, trial pits and seven cable percussive boreholes with rotary coring follow on. The exploratory holes encountered Made Ground to a depth between 1.0 to 4.5m bgl. This was underlain by Glacial Till (up to 3.5m thick) followed by sandstone bedrock encountered at depths ranging from 4.2 to 7.1m bgl. Underlying the sandstone strata, the Manchester Marls Formation was encountered at depths ranging from 9.5 to 18.5m bgl. The top of the Manchester Marl was encountered at shallow depths in the eastern portion of the site and appeared to dip in a westerly direction. Groundwater levels from monitoring ranged between 9.0 to 11.9m bgl.

3.3.3 Summary

From Arup's local knowledge, the site is expected to have made ground (up to around 4.5m thick) present underlain by glacial sands and gravels (around 2m thick) followed by glacial till (up to around 6m thick). Bedrock described as a highly to moderately weathered sandstone is anticipated to be encountered around 6.8m to 9.9mbgl. Marl is expected to underlie the sandstone at around 32 to 36mbgl. Groundwater level is anticipated to be present circa 9 to 12mbgl based on data from the historical ground investigations conducted in the area.

3.4 Radon

The Groundsure Report indicates that there is a low risk from radon at the site, with less than 1% of properties exceeding the Radon Action Level. Therefore, no radon protective measures are deemed necessary for the site.

3.5 Hydrology and hydrogeology

The bedrock geology is classified as a Principal Aquifer. These are layers with high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale.

With regards to superficial deposits, these are designated as Secondary A. These are 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.

Groundwater abstractions are shown to be licensed within 2km of the site with the nearest being approximately 55m north of the site. The site is located within Source Protection Zone 3.

There are no surface water bodies nearby the site.

3.6 Flooding

The EA flood mapping indicates the risk of flooding from rivers and the sea. From this, the southwestern corner of the site is within flood zone 2 (medium probability).

The highest risk of surface water flooding is a 1 in 30-year rainfall event where surface water levels could be between 0.1m and 0.3m in height. The risk of flooding from groundwater is reported as moderate-high.

3.7 Environmental permits and incidents

Data on environmental permits, waste exemptions, licensed industrial activities and reported pollution incidents are included in the Groundsure report[1][2]. Waste exemptions are listed in the surrounding area,

associated with nearby site development. Nearby environmental permits and waste exemptions are not considered to significantly impact the site or the proposed development.

3.8 Landfills

No active or former landfills are recorded on site.

A former wastepaper works present in 1950s is shown within 500m of the site (277m north), although it is considered not to significantly impact the site or proposed development.

3.9 Unexploded ordnance (UXO)

A Stage 1 Preliminary UXO Risk Assessment was carried out by specialists Igne [5].

Two bomb strikes were recorded on the site causing serious damage to the large building in the southern section of the site and at least ten bomb strikes have been recorded within 300m of the site.

The site has initially been given a High Preliminary Risk Level and further discussion is presented in Section 5.

4. Preliminary geoenvironmental assessment

4.1 Approach

Land contamination can present an environmental liability and a constraint to site development. The principal UK legislation related to land contamination is contained within Part 2A of the Environmental Protection Act 1990. Only land where unacceptable risks are clearly identified, after a risk assessment has been undertaken in accordance with guidance, should be considered as meeting the Part 2A definition of contaminated land. In England policy relevant to site development is set out in National Planning Policy Framework (NPPF) (updated September 2023).

The central objectives of the land contamination regime across the UK are the prevention of significant harm, promotion of sustainable development and a “suitable for use” approach to land remediation. It is founded upon the promotion of a risk assessment approach to managing land contamination, focusing on establishing where risks to human health or the wider environment are unacceptable, and then taking appropriate and cost-effective action to deal with these risks.

Across the UK a source-pathway-receptor approach to contamination risk assessment and management is applied based upon the development of a conceptual model for the site, which identifies potential pollutant linkages. The “source” is defined as any contamination on the site, which may impact one or more “receptors”, including people, plants, ecosystems, building materials and water resources. For there to be a contaminant linkage, and therefore a potential risk, there must be a “pathway” between the source and the given receptor. The conceptual site model (CSM) is used to articulate and systematically guide assessment of risks associated with contamination at the site.

For the purposes of this CSM, understanding of the site history and anticipated ground conditions have been used to identify the potential risks to human health and the groundwater environment.

This preliminary geoenvironmental risk assessment has been prepared to inform decisions related to possible sources of contamination identified at the site. The risk assessment follows the UK approach to assessing contaminated land as outlined in the Land Contamination: Risk Management guidance [9].

4.2 Possible sources

The site has historically housed residential buildings, a tramway, timber yards, a park and warehouse. The current site use is a building used for student accommodation. The surrounding area has seen electric substations, car parks, schools, and a hospital.

Where available, the Department of Environment (DoE) Industry Profiles [6] were used to identify possible contaminants associated with historical land uses and are summarised in Table 3.

Table 3: Possible contaminants based on sources of historical land use

Possible Source	Potential Contaminants	Comments
Made ground beneath site associated with historical development	Asbestos Heavy metals Extremes of pH Hydrocarbons Polycyclic aromatic hydrocarbons (PAHs) Ground gas (methane, carbon dioxide, hydrogen sulphide)	A range of contaminants can be associated with made ground. Demolished buildings/facilities of fill derived from demolition activities may contain asbestos.
General contaminants associated with past land use in the surrounding	Heavy Metals Hydrocarbons Asbestos Polycyclic aromatic	Contamination from offsite sources can potentially move laterally along buried services etc.

land including car parks, hospital and a school	hydrocarbons (PAHs)	
Timber yards ¹	Creosotes Phenolics Organic Solvents Asbestos	Coating of timber products may have been undertaken within the timber yards.
Electric substations	Polychlorinated biphenyls (PCBs)	Compounds commonly used in former substations and may be present on site due to nearby former substations.
¹ DoE Industrial Profile: Timber treatment works		

4.3 Receptors

The proposed development involves the demolition and construction of a building providing student accommodation. Potential receptors both during construction and after completion of the development include:

- Construction workers and site neighbours during development;
- Future site users and maintenance/ ground workers of the new development;
- Groundwater within the Principal aquifer (Bedrock) and Secondary A aquifer (Superficial); and
- Building materials

4.4 Pathways

Potential pathways that may be present during construction and operational phases of development include:

- Human health – ingestion of soils or dust;
- Human health – inhalation of dust, vapour or ground gas;
- Human health – dermal contact with soils, surface water and groundwater;
- Controlled waters – leaching of contaminants from soils into groundwater;
- Controlled waters – migration of dissolved phase contamination within groundwater;
- Ground gas – ingress of ground gas into buildings; and
- Building materials – direct contact with soils and/or groundwater.

4.5 Contamination assessment

4.5.1 Soil human health risks

Made ground is anticipated to be present. The proposed site use limits the potential that future site users will come into contact with the soils on site, with the exception of areas of soft landscaping.

Where made ground is present at shallow depth beneath any soft landscaping there is a risk that site users could come into contact with contamination via dermal contact, inhalation and ingestion pathways. However, this would be mitigated by the provision of clean cover system in all landscaped areas and therefore risks to future site users are considered to be low.

The biggest risk from interaction with soil on site arises during the construction works. There is a possibility that, if contaminated, the made ground may pose a short-term risk to human health for the construction workforce via potential exposure pathways including dermal contact, dust/fibre inhalation and ingestion pathways outdoors, and inhalation of gases. There is also a possible risk to site neighbours during

construction via dust/fibre inhalation exposure pathways. Such risks can be mitigated by the contractor following standard good practice during construction and adoption of adequate health and safety procedures.

Historical ground investigation conducted prior to the development of the existing halls of residence did not encounter any significant contamination and remediation was not required to enable the current development. Any residual risks associated with the site history is to be identified during ground investigation.

4.5.2 Controlled waters risk

Any contamination potentially present in made ground and superficial deposits may pose a risk to controlled waters through leaching and transport in groundwater.

Piling or deeper excavations may create a pathway that may allow the vertical migration of dissolved contamination to unimpacted groundwater at greater depth (Chester Pebble Beds Formation). Significant contamination is not anticipated, and the risk is considered low. The extent of soil contamination will be identified during ground investigation.

If significant contamination is encountered during ground investigation a foundation works risk assessment may be required.

4.5.3 Ground gas risk

The made ground on this site is most likely to comprise demolition materials from former buildings on the site and therefore the presence of significant organic content is unlikely.

Ground investigation should assess the extent of degradable materials. Ground gas monitoring could be carried out to determine the ground gas regime, but only if a potential source of hazardous gas is identified.

4.5.4 Buried structures and services

Buried structures and services may be at risk from corrosion or degradation as a result of the direct contact with contaminants in made ground and, for example, naturally elevated sulphate levels.

These risks can be mitigated by the selection of appropriate materials for buried serviced and concrete design. Risks to buried structures and services requires assessment in the context of ground contamination at the site.

4.5.5 Summary of conceptual site model

A summary of the plausible pollutant linkages requiring assessment in relation to the site is presented in Table 4 below.

Table 4: Summary of conceptual model (post-development)

Sources		Pathways		Receptors	Comments
Made ground	→	Dermal contact with soils	→	Site workers during construction	Ground investigation is recommended to assess whether contaminated soils are present. Appropriate site management protocols to be adopted during construction and maintenance works.
		Ingestion of soil, fibres or dust	→	Maintenance workers Future site users Users of future site (only in soft landscaping areas),	
		Inhalation of soil vapours and ground gases	→	Site workers during construction and site neighbours	

Sources		Pathways		Receptors	Comments
		Inhalation of soil and soil dust	→	Maintenance workers Future site users Users of future site (only in soft landscaping areas),	A clean cover system may be required in soft landscaping areas.
Leachable contaminants in the made ground		Vertical migration of dissolved phase contamination	→	Groundwater within bedrock geology (Principal Aquifer) and Superficial Deposits (Secondary A Aquifer)	Significant contamination is not anticipated on site. Sampling and analysis to be undertaken during ground investigation.
Ground gases	→	Accumulation of gases in confined spaces producing asphyxiation and explosion risk	→	Users of future site buildings	No potential source of hazardous ground gas identified. Ground gas monitoring will only be considered if significant volume of degradable material identified during ground investigation.
Soils or groundwater aggressive to building materials	→	Contact with aggressive soils and groundwater	→	Buried water supply pipes	Ground investigation is recommended to assess whether contaminated soils are present. Selection of appropriate materials for buried services.

5. Engineering considerations

5.1 Ground model

The ground model below summarises the ground conditions from available historical ground investigation data.

Table 5: Ground model

Strata	Description	Top mgbf (Elevation mOD)	Base mgbf (Elevation mOD)	Thickness (m)
Made Ground	Mixed demolition rubble, generally used to backfill former terrace basements. Working platform likely to have been placed for construction of the existing buildings.	0.0 (36.5 to 37.6)	1.0 to 4.7 (35.7 to 36.4)	1.0 to 4.7
Glacial Deposits (sands and gravels)	Firm yellow brown mottled grey silty slightly sandy CLAY over loose to medium dense slightly orange brown slightly silty SAND AND GRAVEL with some cobbles.	1.0 to 1.7 (35.7 to 36.4)	3.0 to 3.5 (31.9 to 34.4)	1.8 to 2.3
Glacial Deposits (till)	Stiff to very stiff brown silty CLAY with a little subangular to rounded fine to medium gravel of mixed lithology. Locally firm.	3.0 to 3.5 (31.9 to 34.4)	6.8 to 9.9 (26.8 to 29.8)	2.1 to 6.2
Sandstone	Orange brown fine to medium grained SANDSTONE, weak, highly to moderately weathered in the upper few metres.	6.8 to 9.9 (26.8 to 29.8)	32.0 to 36.0 (4.5 to 0.5)	Circa 25.0
Manchester Marl	Extremely weak to weak reddish brown moderately to highly weathered occasionally completely weathered mudstone	32.0 to 36.0 (4.5 to 0.5)	Not proven	Not proven
Notes: - It is anticipated that sandstone is encountered as being weathered becoming less weathered with depth - Estimated elevation and depths have been obtained from historical ground investigation.				

