Robson Liddle

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# Better Barnsley
# Barnsley Town Centre

# Preliminary Land Contamination and Geotechnical Risk Assessment

On behalf of Barnsley Metropolitan Borough Council

Report 12-17-16-1-6001/DSR1
April 2015

• Structures • Civil and Infrastructure • Geotechnical & Geo-environmental

# Report Issue Record

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# Appendices

# Executive Summary

| | | |
|---|---|---|
| SITE INFORMATION | Client | Barnsley Metropolitan Borough Council. |
| | Site | Better Barnsley. |
| | Site Location | Barnsley Town Centre, S70 1DD (nearest). NGR 434671, 406312. |
| | Current Use | Mixed Commercial – Barnsley Town Centre. |
| | Proposed Development | Demolish existing buildings and redevelop with retail and leisure facilities. |
| SITE SETTING | Previous Investigations | A series of investigations have previously been undertaken for the Barnsley Market redevelopment. |
| | Geology | Pennine Middle Coal Measures. No superficial deposits shown. Made Ground is anticipated to be present on the site. |
| | Hydrogeology | Secondary A Aquifer. The site does not lie within a source protection zone. |
| | Hydrology | The nearest surface water is a culvert, Slough Dyke, runs through the site. The River Dearne lies circa c.850m north east. |
| | Site History | The site was developed at the time of the first mapping in 1850. Historically the site has been utilised by a variety of potentially contaminative industrial land uses including a gas works, foundries, lamp works, malt houses and electrical works. |
| | Topography | Elevations fall eastwards ranging from 97m OD to 91.5m OD. The floor of the basement is at about 91m OD. |
| LAND QUALITY | Human Health | Moderate risks identified due to two hotspots beneath the site. |
| | Controlled Waters | Moderate to high risks identified. |
| | Ground Gas | Risks from ground gases are considered to be low.<br>No radon protection measures are anticipated to be required. |
| GEOTECHNICAL | Foundations | The bedrock is suitable for shallow foundation however the presence of localised areas of deep Made Ground and former foundations may mean that alternative foundation solutions are required in some locations. |
| | Shrinkable Soils | Soils are likely to be non shrinkable. |
| | Floor slabs | Ground bearing floor slab dependant on location specific ground conditions. |
| | Excavation stability | Soils are variable and location specific assessment would be needed. |
| | Pavement | CBR values likely to be adequate for road and car park construction. |
| | Soakaways | Underlying geology likely to be suitable for soakaway drainage in some locations, subject to full scale testing to confirm and calculate infiltration rates. |
| | Natural cavities | None expected. |
| | Mining | The risk at the site was identified as low however shallow coal is present beneath the site and limited areas were identified as possibly worked. Precautionary measures/remediation may be required for the Winter/Adby Seam. |

# 1 Introduction

In April 2015, Robson Liddle Ltd was commissioned by Barnsley Council to undertake a Preliminary Land Contamination and Geotechnical Risk Assessment for Barnsley Town Centre for the proposed redevelopment of the site.

It is understood that the site is being considered for mixed-use redevelopment comprising demolition of existing buildings on application site and replacement with retail and leisure elements, including new market, multi-storey car park and surface level car park, new pedestrian routes, public realm, means of access and landscaping at the 'Barnsley Market Site'.

The site comprises commercial properties which form part of Barnsley town centre. The location of the site is shown on Figure 1.

## 1.1 Project Requirements and Scope of Works

The overall objectives of the Phase I assessment are to determine the potential risks from contamination and to identify preliminary geotechnical risks and constraints.

The objectives of the Phase I report are to:

- Establish the environmental setting, including sensitivity in relation to human health, surface water, groundwater and ecological receptors.
- Review historical and recent land uses to assess the potential for contamination to be present from past and current land-use.
- Quantitatively assess the potential nature and extent of contamination from those uses and the environmental risks and liabilities which may be posed to the identified receptors (human health and the environment).
- Develop a ground model for the site.
- Assess any potential geotechnical risks, including mining.

## 1.2 Information Sources

During the production of this report the following sources have been reviewed:

- An EnviroInsight Report prepared by Groundsure (Report Number GS2017327 dated 14th April 2015).

- A GeoInsight Report prepared by Groundsure (Report Number GS2017328 dated 14th April 2015).
- Coal Authority Mining Report (Report no: 51000849914001dated 20th April 2015).
- Historic Ordnance Survey maps.
- British Geological Survey maps.
- British Geological Survey borehole records.
- Environment Agency landfill records.
- Environment Agency groundwater data.
- BRE 211 (2007) Radon Atlas.

## 1.3 Previous Investigations

An initial desk study and subsequent investigation and assessment reports on the site have previously been developed for the site by Wardell Armstrong (WA) LLP. These reports are entitled:

- Barnsley Markets and Adjacent CEAG Sites, Preliminary Stage 1 (Pre-demolition) Site Investigation Report. Wardell Armstrong, 2007. (Report Number SD07-00120).
- Barnsley Markets and Adjacent CEAG Sites, Stage 2 (Pre-demolition) Site Investigation Report. Wardell Armstrong, 2008. Report Number SD08-0061.
- Soil Mechanics Factual Report on Ground Investigation, May 2008, Report ref A8017.

During the production of this report the information in these reports has been reviewed and a summary of their findings is described in Section 3.

# 2 Site Location

Address: Barnsley Town Centre

Post Code: S70 1DD (nearest).

National Grid Reference: 434671, 406312.

The site location is shown on Figure 1 and a more detailed plan including an approximate site boundary in Figure 2.

Full details of the site's features and land use are presented in Section 4.