5.2 Buried obstructions, soft ground and voids

Residential buildings were present in the north of the site dating back since the earliest mapping date (1848) and a large building inferred to be a warehouse constructed in the south of the site in the late 1890s. The site was redeveloped in the mid-1990s to provide student accommodation for the Manchester Metropolitan University.

From the historical ground investigation information, intact brick walls were encountered in three trial pits in the north of the site, at depths of approximately 2m below ground level. This could be associated with intact buried structures (infilled cellars and basements) associated with the former residential development.

In the south of the site, an intact concrete slab was encountered in one exploratory hole location at approximately 4m below ground level, potentially associated with a basement to the former warehouse. This slab was not encountered across the entire footprint of the former warehouse and may only be still intact within the southeast of the site.

Made ground was encountered up to 4.7m thick described as being demolition rubble mixed with reworked glacial material, which has been interpreted as backfilled basements. Voids may be associated with any period of uncontrolled backfilling, redundant utilities or any partially infilled basements associated with historical development. Historical poor backfilling of made ground may lead to the presence of shallow localised soft spots that may not have been dealt with prior to construction of the existing buildings.

Obstructions associated with the existing building foundations will also be present, the foundation arrangement of the existing student accommodation is not known at this stage, but is thought most likely to comprise pad footings bearing onto the glacial soils.

Buried obstructions, soft spots and voids may impact temporary works and foundation solutions, and their presence should be investigated using trial pitting as part of an intrusive ground investigation.

5.3 Shallow groundwater

The groundwater level is at indicative level of 9 to 12mbgl from nearby ground investigation information. However, given the historical development at the site, there is potential for the presence of shallow perched ground water contained within the made ground and residual substructures.

The ground investigation should include the installation of standpipes to allow ground water levels to be determined and monitored.

5.4 Foundations

The choice of foundation solution will depend on the imposed loads from the structure and the depth to bedrock.

The Made Ground is likely to be variable in composition and strength and is considered unsuitable as a foundation stratum.

Glacial Deposits are anticipated to be present beneath the site, with varying thicknesses of granular and cohesive materials reported across the site. Given the anticipated significant building loads, it is considered unlikely that these materials will be suitable for supporting shallow foundations for the main structure.

Based on extensive experience of nearby sites, the underlying sandstone will provide a suitable founding material for piled foundations and is the most likely solution for the proposed development.

At this stage it is considered likely that a bored or cast in situ piling solution will be most appropriate with piles socketed into the underlying sandstone, dependent on the thickness of the weathered profile.

Three United Utilities sewers are present on site, aligned northeast to southwest (see Section 2.3). The most notable of the sewers is a 1950mm diameter brick lined sewer located at an invert level of approximately 12mbgl in the centre of the site. The foundations will have to adhere to United Utilities wayleaves and foundation depths should be designed to not adversely load the deep brick lined sewer.

Consideration needs to be given to noise and vibration during piling operations, particularly due to the nearby sewers, selection of a continuous flight auger technique will mitigate this concern provided that obstructions within the ground can be managed.

5.5 Earthworks

Site levels are constrained by the adjacent roads on three sides of the site and the MMU Faculty of Business and Law building. In addition, no basement structure is currently proposed for the development. although incoming services will likely require substantial trenches.

A period of enabling works may be required if obstructions are widely found present across the site following ground investigation. Such works would target the removal or penetration of obstructions to de-risk the site in advance of the construction of foundations.

5.6 UXO

The site has initially been given a High Preliminary Risk Level from the Stage 1 Preliminary UXO Risk Assessment. The removal of the tramway sidings in the late 1940s, demolition of the residential buildings and warehouse in the 1960s may have been associated with WWII bomb damage.

Although historical bomb damage has been reported at the site, there remains the potential for further unexploded ordnance at the site.

A Stage 2 Detailed UXO Risk Assessment is required prior to any intrusive works being undertaken to clarify the UXO risk to proposed works.

Dependant on the findings of the Detailed UXO Risk Assessment, a watching brief from a UXO specialist is likely required during ground investigation.

6. Geotechnical and geoenvironmental risk register

Register reference – Cambridge Hall, Manchester Geotechnical and Geoenvironmental Risk Register

Project Cambridge Hall, Manchester

Job number 303452-00

**Package/
topic**

Design stage Desk Study – For Information

Remember: Avoid – Reduce – Control and communicate relevant information to others

Date (+ initials)	Area/location of risk exposure	Description of hazard and risk exposure	Mitigation of risk (potential or achieved)	A	R	C	Further action	By	Status
									Active/closed
15/07/24 ZO	Site wide	Buried obstructions or voids impacting time and cost of ground investigation and construction activities.	Ground investigation to assess extent of buried obstructions on site.			✓	Once risk is established during ground investigation, potential enabling works to remove obstructions in advance of construction	Arup/ Contract or	Active
15/07/24 ZO	Site wide	Risk of clashing with utilities during ground investigation and construction works.	Obtain utility plans/GPR survey in advance of ground investigation.			✓	Designer to avoid known services where possible. Contractor to take appropriate precautions during works.	Client/ Contract or	Active
15/07/24 ZO	Site wide	Contamination causing risk to human health of workers during construction and future site users during operation.	Undertake ground investigation to collect soil samples for geoenvironmental testing.			✓	Undertake risk assessment on basis of ground investigation findings.	Arup/ Contract or	Active
15/07/24 ZO	Site wide	Migration of contamination into underlying aquifer due to foundation piling.	Undertake ground investigation to collect soil/water samples for geoenvironmental testing.			✓	If evidence of significant soil contamination is encountered, prepare a piling works risk assessment.	Arup/ Contract or	Active
15/07/24 ZO	Site wide	Shallow groundwater impacting construction works	Undertake groundwater monitoring during ground investigation			✓		Arup/ Contract or	Active
15/07/24 ZO	Site wide	Risk of encountering unexploded ordnance (UXO) during ground investigation and construction	Detailed UXO Risk Assessment to be carried out			✓	Follow recommendations of Stage 2 Detailed UXO Risk Assessment.	Arup/ Contract or	Active

Register reference – Cambridge Hall, Manchester Geotechnical and Geoenvironmental Risk Register

Project Cambridge Hall, Manchester

Job number 303452-00

**Package/
topic**

Design stage Desk Study – For Information

Remember: Avoid – Reduce – Control and communicate relevant information to others

Date (+ initials)	Area/location of risk exposure	Description of hazard and risk exposure	Mitigation of risk (potential or achieved)	A	R	C	Further action	By	Status
									Active/closed
		works.							
15/07/24 ZO	Site wide	Ground gases affecting any construction workers within excavations during ground investigation or construction works.	Gas monitoring included within ground investigation proposals.			✓	To be reviewed following ground investigation.	Arup/ Contract or	Active
15/07/24 ZO	Site wide	Potentially high sulphate concentration in the ground can attack any proposed buried infrastructure.	Collect samples for BRE Special Digest 1 testing.			✓	Concrete sulphate class to be designed following ground investigation	Arup/ Contract or	Active
29/07/24 SC	Centre of the site	Foundation works adversely loading the deep 1950mm diameter sewer, resulting in collapse	Foundations are to be designed to minimise additional loads on the sewer			✓	Foundation technique should be selected to minimise vibration in close proximity to the sewer	Arup/ Contract or	Active

7. Conclusions and recommendations

7.1 Conclusions

The site is expected to have made ground (up to 4.7m thick) present underlain by glacial sands and gravels (1.8-2.3m thick) followed glacial till (up to 6.15m thick). Bedrock described as a highly to moderately weathered sandstone is anticipated to be encountered around 6.8m to 9.9mbgl. Groundwater level is anticipated to be present circa 9 to 12mbgl based on data from the historical ground investigations conducted in the area.

The 1848 Ordnance Survey map showed the north of the site being occupied by terraced residential buildings. By 1851, timber yards are shown in the south of the site and in the early 1900s, a large warehouse was built in the south of the site. A tramway operated through the site from the 1880s until it was dismantled in 1940s. The warehouse and residential properties were demolished by 1960s. The site was undeveloped in the 1980s, understood to be university playing fields. By the year 2000, a student accommodation building occupied the site with no further change being observed on the site to date. The surrounding area has seen electric substations, car parks, schools, a garage, and an hospital.

The made ground is a potential source of contamination. Historical ground investigation conducted prior to the development of the existing halls of residence did not encounter any significant contamination and remediation was not required to enable the current development. Any residual risks associated with the site history is to be identified during ground investigation.

Obstructions have been reported in the historical ground investigation information for the site, where intact brick walls encountered at 2mbgl in the north of the site associated with the former residential development and a concrete slab at 4mbgl in the south of the site associated with the former warehouse development. The presence of potentially intact concrete slabs or other substructures may constrain the construction of foundations. Ground investigation is recommended to identify these obstructions and the most appropriate methods of dealing with them. A period of enabling works may be required if obstructions are widely found present across the site following ground investigation. Such works would target the removal or penetration of obstructions to de-risk the site in advance of the construction of foundations.

Three United Utilities sewers are present on site, aligned northeast to southwest (see Section 2.3). The most notable of the sewers is a 1950mm diameter brick lined sewer located at an invert level of approximately 12mbgl in the centre of the site. The foundations will have to adhere to United Utilities wayleaves and foundation depths should be designed to not adversely load the deep brick lined sewer.

Based on extensive experience of nearby sites, the underlying sandstone will provide a suitable founding material for piled foundations and is the most likely solution for the proposed development. At this stage it is considered likely that a bored or cast in situ piling solution will be most appropriate with piles socketed into the underlying sandstone.

The Preliminary UXO Risk Assessment has assigned a 'High' Preliminary Risk Level and a Stage 2 Detailed UXO Risk Assessment is recommended prior to any intrusive works on the site.

7.2 Recommended outline scope of ground investigation

It is recommended that a development specific intrusive ground investigation specific is undertaken.

Ground investigation objectives include the following:

- 1) Characterise the thickness and nature of made ground;
- 2) Investigate the nature, extent and depths of the buried obstructions and/or voids;
- 3) Characterise the nature of natural superficial materials and bedrock to inform foundation design;
- 4) Assess soil contamination to inform contamination risk assessment and soil re-use or disposal routes;

- 5) Assess groundwater levels and, if soil contamination is encountered, investigate groundwater contamination via sampling from standpipes.

Access prior to demolition of the existing building will be a major constraint. Mobilising rigs and other exploration equipment into most of the site requires consideration of the available access routes and headroom in working areas. It is recommended that two phases of ground investigation are considered. The first phase should be undertaken prior to demolition of the existing structures on site to examine key constraints to development e.g. extent of obstructions and to allow a programme of sampling and chemical testing to inform a preliminary contamination risk assessment of the site. Where possible, information on the depth to rockhead will be collected as part of this investigation but the depth of investigation may be limited by limited access and the type of plant used e.g. hand excavation or window sampling. Information from the first phase of investigation will inform the planning application for the new development.

The second phase of investigation should be undertaken post demolition when access will be available to a wider area of the site. The second phase of investigation should include deep boreholes including rotary coring into the underlying sandstone to collect data on the depth and nature of bedrock. This will provide data for the design of piled foundation solutions.

If ground investigation can only be conducted in a single phase before demolition works, there will be limitations in the quality of information that can be obtained from the ground investigation due to access restraints. This may result in a broader scope for the enabling works and a more conservative foundation design.

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- [2] Groundsure Enviro Insight report (2024) Report reference: GS-3GV-IYB-YV9-QOJ
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Appendix A

Groundsure Report

Site Details:

CAMBRIDGE NORTH HALL,
CAVENDISH STREET,
MANCHESTER, M15 6TT

Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: County Series

Map date: 1848

Scale: 1:10,560

Printed at: 1:10,560



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Edition 1848
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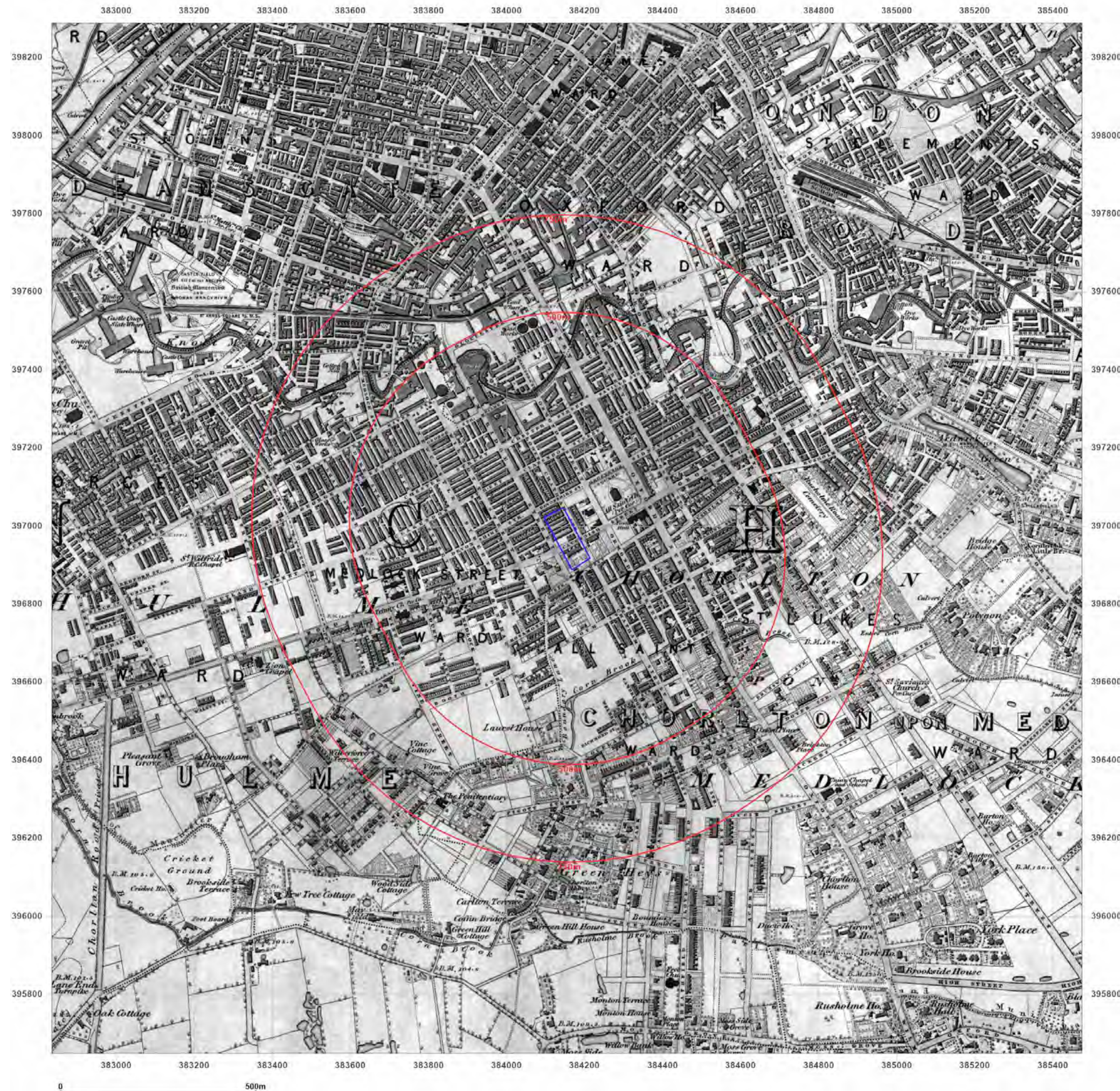


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Site Details:

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Grid Ref: 384154, 396968

Map Name: County Series

Map date: 1890-1891

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Edition N/A
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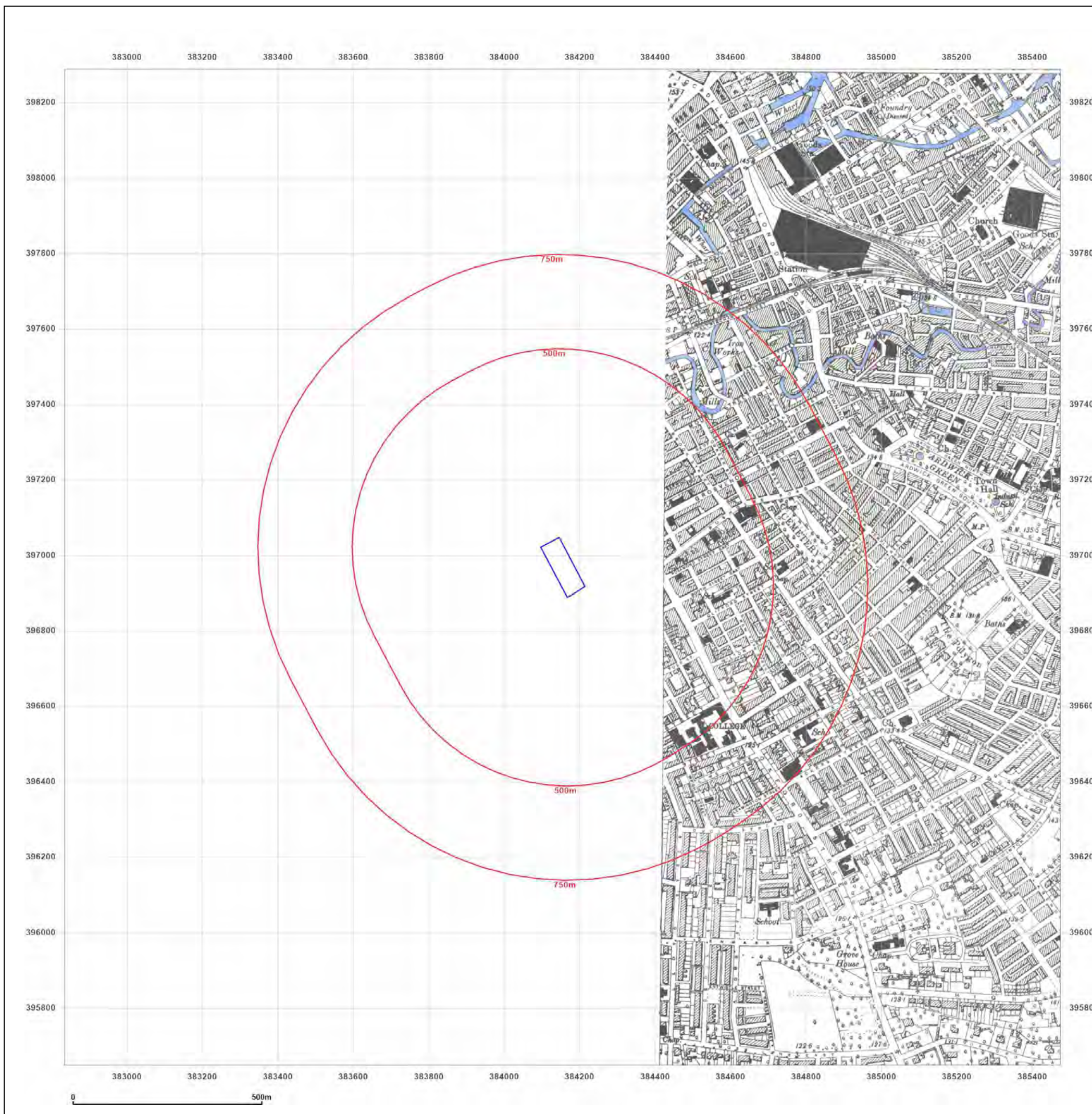


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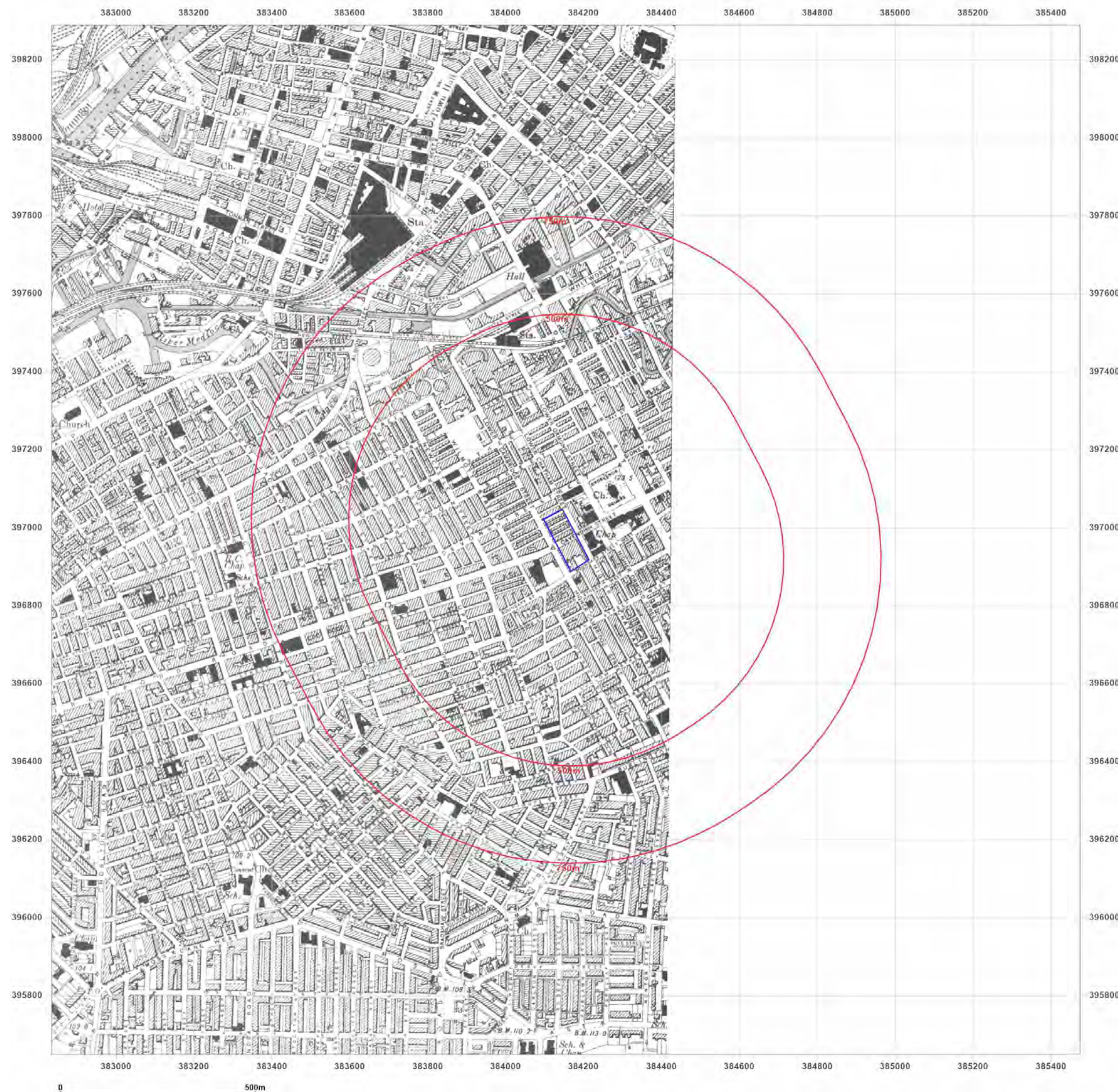