Figure 1 Site location plan

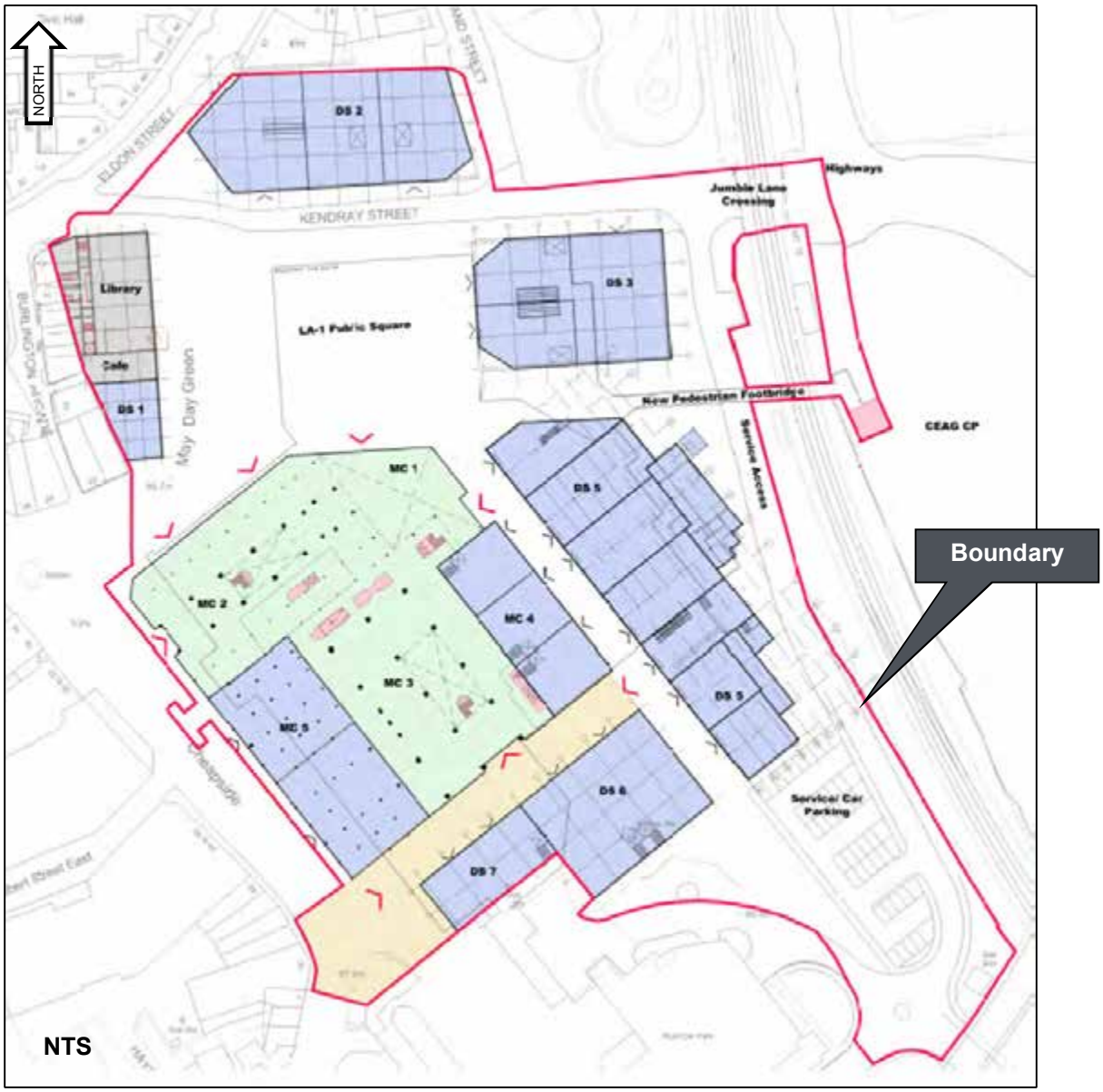


Figure 2 Approximate site boundary

# 3 Summary of Previous Work

The site has been subject to a Preliminary Stage 1 Site investigation and Stage 2 Pre-Demolition Investigation as part of a previous planning application. The following documents were available to view on the planning portal.

- Barnsley Markets and Adjacent CEAG Sites, Preliminary Stage 1 (Pre-demolition) Site Investigation Report. Wardell Armstrong, 2007, Report Number SD07-00120.
- Barnsley Markets and Adjacent CEAG Sites, Stage 2 (Pre-demolition) Site Investigation Report. Wardell Armstrong, 2008. Report Number SD08-0061.
- Soil Mechanics Factual Report on Ground Investigation, Barnsley Markets, November 2007, Report ref A7008.
- Soil Mechanics Factual, Report on Phase 2 Ground Investigation, Barnsley Markets, May 2008, Report ref A8017.
- Environmental Statement chapter on Ground Conditions and Contamination.

It is noted that these reports included for a residential land use as at this time apartments over the commercial/retail development were being considered. The former CEAG site (to the east of the current site boundary) was also included within the site assessed by Wardell Armstrong.

These reports confirmed the following:

- Historically the site has been utilised by a variety of potentially contaminative industrial land used including a gas works, foundries, lamp works, malt houses and electrical works. There are also a railway line and sidings present immediately east of the site.
- Ground conditions comprise of Made Ground (typically 2 to 3m thick up to a max of 6m) overlying Glacial Till (stiff clays and dense gravels) over Weathered Pennine Middle Coal Measures (stiff gravelly clay) over Coal Measures Bedrock. The bedrock consisted of weak to moderately strong grey mudstone inter-bedded with siltstone and sandstone and underlain by Kent's Rock Sandstone.

- Bedrock was encountered between 86 and 91m OD. Groundwater was typically encountered at or around the bedrock at between 86 and 92m OD. A shallow perched groundwater was also encountered in the Made Ground in the Market Basement area.
- Drilling identified the presence of four coal seams at depths ranging between 0.30m to 35.55m bgl. The thickness ranged from 0.25m to 1.23m. Possible workings were highlighted in two coals seams. The Winter/Abdy coal records possible backfill material at a depth between 9.1m to 10m bgl in addition to total loss of drilling flush at borehole location BH213. No other boreholes recorded potential working within the Winter/Abdy coal. Research records indicate that underground workings took place in the Winter/Abdy coal approximately 200m to the north-east from Mottram Wood Colliery prior to 1920.
- The report concluded that it is considered that the likelihood of shallow unrecorded abandoned workings being extensive beneath the site is very low and even if present would likely be of a very limited nature. The subsequent risk of potential surface subsidence is low. However, given the sensitive nature of the development precautionary measures are recommended where the Winter/Abdy coal is present beneath the development area.
- The extent of any significant contamination was recorded as limited to relatively small and discrete areas. The key on-site areas identified as potentially requiring further assessment and/or remediation included May Day Green (Benzo(a)pyrene) and Markets Basement (Cyanide, Naphthalene, Phenol, BTEX, aromatic hydrocarbons: C8-C10). A further hotspot was identified in the Southern CEAG – (aromatic hydrocarbons: C12-C21) which is outside the current site boundary.
- The Coal Measures Formation is classified as a Secondary A Aquifer. The closest sensitive abstraction lies 900m west (up gradient) from the site.
- The Sough Dyke is the closest water course to the site, and is currently culverted beneath the site.
- The groundwater quality beneath the site is locally poor, particularly in association with areas of local soil contamination, but is generally considered not to represent an on-going contaminant source that needs be addressed by

remedial activities. However further modelling to quantify the potential risk to environmental receptors from the Markets Basement hotspot was recommended.