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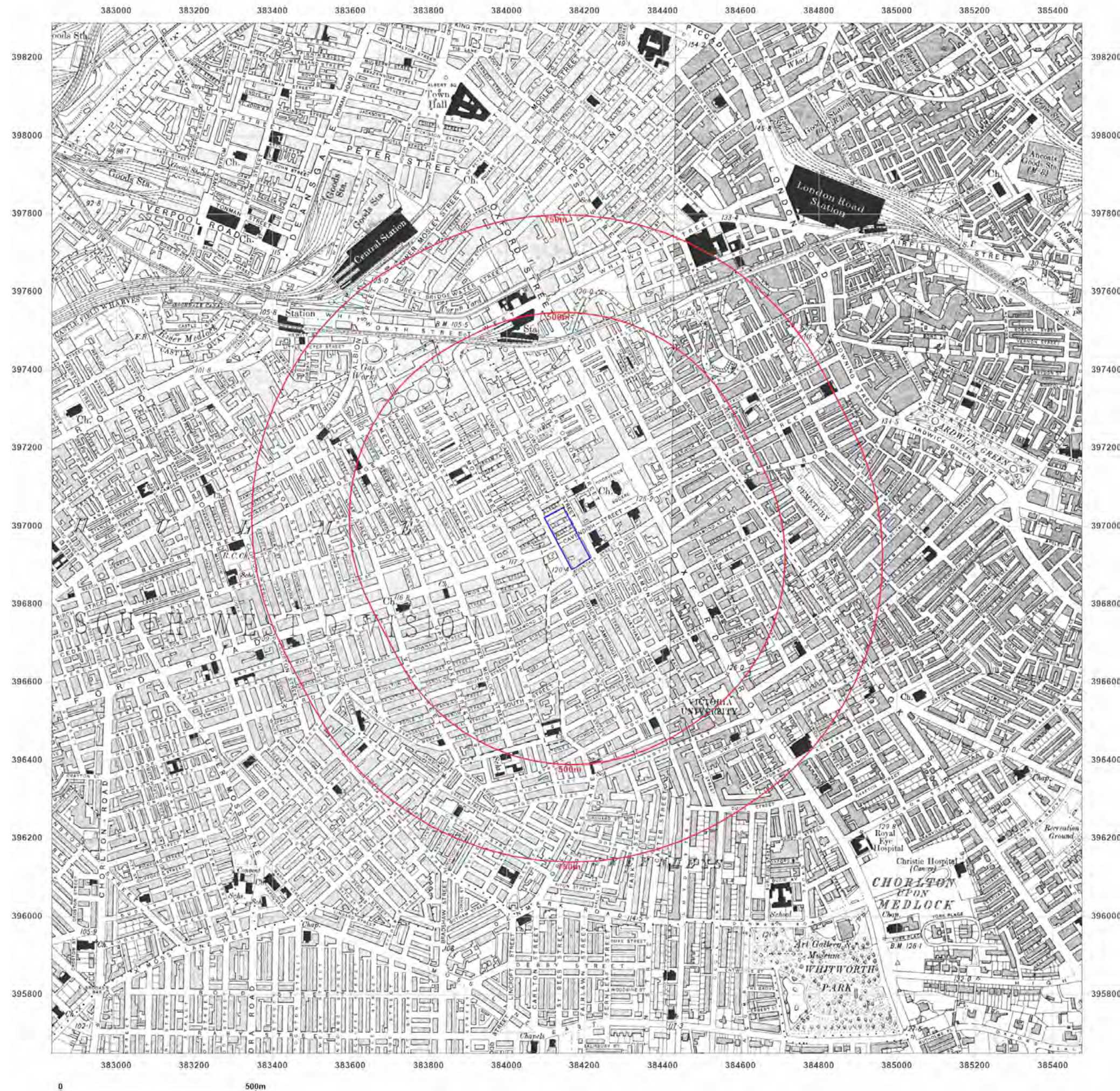


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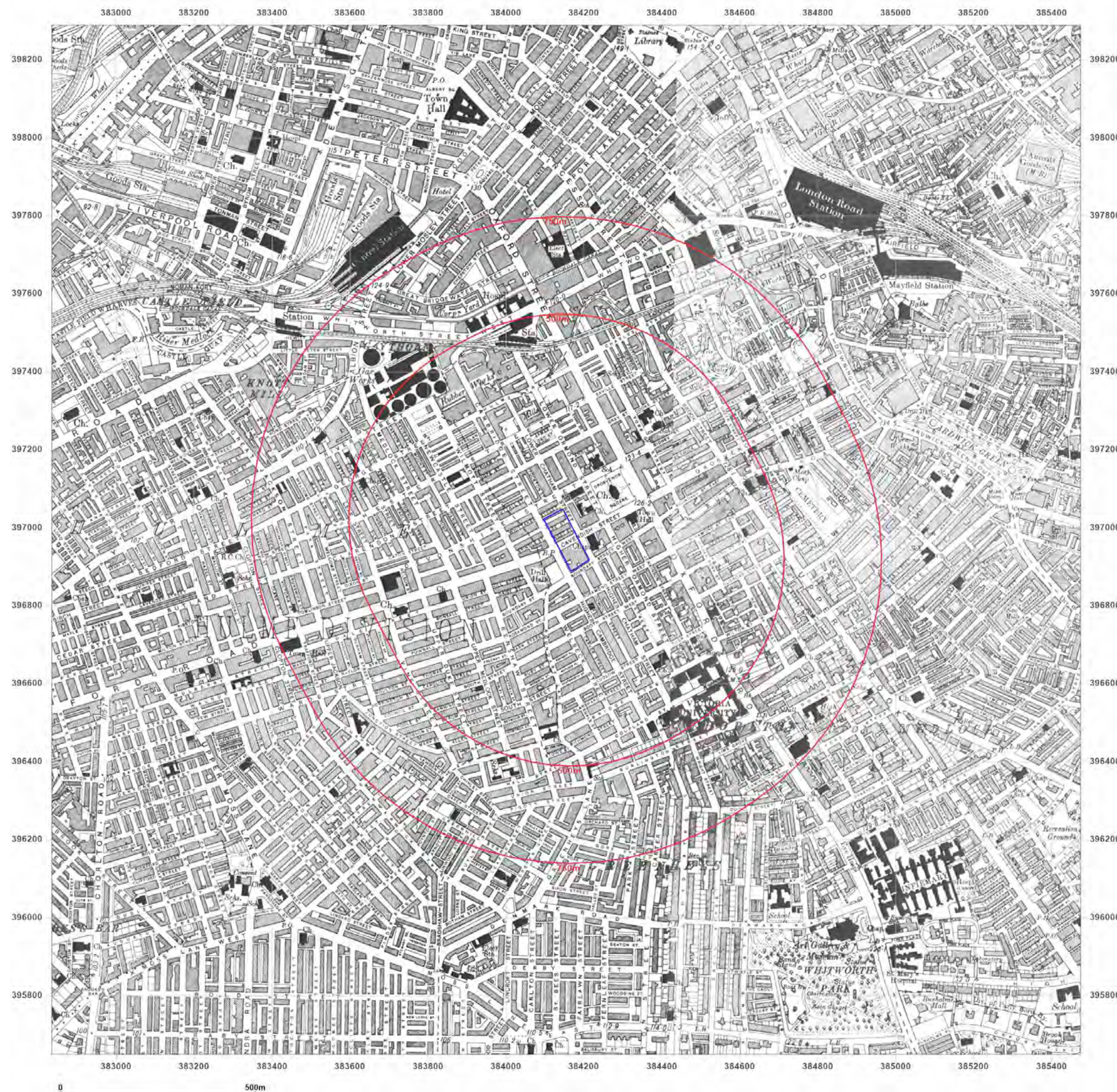


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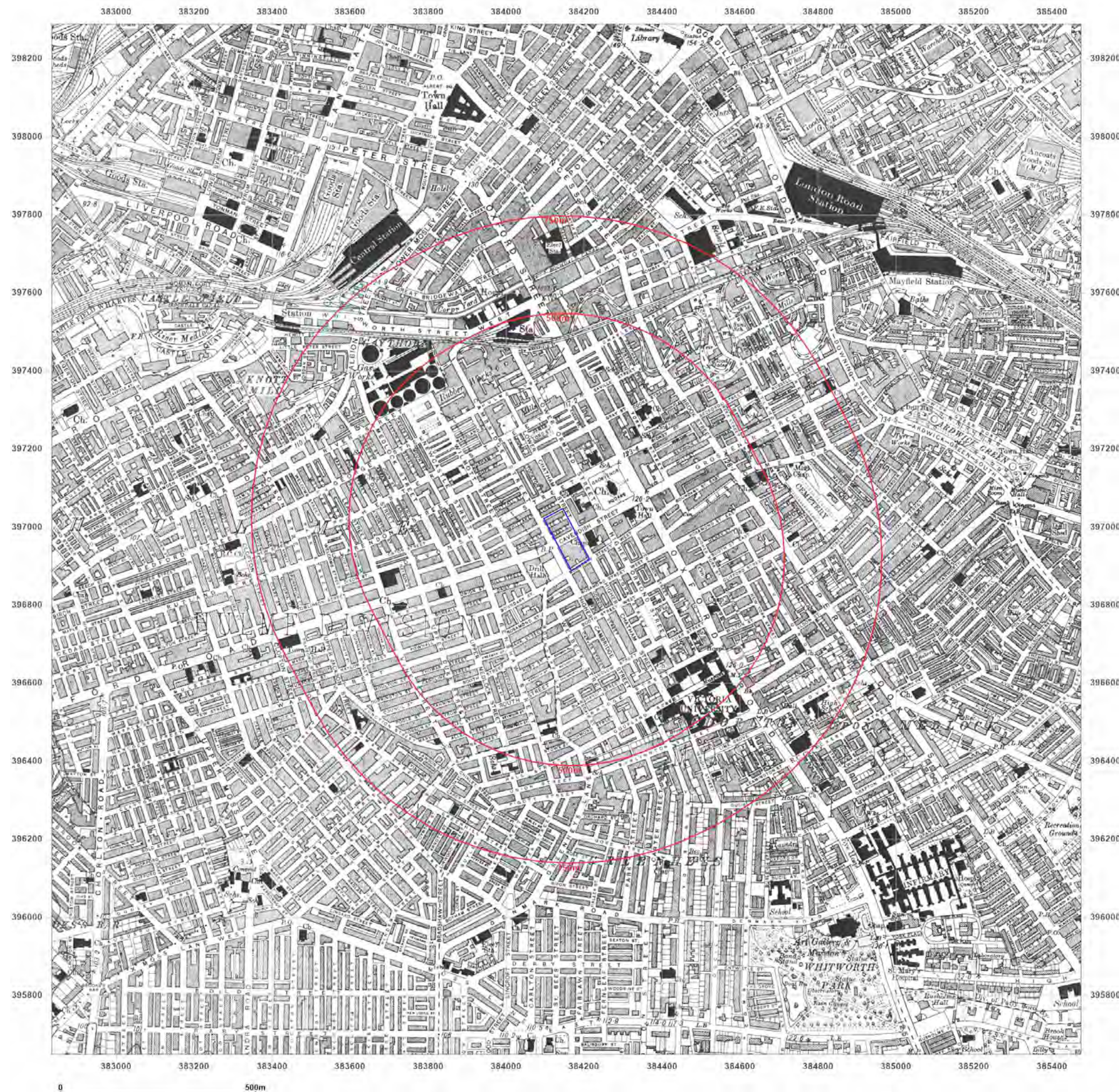


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Map Name: County Series

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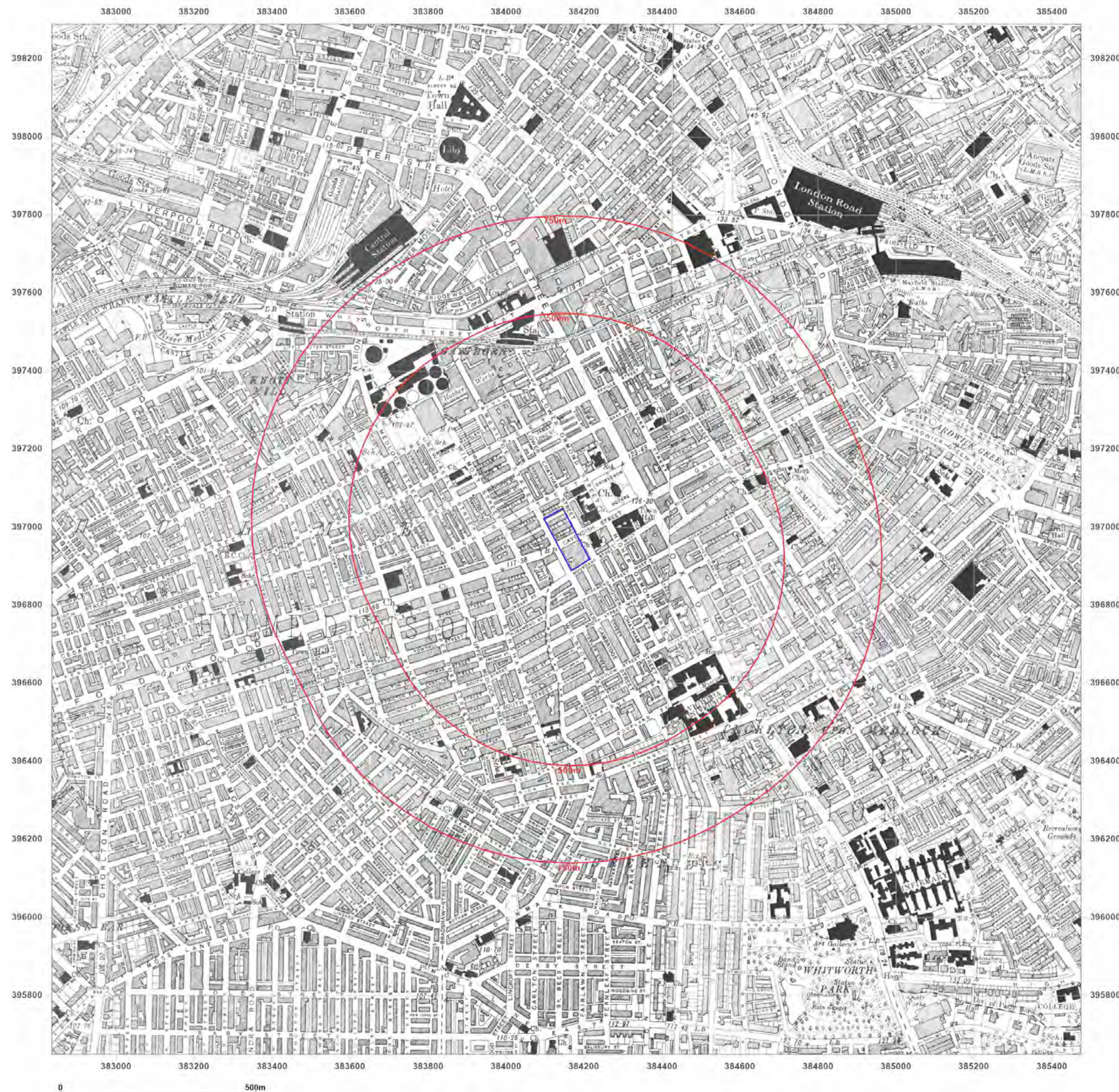


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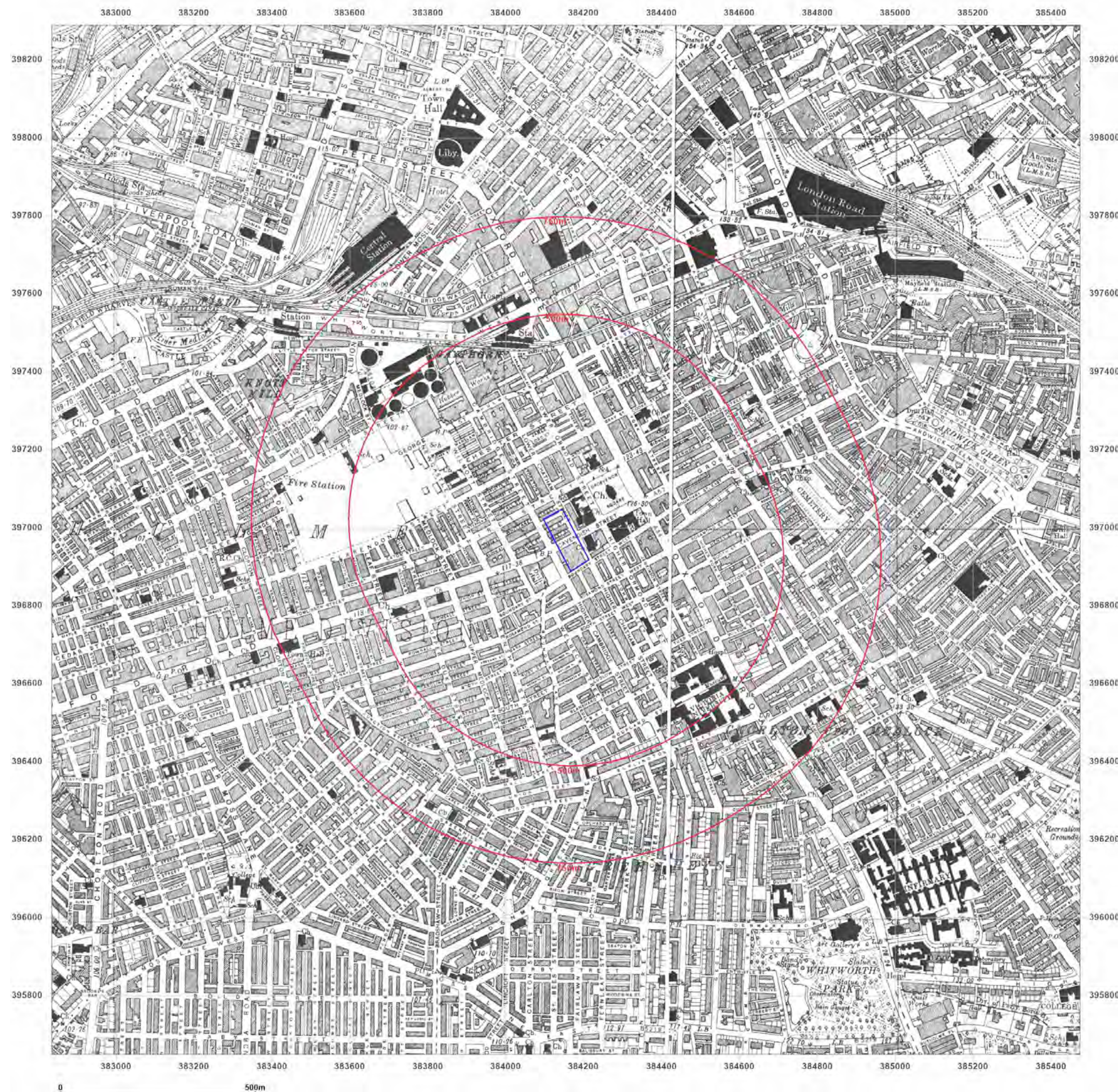


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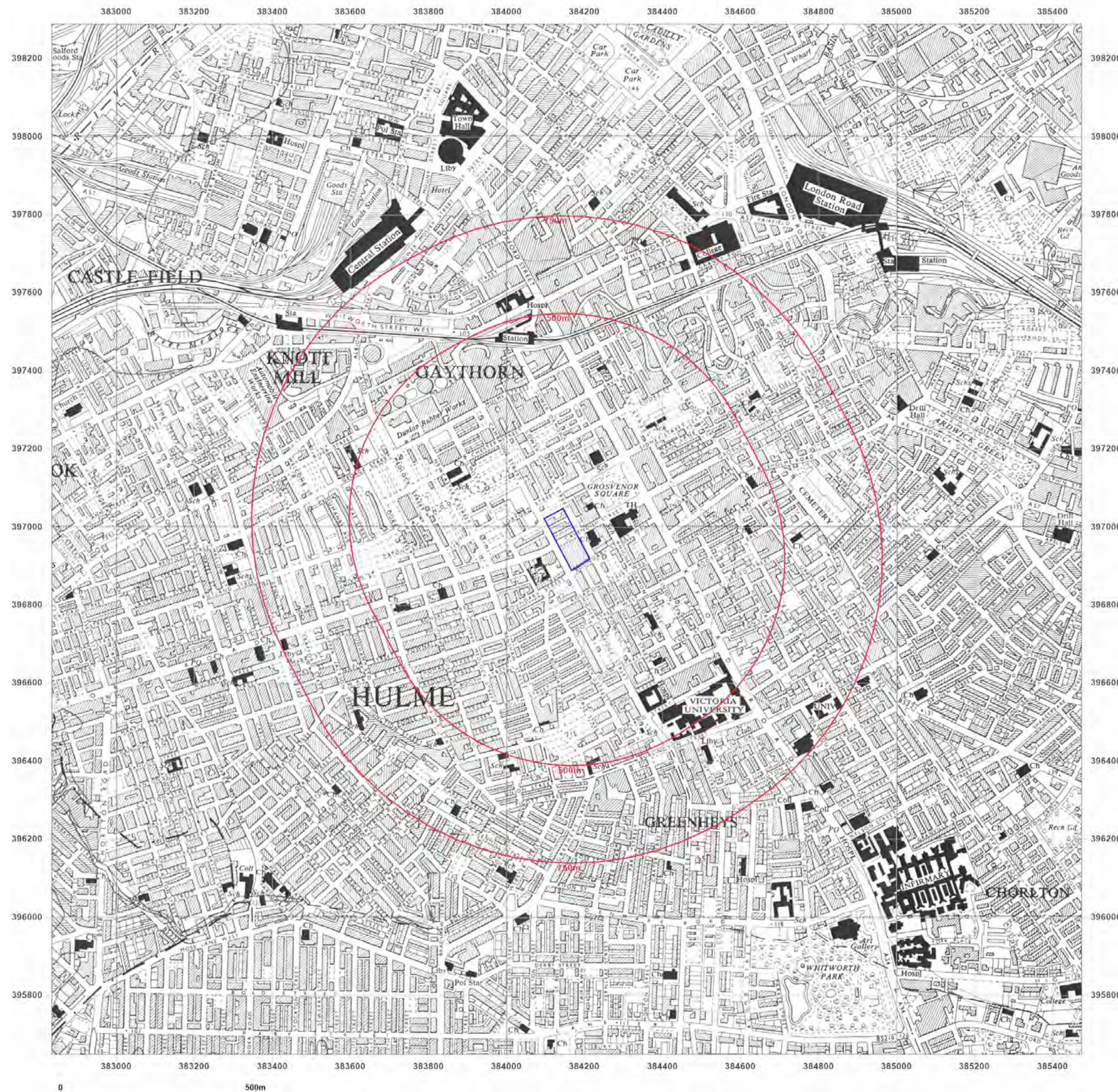