- The report recommends a Design Class of DS4 and AC-3 should be assumed for buried concrete in accordance with BRE Special Digest 1 (BRE, 2005).
- Gas monitoring identified slightly elevated concentrations of methane and carbon dioxide beneath the site. A Characteristic Situation 2 (low risk) was considered appropriate to the site due to elevated concentrations of carbon dioxide and methane.
- Basic protection against radon for residential dwellings or new structures of similar form of construction on the site.
- The bedrock is suitable for shallow foundations however the presence of localised areas of deep Made Ground and former foundations may mean that piled foundations are required in some locations.
- Ground bearing slabs may be adopted.
- Excavations for the new development will generate three waste streams: inert, non-hazardous and hazardous.

# 4 Site Description

The site is located off Eldon Street, Kendray Street and Cheapside and lies within Barnsley town centre. The site occupies an area of approximately 3.94ha and is located at National Grid Reference (NGR) 434671, 406312.

Ground levels within the main existing market/car park area fall eastwards from about 97m OD in the north west to levels of about 93-94m OD, which are retained above the railway. Levels near to the railway and the Markets Basement entrance road are at about 91.5m OD. The floor of the basement is at about 91m OD.

A site walkover survey was undertaken on 15th April 2015 by Robson Liddle Ltd. The site comprises Barnsley markets, a multi-storey car park and the former council offices. Figure 3 shows the site setting.

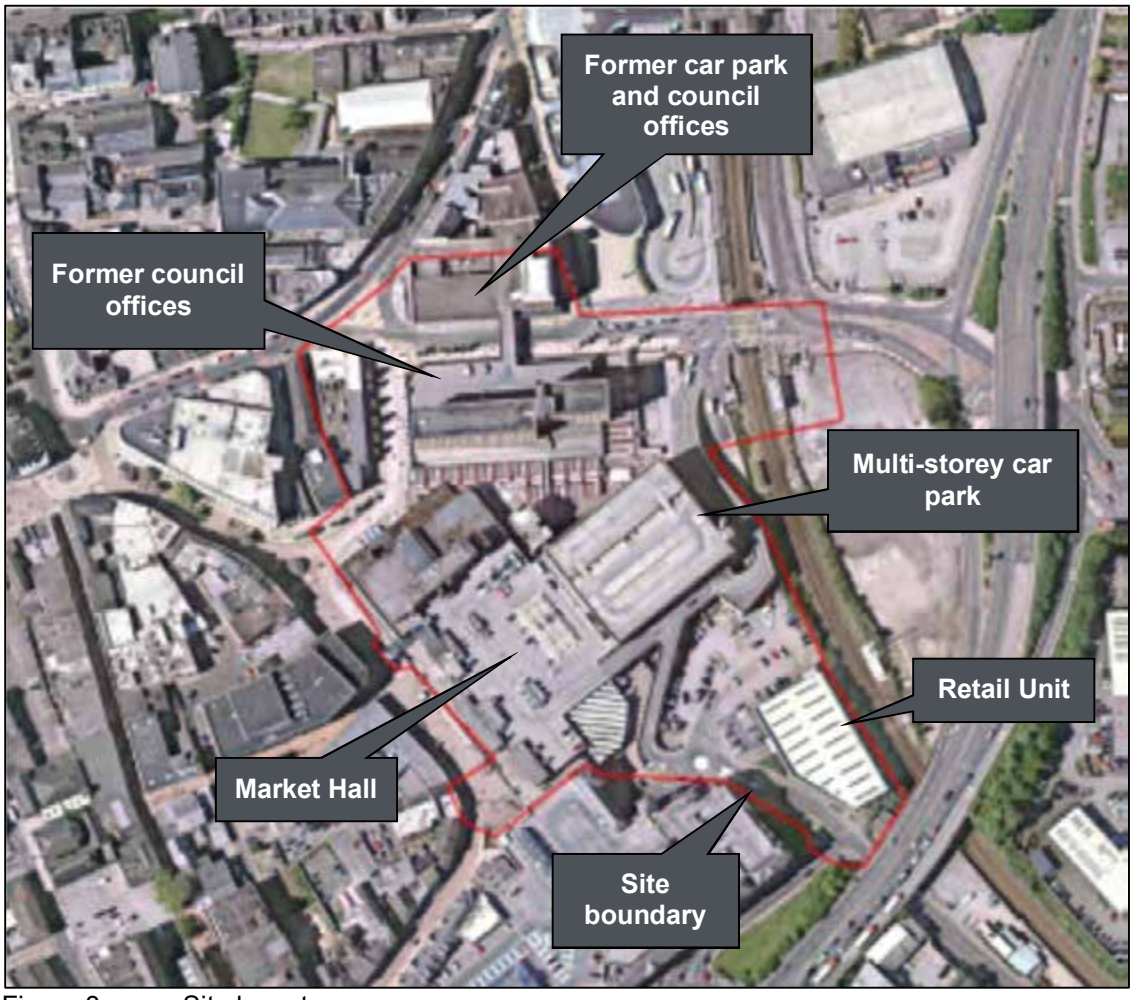


Figure 3 Site layout

## 4.1 Photographs

Photograph 1 Looking north east to disused retail store to the south of the site.

Photograph 2 Looking west along Kendray Street, former council offices to left of picture and right of picture


Photograph 3 Shops to the west of May Day Parade.

Photograph 4 Looking south across former car park site to east of railway line.

Photograph 5 Looking towards multi-storey car par and market basement entrance

Photograph 6 Rear of the council office to the right and markets to the left


Photograph 7 Front of the markets building.