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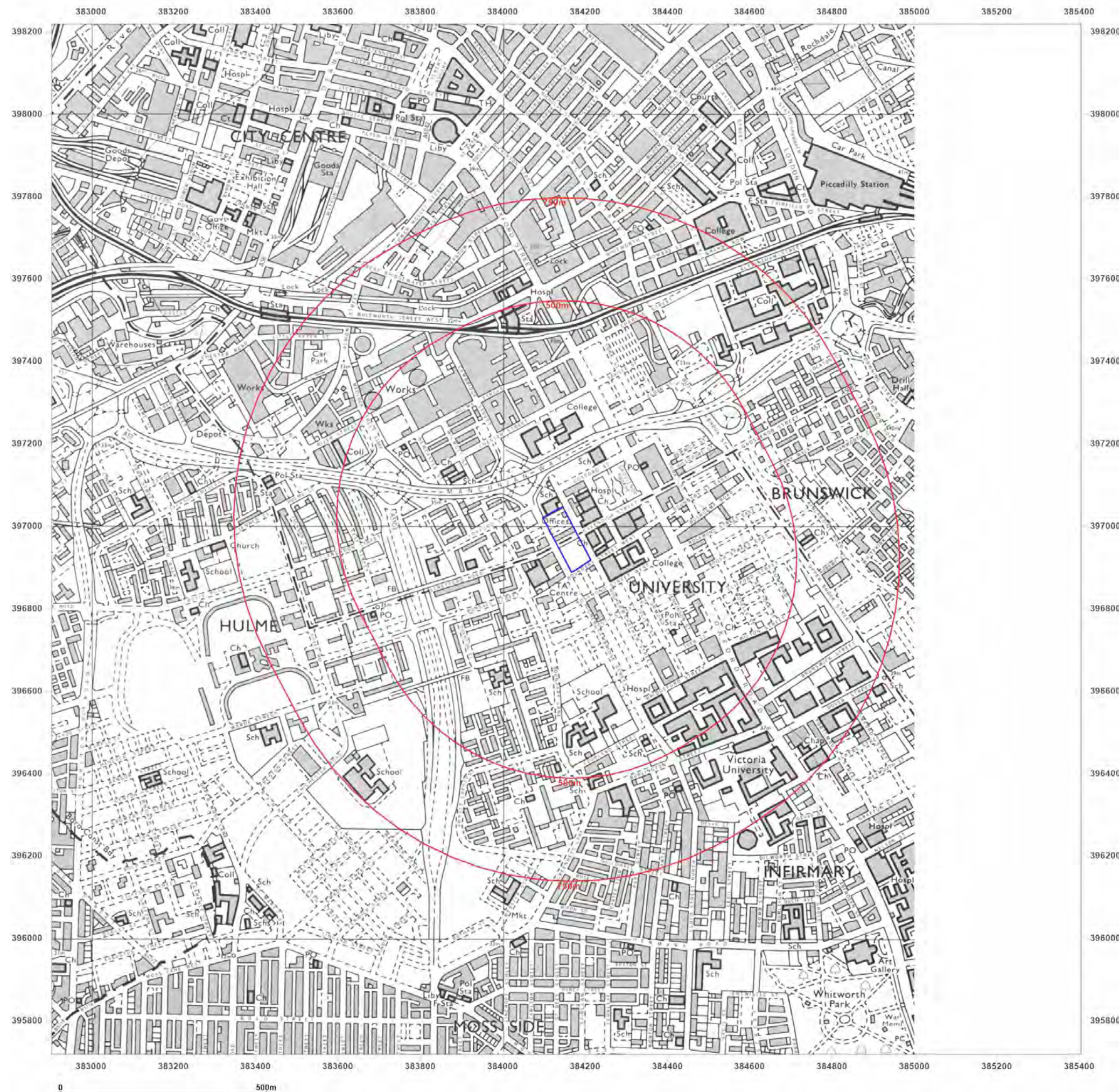


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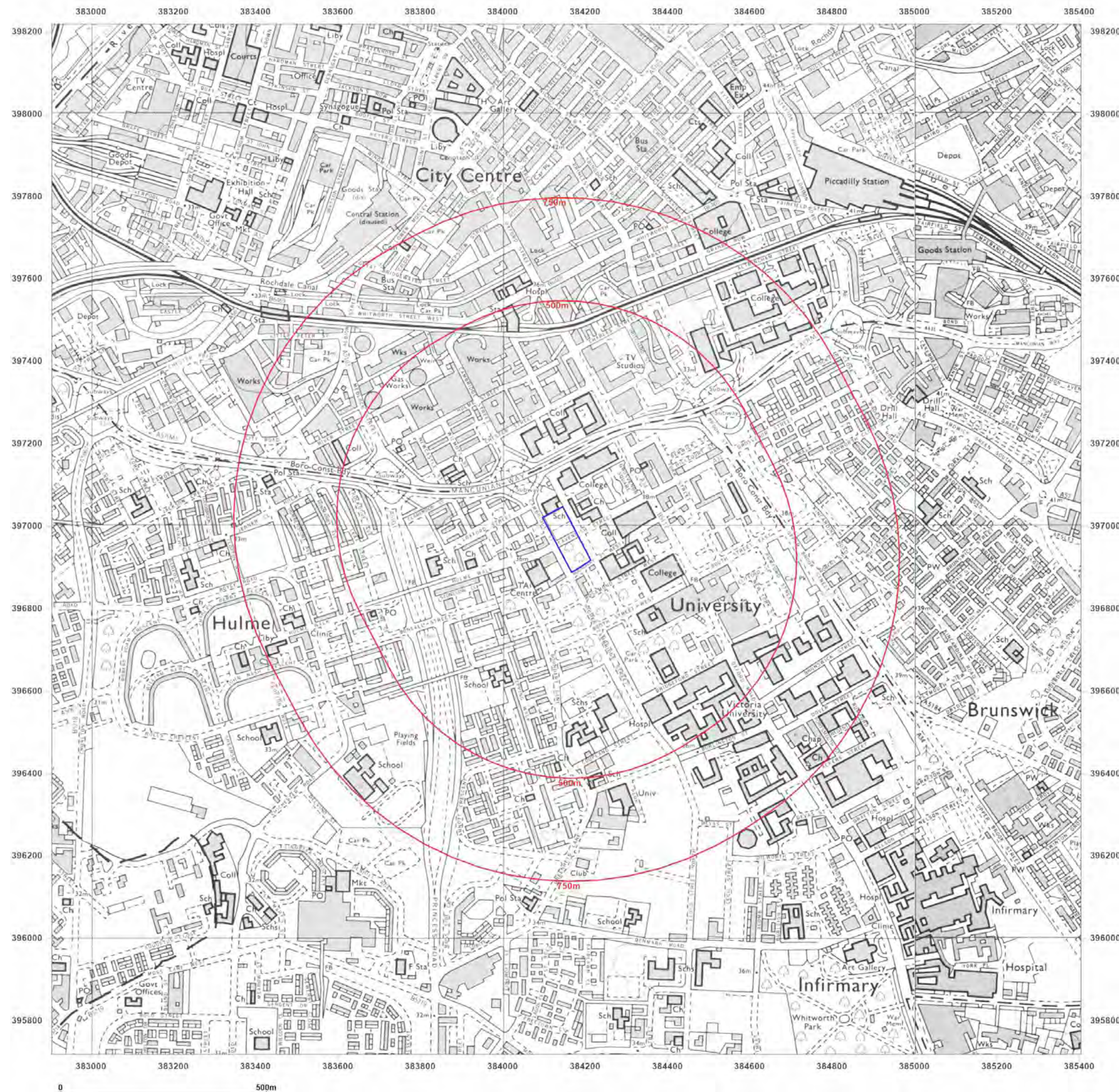


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Site Details:

CAMBRIDGE NORTH HALL,
CAVENDISH STREET,
MANCHESTER, M15 6TT

Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: National Grid

Map date: 1981-1985

Scale: 1:10,000

Printed at: 1:10,000



Surveyed 1983
Revised 1985
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1976
Revised 1980
Edition N/A
Copyright 1981
Levelled 1976

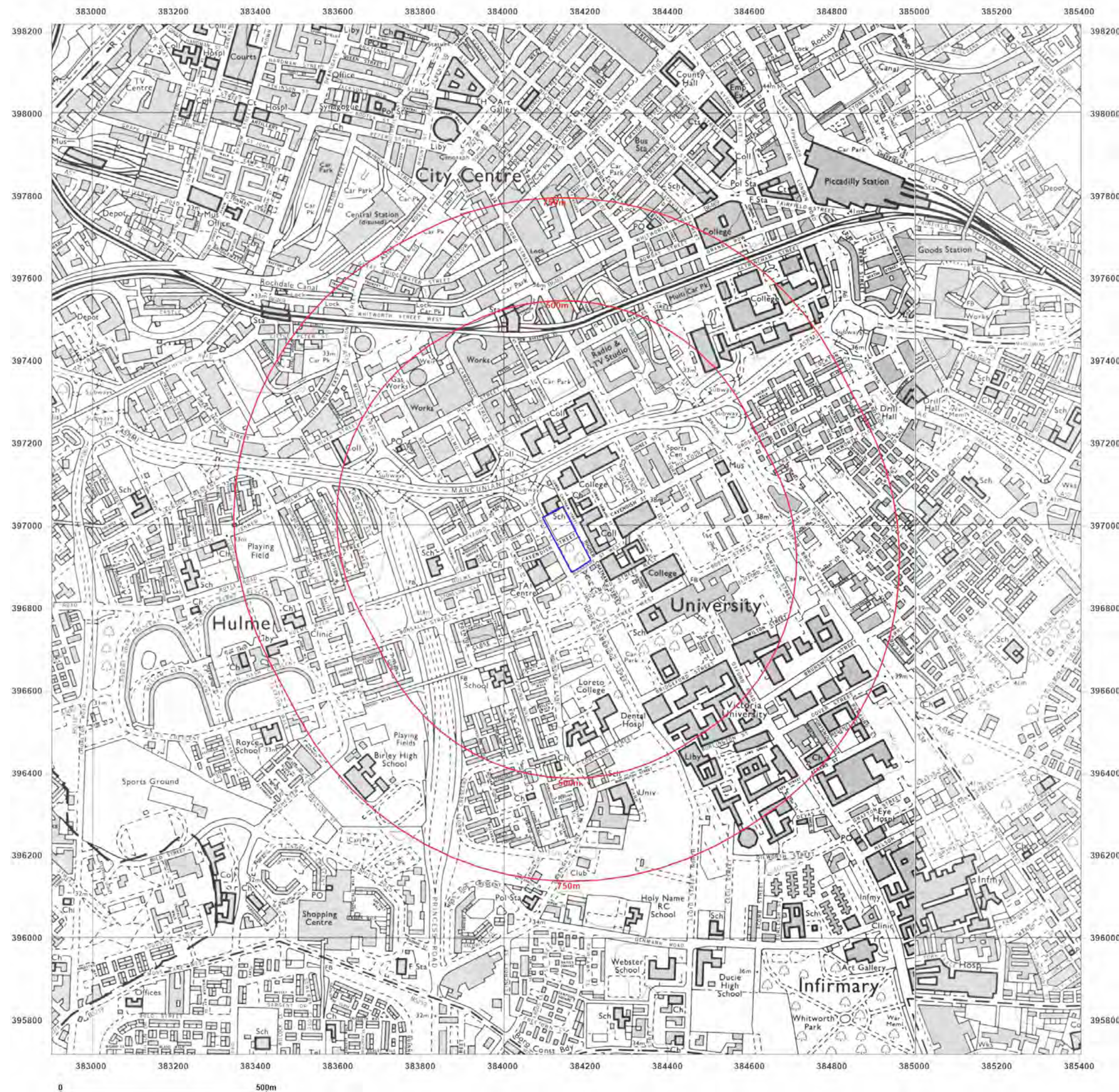


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Site Details:

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Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: National Grid

Map date: 1988-1991

Scale: 1:10,000

Printed at: 1:10,000



Surveyed 1986
Revised 1988
Edition N/A
Copyright N/A
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Surveyed 1985
Revised 1991
Edition N/A
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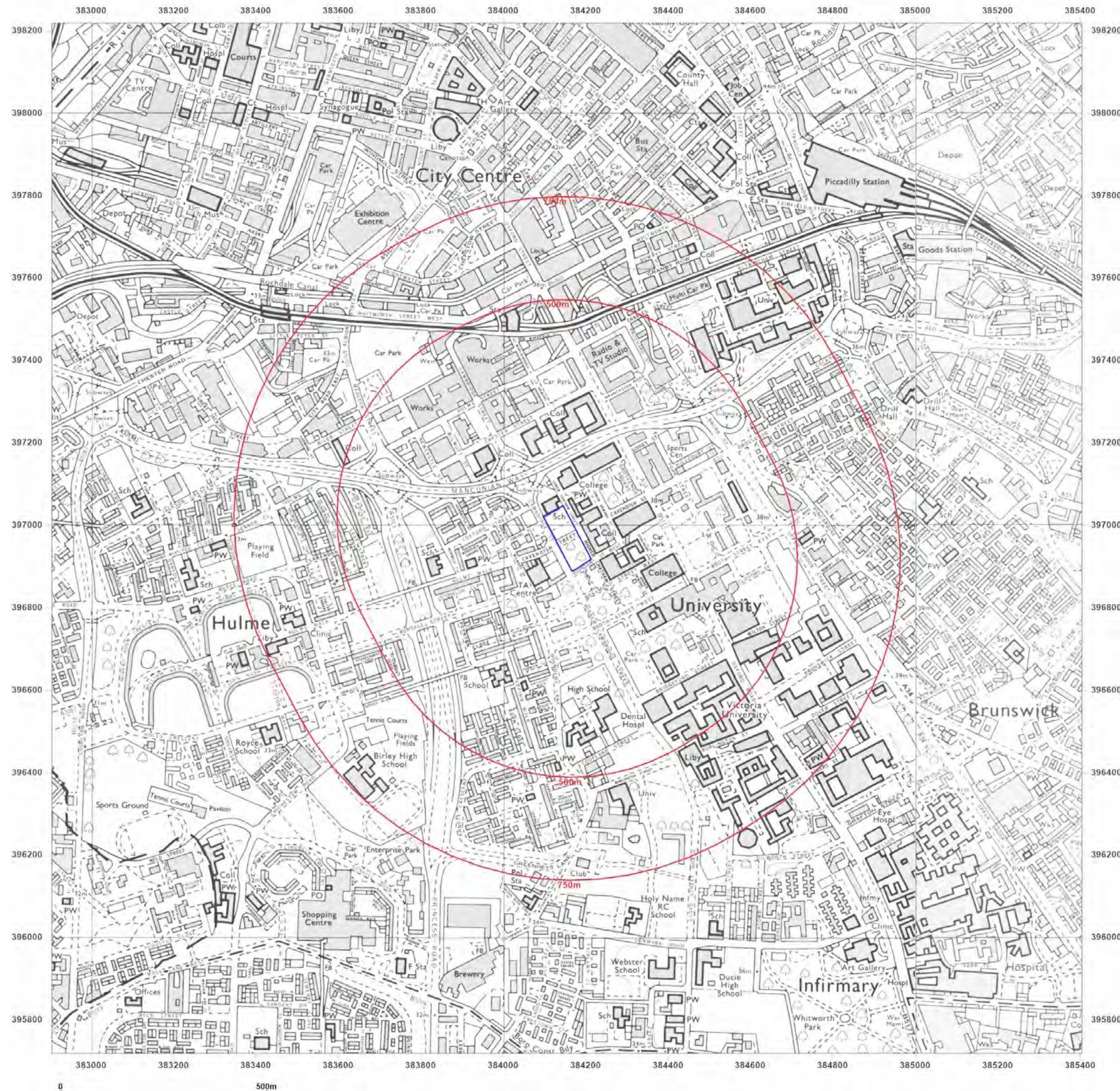


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MANCHESTER, M15 6TT

Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: National Grid

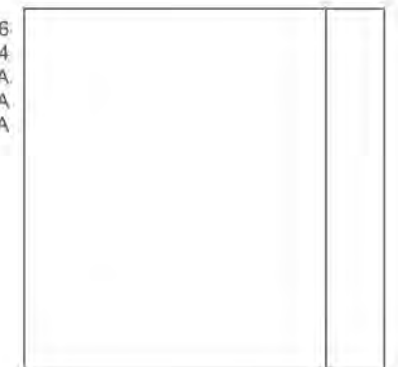
Map date: 1994

Scale: 1:10,000

Printed at: 1:10,000



Surveyed 1986
Revised 1994
Edition N/A
Copyright N/A
Levelled N/A

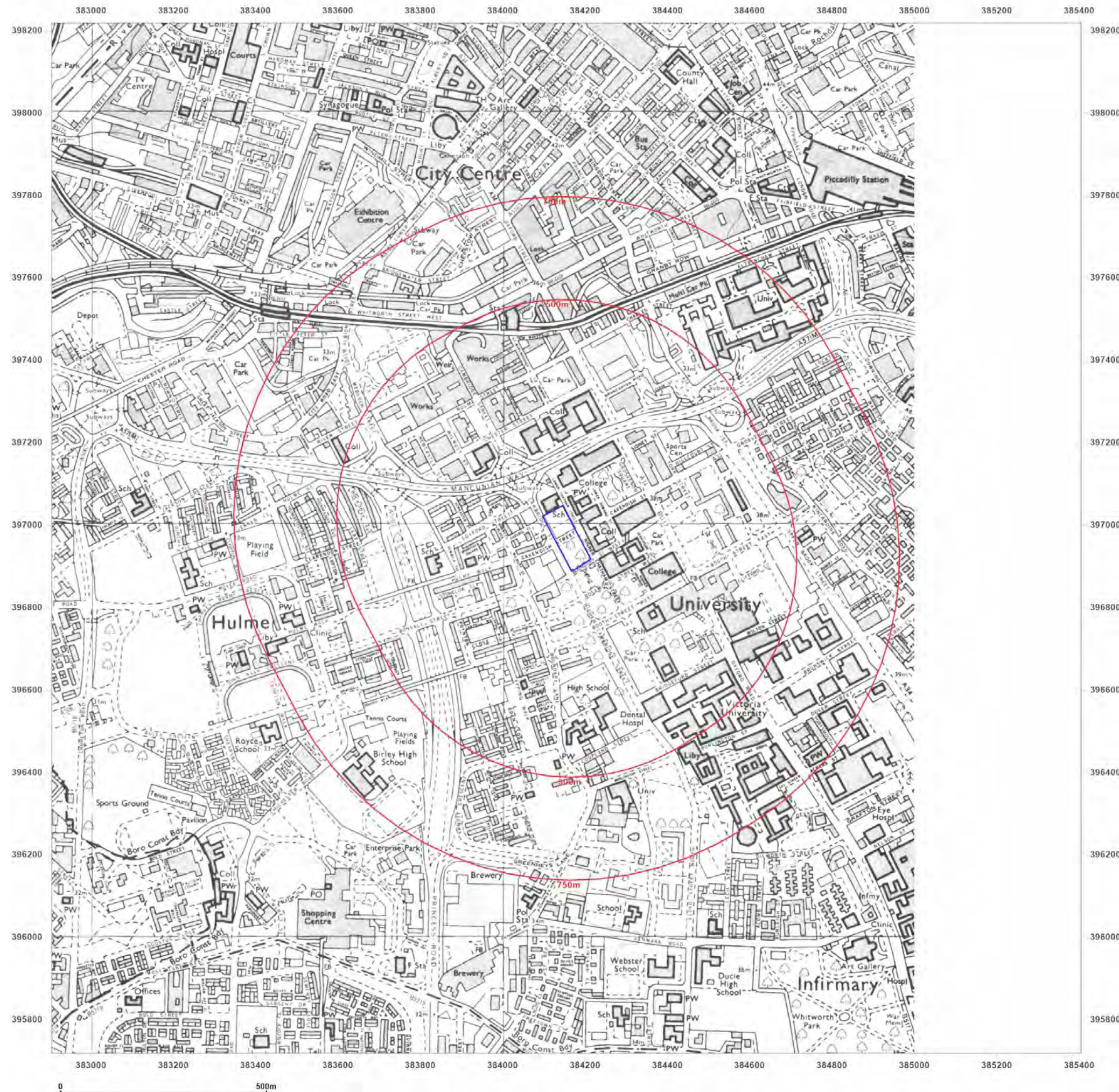


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Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: National Grid

Map date: 2001

Scale: 1:10,000

Printed at: 1:10,000



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Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: National Grid

Map date: 2010

Scale: 1:10,000

Printed at: 1:10,000



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Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: National Grid