# 5 Environmental Setting

## 5.1 Geology

The 1:50,000 scale British Geological Survey (BGS) geological map (Sheet 87 Barnsley) indicates that the site is underlain by the Pennine Middle Coal Measures. To the north west of the site the Kent's Rock, a sandstone flag within the Pennine Middle Coal Measures outcrops. There are no superficial deposits underlying the site. There are three coal outcrops indicated to be present within the site.

The Pennine Middle Coal Measures Formation is described by the BGS as "*Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams*".

The site investigation undertaken by Wardell Armstrong for the redevelopment of the Markets in 2007 and 2008 proved Made Ground over the majority of the site overlying a thin layer of Glacial Till over weathered Pennine Coal Measures.

The Made Ground typically comprised gravel, sand and clay with brick, sandstone and concrete and some coal, ash and clinker. The depth of Made Ground was typically found to be 2 to 3m deep with a maximum depth of 6m recorded. However it was absent in the western section of the Market Basement.

Although no superficial deposits are recorded on the BGS mapping the Wardell Armstrong report recorded a layer of firm to stiff sandy gravelly clays which were identified as characteristic of Glacial Till deposits. Occasional plant remains were recorded within this stratum.

The Glacial Till was underlain by the solid geology of the Pennine Middle Coal Measures. This material was weathered to stiff gravelly clay near the surface, with intact bedrock being encountered at depths of 0.3m and 8.6m bgl (86 and 91m OD). The Kent's Rock, a sandstone flag within the Pennine Coal Measures, was recorded at depths between 15.75m bgl and 35.5m bgl. The thickness of the Kent's Rock was proven in five locations to be between 6.11m and 12.85m.

Three coal seams were recorded in the strata above the Kent's Rock and they were interpreted as comprising the Winter/Abdy, Top Beanshaw and Low Beamshaw coals.

The Winter/Abdy seam was encountered during the Wardell Armstrong investigation at between 2.5m bgl and 10.28m bgl. The Winter/Abdy coal was recorded as ranging from 0.58m thickness split over three leaves of coal to 1.17m.

The Top Beamshaw coal was present in boreholes across the majority of the site investigated by Wardell Armstrong ranging from depths of between 0.3m bgl (within the market basement) in the west of the Site to 23.95m bgl in the south-east of the Site. The Top Beamshaw coal varies widely in thickness and quality across the Site and is often recorded as a shaley coal or a mudstone and coal. The coal is generally subdivided into two leaves separated by a dark grey mudstone, however, it is often recorded as being a single coal and is also recorded as three coals at one location. The Top Beamshaw ranges in thickness from 0.25m to 1.23m split over two leaves of coal.

The Low Beamshaw coal is present in boreholes beneath the Top Beamshaw coal at depths ranging from 5.16m bgl to 31.23m bgl. The Low Beamshaw is present generally as a single coal ranging widely in recorded thickness across the Site from 0.35m (BH104) to 1.14m including a mudstone parting.

## 5.2 Soil Geochemistry

BGS estimated soil geochemistry information is included as part of the Groundsure GeoInsight report. The BGS digital estimated soil chemistry data indicates the estimated geometric mean concentrations (mg/kg) of Arsenic, Cadmium, Chromium, Nickel and Lead in topsoil derived by spatial interpolation of the point source soil chemistry data. The original samples were collected and analysed as part of the BGS Geochemical Baseline Survey of the Environment (G-BASE) project.

Table 1 summarises the typical estimated concentrations of each determinant in topsoil in the locality of the site.

**Table 1: Summary of BGS Estimated Soil Geochemistry**

| Determinant | Concentration Range (mg/kg) |
|---|---|
| Arsenic | 15 – 25 |
| Cadmium | <1.8 |
| Chromium | 90 – 120 |
| Lead | <100 |
| Nickel | 30 - 45 |

## 5.3 Hydrogeology

The Environment Agency classifies the bedrock geology at the site to be Secondary A Aquifer. The site does not lie within a Source Protection Zone. The nearest groundwater abstraction lies circa 900m west as is licence for the abstraction of groundwater for bottling i.e. potable water.

The Wardell Armstrong report recorded groundwater as typically encountered at or around the bedrock at between 86 and 92m AOD; typically between 5m and 8m bgl. A shallow perched groundwater circa 3m bgl was also encountered in the Made Ground in the Market Basement area.

The site lies over a Secondary A Aquifer, however the only groundwater abstraction lies up gradient of the site. The above would suggest that groundwater would be of low sensitivity to any potential sources of contamination.

## 5.4 Hydrology

The nearest surface water is a culvert, Slough Dyke which runs along the northern boundary of the site. The closest designated watercourse is the River Dearne which lies c.850m north east of the site at its closest point.

The Environment Agency classifies the River Dearne as having an ecological quality of Moderate Potential and a chemical quality of Good.

The proximity of Slough Dyke to the site would suggest that surface water is considered to be of high sensitivity to any potential sources of contamination. The Wardell Armstong's report recommended that further modelling was required to quantify the potential risk to this receptor.

## 5.5 Landfill Sites

The Groundsure EnviroInsight Report records one former landfill site within 250m of the site. It is listed as The Old Vicarage, Doncaster Road, Barnsley approximately 230m to the south; the waste type is recorded as commercial and the licence was surrendered in January 1994.

The Wardell Armstrong report indicates that The Old Vicarage took excavation waste, soil, subsoil and inert/non hazardous building/demolition waste.

On the basis of the underlying geology, the distance from the site and the type of waste, the landfill is not considered likely to present a risk to the site from gas or leachate migration.

## 5.6 Radon

A site specific radon report obtained by Wardell Armstrong indicates that Basic radon protective measures should be adopted due to the underlying geology of the site.

Reference to the BRE211 (2007) Radon Atlas indicates that the site lies outside a square that requires radon protection. This is confirmed by the Groundsure GeoInsight report, which states that the site is in an area where the estimated probability of a home being above the action level of 200Bqm$^{-3}$ is less than 1%, which would not normally require any radon protective measures for new dwellings or extensions.

It is likely that the site specific report obtained by Wardell Armstong included the square to the north within its 150m search buffer. Based on BRE 211 and the Groundsure GeoInsight report it is considered that radon protection measures would not be required for residential dwellings. Radon protection requirements for non residential buildings are not covered by BRE 211 or the site specific reports and confirmation of any protection measures should be agreed with the local authority building control.

## 5.7 Sensitive Land Uses and Designated Areas

The site lies within a nitrate vulnerable zone. There are no other sensitive land uses or designated areas in the vicinity of the site.

## 5.8 Land Use History

The historical land uses of the site and its surrounding area have been established from superseded editions of Ordnance Survey maps and are detailed in Table 2. Copies of the maps are included in Appendix A.

**Table 2: Summary of Historical Maps**

| Date | On Site | Offsite |
|---|---|---|
| 1850 | The site is already developed for a mixture of residential and industrial purposes by the time of the first mapping. The scale does not allow for determination of the individual land uses. | The railway line is present to the east of the site. The surrounding area is fully developed with a mixture of industrial and residential land uses. |

| Date | On Site | Offsite |
|---|---|---|
| 1889-1892 | Residential premises and a public house are present along the western boundary of the site. A cattle market is present in the north west corner of the site. Railway Saw mill including a chimney lies to the north. The central area of the site comprises a mixture of residential housing, the Union Foundry, the Orchard and a gas works. Borough Foundry is located in the south eastern portion of the site | The site is surrounded by residential properties to the north, west and south with some industrial premises including timber yards, foundry. To the east of the site lies a railway line and sidings, a malthouse, residential properties beyond which lies open land. There is clay pit c.40m east and Mount Osborne Colliery 150m south east. |
| 1904-1906 | The Orchards is replaced by an electricity works. The saw mills is not longer present on site. | Mount Osborne Colliery has been replaced by Yorkshire Metal Works |
| 1929 | The union foundry buildings are no longer present on site | A lamp works is presented adjacent to the malt house. Borough Colliery (drift) present c.250m north east. |
| 1938 | No significant changes are evident. | No significant changes are evident. |
| 1948-1951 | Four circular tanks (identified in the Wardell report as water coolers) have been constructed on site two to the west and two to the north of the site. | No significant changes are evident. |
| 1960-1965 | The whole of the site has undergone significant change. The former cattle market is market as Kendray Market. The former saw mill is marked as Queens market. The majority of the residential housing has been demolished. The former union foundry is now marked as new market. The former electricity works, gas works and Borough foundry have been replaced by two work and a depot. | The lamp works has extended, taking the place of the malthouse. The area to the east has undergone significant development; the majority of which is residential with some recreational and industrial land. The former Colliery is no longer active; the only structure left is a disused air shaft. |
| 1973-1974 | The majority of the buildings have been demolished from the site with only a works present to the south east. | No significant changes are evident. |
| 1975-1977 | A pair of buildings have been constructed either side of the realigned Kendray street to the north of the site and a third series of buildings has been constructed off May Day green to the north west. The central area of the site has been developed as a market hall and multi-storey car park. The works is still present to the south of the site. | No significant changes are evident. The dual carriageway to the east of the site has been constructed. |
| 1984-1987 | No significant changes are evident. | No significant changes are evident. |
| 1988-1993 | No significant changes are evident. | No significant changes are evident. |

| Date | On Site | Offsite |
|---|---|---|
| 2002 | Works to the south of the site demolished and replaced with a retail unit (former Carpet World). | No significant changes are evident. |
| 2010 | No significant changes are evident. | No significant changes are evident. |
| 2014 | No significant changes are evident. | No significant changes are evident. |

### 5.8.1 Summary of Development History

**On site**

The site was already developed by the time of the first mapping in 1850. The site has been used for a number of industrial uses including cattle market, saw mill, foundries, gas works, depot and works. The current site was redeveloped in the mid to late 1970s when the council buildings, shops off May Day Green, Market Hall and Car Park. It achieved its current layout in the early 2000s when the retail unit to the south of the site was constructed.

**Off Site**

The surrounding land use was typically residential interspersed with some industrial land use. Mount Osborne Colliery was present circa 150m south east from the late 1880s to the early 1990s. Borough Colliery (drift) was present circa 250m north east fro the 1920s to the early 1960s.

Other industrial land uses in the immediate surrounding area included a malt house (c.20m east), Lamp works (c.20-60m east). Railway line and siding (immediately east), timber yard (c.20m north east)

## 5.9 Statutory Authority Records

A review of public registers contained within the Groundsure EnviroInsight report has been undertaken. These entries relate to trade directories, pollution control registers, hazardous sites, enforcement notices etc. A summary of those that might be of relevance to the site is presented below, for full details of all entries, reference should be made to the EnviroInsight report in Appendix B.

- Two Electricity Sub Stations located on site.
- Chimney located on site
- Morrison's petrol station located circa 235m south west of the site.

- Obsoleted petrol station located circa 290m south east of the site.

## 5.10 Summary of key findings

No areas of potential concern were identified from the site walkover. The site however has had a number of historical industrial uses which may have results in contamination.

## 5.11 Potential Contaminant Sources

A summary of the risks from potential contamination sources identified from the desk study and walkover is presented in Table 3.

**Table 3: Summary of Potential Contamination Sources.**

| Potential Hazard | On site | Off site |
|---|---|---|
| Significant imported soils / Made Ground / landfill | Possible | Possible |
| Current industrial use | Unlikely | Possible |
| Historic industrial use | Likely | Likely |
| Fuel, oil or solvent storage | Possible | Possible |
| Electricity sub-stations | Likely | Possible |
| Spills from machinery and plant | Possible | Possible |
| Naturally occurring metals | Unlikely | Unlikely |

## 5.12 Potential Contaminants of Concern

On the basis of the identified sources of contamination the contaminants of concern are as follows: total petroleum hydrocarbons, poly-aromatic hydrocarbons, heavy metals and asbestos.

# 6 Contamination Risk Assessment

## 6.1 Legislative Background

The primary legislative mechanism for contaminated land management in the UK is Part 2A of the Environmental Protection Act, 1990 (EPA). Part 2A was introduced into the EPA under Section 57 of the Environment Act 1995 to help deal with the substantial legacy of land contamination. It focuses on the identification and remediation of land which is in such a condition by reason of contamination that it gives rise to significant harm or the significant possibility of significant harm to certain named receptors, or gives rise to pollution of controlled waters or the likelihood of such pollution. Part 2A applies where there is unacceptable risk, assessed on the basis of the current use and the relevant circumstances of the land. It is not directed to assessing risks in relation to a future use of the land that would require a specific grant of planning permission.