Map date: 2024

Scale: 1:10,000

Printed at: 1:10,000

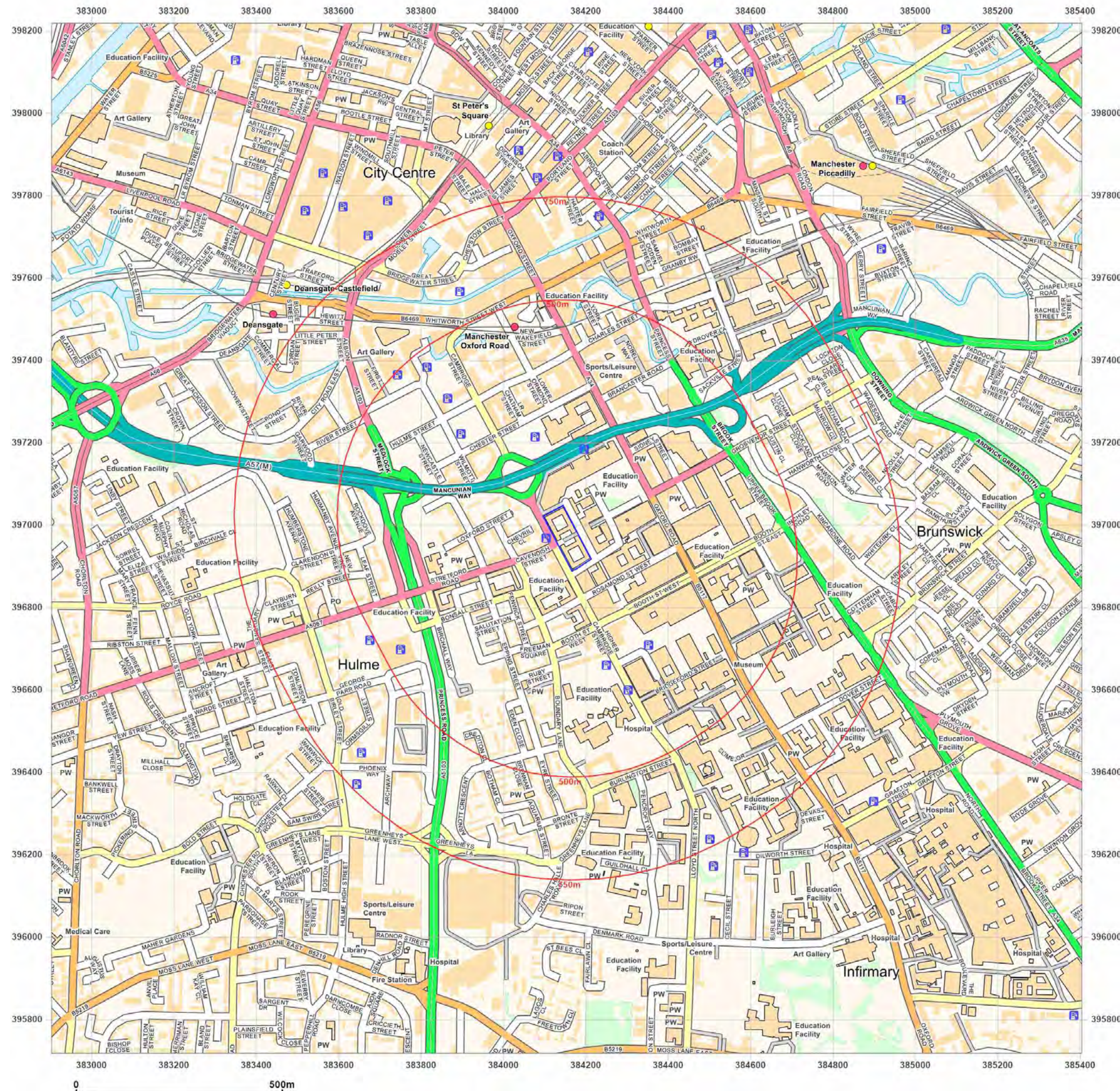


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Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: 1056 Scale Town Plan

Map date: 1851

Scale: 1:1,056

Printed at: 1:1,056



Surveyed 1844
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Surveyed 1849
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Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: County Series

Map date: 1889-1893

Scale: 1:2,500

Printed at: 1:2,500



Surveyed 1893
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Edition N/A
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Surveyed 1889
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Edition N/A
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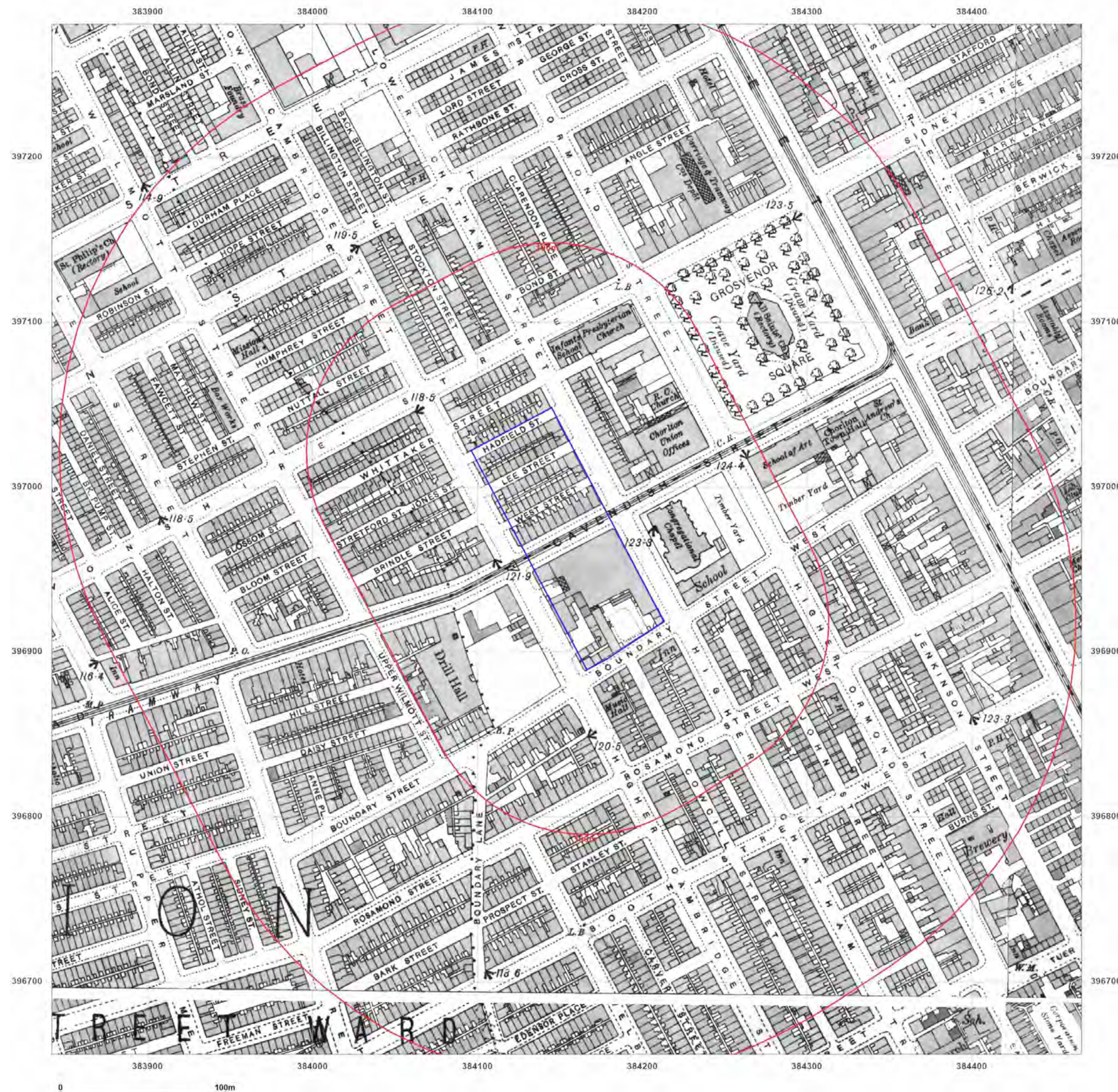


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Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: County Series

Map date: 1908

Scale: 1:2,500

Printed at: 1:2,500



Surveyed 1908
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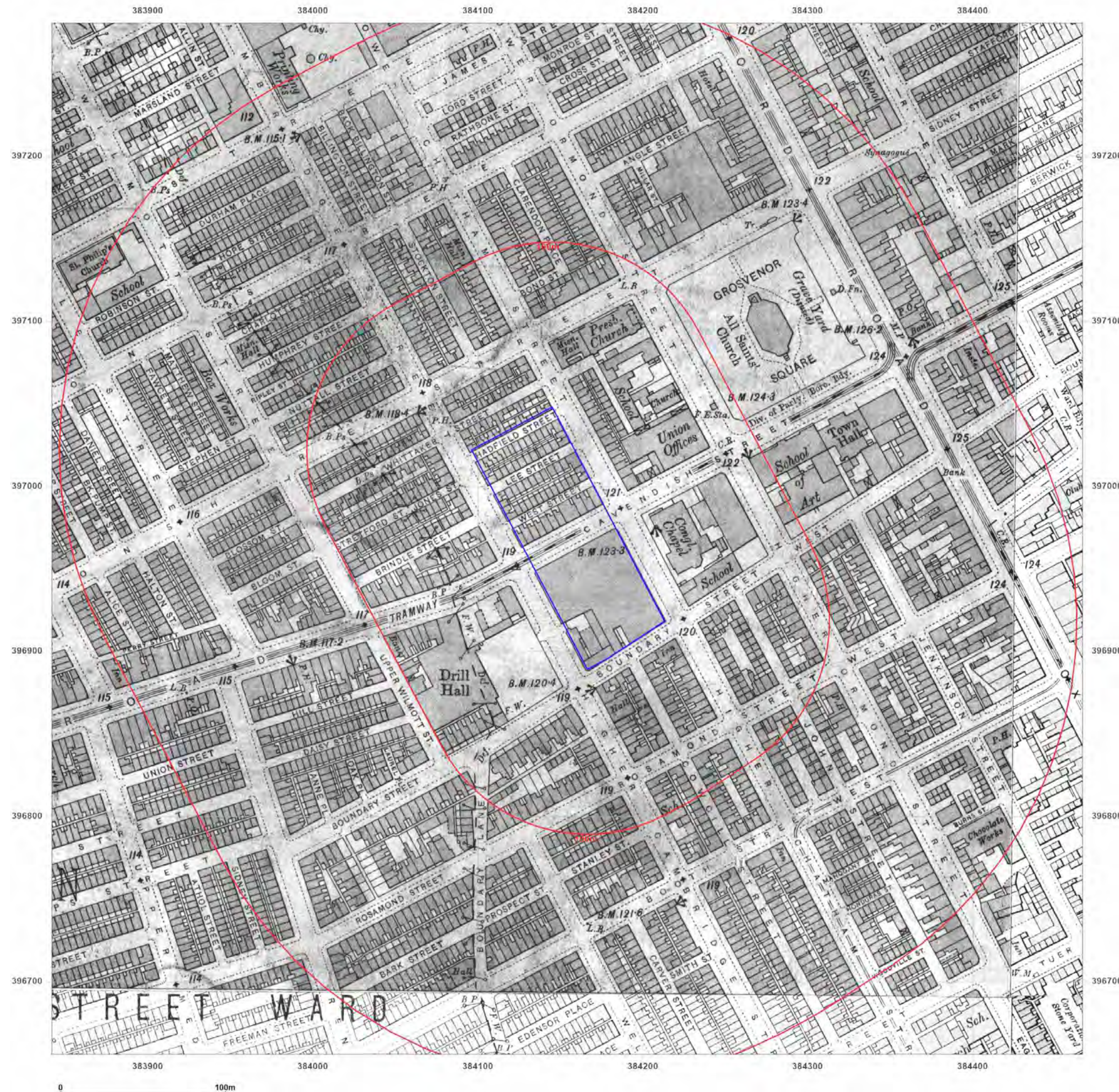


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Client Ref: 303452-00
Report Ref: GS-EKO-SRE-W7V-DNV
Grid Ref: 384154, 396968

Map Name: County Series

Map date: 1922

Scale: 1:2,500

Printed at: 1:2,500



Surveyed 1922
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