The control of development and land use in the future is the responsibility of the planning system. A fundamental principle of sustainable development is that the condition of land, its use and its development should be protected from potential hazards. The National Planning Policy Framework (NPPF) requires the developer to obtain adequate site information to confirm that the site is suitable for its proposed use.

*Part 2A*

Part 2A provides a regulatory regime for the identification and remediation of contaminated land and is the primary mechanism in the contaminated land regime. Local authorities are the principal regulator for inspection of land under Part 2A. In England, Part 2A is described fully in DEFRA Circular 01/2006, which also contains the statutory guidance (DEFRA, 2006). Part 2A defines contaminated land as:

*'…any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that*

*a. significant harm is being caused or there is a significant possibility of such harm being caused; or*

*b. Pollution of controlled waters is being, or is likely to be, caused.'*

Part 2A is designed to 'enable the identification and remediation of land on which contamination is causing unacceptable risks to human health or the wider environment. It does not necessarily include all land where contamination is present, even though such contamination may be relevant in the context of other regimes'.

In applying the definition of Contaminated Land, Part 2A states that 'the Local Authority must:

- Identify a 'Pollution Linkage'. That is, a linkage between a contaminant and a receptor, by means of a pathway(s).
- Determine if the contaminant is causing significant harm to that receptor, or there is a significant possibility of such harm being caused by that contaminant to that receptor.

If any one element of the pollutant linkage is not present then the land should not be identified as 'contaminated land'.

*NPPF*

NPPF States that 'to prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location.'

Planning policies and decisions should also ensure that:

- the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;

NPPF also states that after any required remediation, the land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990.

## 6.2 Preliminary Conceptual Site Model

Following a review of the desk based geo-environmental information, site reconnaissance and the investigations undertaken at the site in 2007 and 2008 have

confirm that a preliminary CSM has been formulated to identify potential sources of contamination, likely receptors and potential pathways on and in the immediate vicinity of the site.

It should be noted that some uncertainties exist due to the limited site specific data available. However, potential contaminants and receptors have been identified based on this Phase 1 desk study review. Pathways have been established on reasonable scientific knowledge of the behaviour of the contaminants in the ground.

It should also be noted that because the assessment is based on documentary evidence, contaminants may be identified, which in practice are not present and contaminants may be present which have not been identified.

The guidance provided in CLR11 indicates the CSM should identify those contaminants, pathways and receptors which are 'likely' to represent an 'unacceptable' risk either to human health or the surrounding environment.

## 6.3 Potential Contaminant Sources

The following potential sources of contamination are identified as follows:

- Two electricity substations located within the market basement.
- Historical use of he site as a gas works
- Historical use of the site as a foundry
- Historical use of the site as an electrical works
- Historical use of the site as Depot and works
- Historical use of the site as cattle market.

The site is 100% hardstanding i.e. tarmac, paving and buildings; no visual evidence of contamination was noted during the site walkover. Given the age of the buildings it is anticipated that they will contain asbestos.

Investigations undertaken at the site in 2007 and 2008 have confirmed that concentrations of metals, semi-metals and non-metals recorded across the Site were not considered to present a significant possibility of significant harm to long term human health. The investigations identified visual and olfactory evidence for hydrocarbon contamination at numerous site investigation locations. However, the

maximum recorded concentrations of petroleum hydrocarbons, PAH, SVOC and VOC are below the relevant screening criteria for the majority of samples taken from across the Site. The exceptions to this are samples from the May Day Green and Markets Basement.

### 6.3.1 Imported man made soils

Investigations undertaken at the site in 2007 and 2008 by Wardell Armstrong have confirmed that the majority of the site is underlain by Made Ground. The report confirmed that hydrocarbon contamination within the Made Ground was present as two hotspots located in May Day Green and the Markets Basement.

### 6.3.2 Naturally occurring metals

The underlying geology at the site comprises coal measures (interbedded mudstone, siltstone and sandstone), which is not generally associated with elevated levels of naturally occurring heavy metals. The BGS estimated soil geochemistry does not indicate elevated concentrations of naturally occurring metals (Section 5.2).

Consequently, it is considered that the naturally occurring metals likely to be present at the site do not present a potential source of contamination.

### 6.3.3 Off site potential sources

The surrounding land use was typically residential intersperse with some industrial land use. Mount Osborne Colliery was present circa 150m south east from the late 1880s to the early 1990s. Borough Colliery (drift) was present circa 250m north east fro the 1920s to the early 1960s. Other industrial land uses in the immediate surrounding area included a malt house (c.20m east), Lamp works (c.20-60m east). Railway line and siding (immediately east), timber yard (c.20m north east). Several of these land uses are considered to be a potential source of contamination.

An obsoleted petrol station is located circa 290m south east of the site. However, the location is topographically down gradient and consequently any leakage from the tanks is considered unlikely to present a risk of on site migration of contaminants.

### 6.3.4 Landfill gas

Only one historical landfill is known to exist within 250m of the site. No organic soils are anticipated to lie beneath the site. The Old Vicarage, Doncaster Road, Barnsley approximately 230m to the south; the waste type is recorded as commercial and the

licence was surrendered in January 1994. The Wardell Armstrong report indicates that The Old Vicarage took excavation waste, soil, subsoil and inert/non hazardous building/demolition waste. Given the time since the licence was surrendered, the distance to the landfill and the nature of the fill material it is considered unlikely that the quarry will represent a significant on going source of landfill gases.

Consequently the risks to end users from explosive or asphyxiating gases is considered low.

### 6.3.5 Radon

A site specific radon report obtained by Wardell Armstrong indicates that Basic radon protective measures should be adopted due to the underlying geology of the site.

Reference to the BRE211 (2007) Radon Atlas indicates that the site lies outside a square that requires radon protection. This is confirmed by the Groundsure GeoInsight report, which states that the site is in an area where the estimated probability of a home being above the action level of 200Bqm$^{-3}$ is less than 1%, which would not normally require any radon protective measures for new dwellings or extensions.

It is likely that the site specific report obtained by Wardell Armstong included the square to the north within its 150m search buffer. Based on BRE 211 and the Groundsure GeoInsight report it is considered that radon protection measures would not be required for residential dwellings. Radon protection requirements for non residential buildings are not covered by BRE 211 nor the site specific reports and confirmation of any protection measures should be agreed with the local authority building control.

## 6.4 Receptors

It is understood that the site will be redeveloped with a mixture of commercial, retail and leisure. Visitors and workers are assumed to occupy the site part time and are not expected to be exposed directly to soils within the site. Construction workers would be directly exposed to soils, however this would only be short term.

- Visitors and workers
- Construction workers
- Construction materials (including services)

- Groundwater – Secondary A Aquifer.
- Surface Water - Slough Dyke on site (crosses the north eastern corner of the site)
- Flora and fauna.

## 6.5 Pathways

Generic possible pathways between potential sources and receptors are discussed as follows:

### 6.5.1 Receptor – Future Residents, Visitors and Workers

- Indoor and outdoor inhalation of dust or vapours.

### 6.5.2 Receptor – Construction Workers

- Dermal contact with contaminated soil or water.
- Ingestion of contaminated soil or water.
- Outdoor inhalation of dust or vapours.

### 6.5.3 Receptor – Buildings and services

- Sulphate attack on concretes.
- Hydrocarbon attack on plastics which can result in tainting of potable water carried in supply pipes.

### 6.5.4 Receptor – Groundwater

- Infiltration and leaching of contaminants in soil into groundwater.
- Migration of contaminated water via drainage system.
- Migration of polluted groundwater to drinking water abstraction.

### 6.5.5 Receptor – Surface Water

- Run off of contaminants into surface water.
- Migration of contaminated water via drainage system.

### 6.5.6 Receptor – Flora and Fauna

- Uptake via root system.
- Displacement of oxygen from root systems.
- Harm to ecosystems from contaminated surface water.

## 6.6 Preliminary Risk Assessment

A preliminary risk assessment was undertaken based on a qualitative assessment of the likely presence of a pollutant linkage. A pollutant linkage is the relationship between a source (or contaminant), a pathway and a target (or receptor). Unless all three elements of a pollutant linkage are present, a significant risk is not considered to exist. The approach adopted is to screen each site based on assigning a simple low, medium or high category. The preliminary risk assessment is shown in Table 4.

**Table 4 Site Conceptual Model**

| Potential Source and Pollutant | Pathway | Receptor | Potential Pollutant Linkage? | Probability of exposure, consequence and magnitude of risk. |
|---|---|---|---|---|
| Geochemistry of underlying soils and made ground at the site.<br><br>Sources on site include<br>• potential for contaminants within any Made Ground e.g. metals, hydrocarbons, polyaromatic hydrocarbons and asbestos.<br><br>Potential off site source which may impact on site include<br>• as above | Direct contact - Dermal contact, soil ingestion and dust inhalation. | Human Health – future users of the site e.g. visitors and workers. | Possible – two localised on-site sources of contamination. | Probability: Possible<br>Consequence: Medium<br>Magnitude: **Medium Risk** |
| | | Human Health – Construction workers | Likely – increased risk of direct contact with soils during the construction period. | Probability: Likely<br>Consequence: Medium<br>Magnitude: **Medium Risk** |
| | Indirect Contact - Vapour inhalation. | Human Health – future users of the site e.g. visitors and workers. | Possible – two localised on-site sources of hydrocarbon contamination. | Probability: Possible<br>Consequence: Medium<br>Magnitude: **Medium Risk** |
| | | Human Health – Construction workers | | Probability: Possible<br>Consequence: Medium<br>Magnitude: **Medium Risk** |
| | Leaching and percolation. | Controlled Waters – groundwater (Secondary A Aquifer) | Possible – hotspot beneath Markets Basement. However contamination not recorded within deeper groundwater. | Probability: Possible<br>Consequence: Medium<br>Magnitude: **Medium Risk** |
| | Groundwater migration & run-off to surface waters carrying entrained sediment or diffuse contamination | Controlled Waters – Surface waters within Slough Dyke | Possible – two localised on-site sources of hydrocarbon contamination. | Probability: Possible<br>Consequence: Medium<br>Magnitude: **Medium Risk** |
| | Direct contact and/or leaching (inc sulphate, pH). | Buildings and Services – On site buildings and/or structures impacted by ground conditions | Likely – underlying geology expected to be pyritic. | Probability: Medium<br>Consequence: Medium<br>Magnitude: **Medium Risk** |
| | Plant uptake. | Ecology - existing trees and landscaping on site. | Possible – No protected ecosystems on or in the vicinity of the site. Localise elevated metals which may pose a risk to sensitive plant growth | Probability: Possible<br>Consequence: Low<br>Magnitude: **Medium Risk** |

| Potential Source and Pollutant | Pathway | Receptor | Potential Pollutant Linkage? | Probability of exposure, consequence and magnitude of risk. |
|---|---|---|---|---|
| Potential Geochemistry of underlying groundwater. | Lateral movement of groundwater | Controlled Waters – groundwater (Secondary A Aquifer) | Possible – hotspot beneath Markets Basement. However contamination not recorded within deeper groundwater. | Probability: Possible<br>Consequence: Medium<br>Magnitude: **Medium Risk** |
| | | Controlled Waters – Surface waters within Slough Dyke | Possible – two localised on-site sources of hydrocarbon contamination. | Probability: Possible<br>Consequence: Medium<br>Magnitude: **Medium Risk** |
| Ground gases. | Permeation through ground and intrusion into buildings and structures on site. | Human Health – future users of the site e.g. visitors and workers. | Possible – dependant on nature and extent of Made Ground and possible shallow coals seams which may have been worked. | Probability: Possible<br>Consequence: Medium<br>Magnitude: **Low Risk** |
| Radon. | Permeation through ground floor. | Human Health – future users of the site e.g. visitors and workers. | Unlikely – no radon protection measures required. | Probability: Low<br>Consequence: Medium<br>Magnitude: **Low Risk** |

# 7 Geotechnical Assessment

The published geological information (Section 5.1) and information from previous site investigations indicates that the site is likely to be underlain by Made Ground (typically 2 to 3m thick up to a max of 6m) overlying Glacial Till (stiff clays and dense gravels) over Weathered Pennine Middle Coal Measures (stiff gravelly clay) over Coal Measures Bedrock. The bedrock consisted of weak to moderately strong, grey mudstone inter-bedded with siltstone and sandstone and underlain by Kent's Rock Sandstone.

An assessment of potential geotechnical risks based on the information from the Groundsure GeoInsight Report and available geological information is presented in the following sections. The risks are summarised in Table 5. The GeoInsight Report is reproduced in Appendix C.

## 7.1 Deep Made Ground

From the available information it is likely that the majority of the site will be underlain by made Ground around 2 to 3m deep, extending to 6m in isolated locations.

## 7.2 Buried Structures

The site is extensively developed with a number of significant structures that are likely to have considerable underground structures (foundations, basements etc.). These are likely to interfere with the proposed development and their impact on the proposed development will need to be carefully assessed.

## 7.3 Compressible Soils

The Groundsure GeoInsight report states that the Compressible Ground risk at the site is "negligible". Based on the expected geology, compressible soils are not anticipated.

## 7.4 Shrinking / Swelling Clay

The Groundsure GeoInsight report states that the Shrinking or Swelling Clay risk at the site is "negligible to very low". Based on the anticipated bedrock geology, shrinking or swelling soils are not anticipated.

## 7.5 Collapsible soils

The Groundsure GeoInsight report states that the Collapsible Ground risk at the site is "very low". Based on the anticipated ground conditions, collapsible soils are not expected.

## 7.6 Aggressive Ground Conditions for Concrete

Based on the published geology, the anticipated soils are expected to contain significantly elevated concentrations of soluble sulphates or pyritic materials which may oxide to form soluble sulphates.

## 7.7 Running Sands / Excavation Instability

The Groundsure GeoInsight report states that the Running Sand risk at the site is "negligible to low". Based on the anticipated ground conditions, running sands are not expected.

## 7.8 Groundwater

The Wardell Armstrong report recorded groundwater as typically encountered at or around the bedrock at between 86 and 92m AOD; typically between 5m and 8m bgl. A shallow perched groundwater circa 3m bgl was also encountered in the Made Ground in the Market Basement area.

## 7.9 Slope Stability

The Groundsure GeoInsight report states that the Landslide risk at the site is "Very low".

Ground levels within the main existing market/car park area fall eastwards from about 97m OD in the north west to a level of around 93 to 94m OD. Levels near to the railway and the Markets Basement entrance road are at about 91.5m OD. The floor of the basement is at about 91m OD.

The current development of the site has been accommodated by a basement with some terraces and slopes to the east of the site. The bedrock strata are generally considered stable. However the ground conditions are anticipated to vary locally from rock, clay, gravel or Made Ground and any proposed slopes or temporary cuttings would be carefully assessed.

## 7.10 Underground Mining

The GeoInsight report states that the site is within an area affected by coal mining. A Coal Authority Mining Report was obtained by Robson Liddle Ltd, this report confirmed:

- The property is in the likely zone of influence from workings in 2 seams of coal at 130m to 370m depth, and last worked in 1939. Any ground movement from these coal workings should have stopped by now.
- In addition the property is in an area where the Coal Authority believes there is coal at or close to the surface. This coal may have been worked at some time in the past.
- There are no known mine entries on or within 20m of the site; however they hold no records on whether any of the mine entrances have been treated.
- The Authority is not aware of any evidence of damage arising due to geological faults or other lines of weakness that have been affected by coal mining.
- The property is not within the boundary of an opencast site from which coal has been or will be removed by opencast methods.
- The Coal Authority has not received a damage notice or claim for the subject property or any property within 50 metres of the property boundary, since 31st October 1994.
- There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.
- The property is in an area for which a notice of entitlement to withdraw support was published in 1963.

The Coal Authority Report is presented in Appendix D.

In the Wardell Armstrong report, boreholes identified the presence of four coal seams at depths between 0.30m and 35.55m beneath the Site. They conjectured that the seams encountered are the Winter/Abdy, Top Beamshaw, Low Beamshaw and the Kent's Thin coals. The thicknesses of the seams range from 0.25m to 1.23m. Consideration is given to possible workings in the Winter/Abdy and Low Beamshaw coal seams during the investigation.

The report indicated that the Abdy/Winter coal varies widely in thickness across the Site, however, it is present at potentially workable thickness in some boreholes. It is considered that the likelihood of shallow unrecorded abandoned workings beneath the Site is low and even if present would be of a very limited nature. The subsequent risk of potential surface subsidence is low. However, given the sensitive nature of the development precautionary measures are recommended where the Winter/Abdy coal is present beneath the development area.

The report considered that though some very limited anomalous areas have been recorded within the Low Beamshaw coal these are either not considered to be old workings or that they are possible old workings of such limited extent to not be of significance. Therefore, no further investigation or precautionary measures are generally required with regard to the Low Beamshaw coal.

## 7.11 Solution Features / Natural Cavities

The site is expected to be underlain by interbedded mudstones, siltstones and sandstones of the Lower Pennine Coal Measures Formation which are not prone to dissolution.

The Groundsure GeoInsight report states that the Ground Dissolution risk at the site is “negligible” and no solution features are recorded within 1km.

# 8 Conclusions and Recommendations

## 8.1 Geotechnical Risks

The potential for geotechnical hazards are summarised in Table 5.

**Table 5: Summary of Geotechnical Hazards.**

| Potential Geological Hazard | Impact on proposed development | Likelihood of presence | Risk |
|---|---|---|---|
| Deep Made Ground up to 3.0m | High | Likely | High |
| Buried structures | High | Likely | High |
| Compressible ground | Moderate | Unlikely | Low |
| Shrinking / swelling clay | Moderate | Unlikely | Low |
| Collapsible ground | High | Unlikely | Low |
| Aggressive ground conditions for concrete | Low | Possible | Medium |
| Running sands / excavation instability | Moderate | Unlikely | Low |
| High water table / groundwater inflows. | High | Unlikely | Low |
| Slope stability | Moderate | Unlikely | Low |
| Underground mining | High | Possible | Medium |
| Ground dissolution / natural cavities | High | Unlikely | Low |

The bedrock is suitable for shallow foundations however the presence of localised areas of deep Made Ground and former foundations may mean that piled foundations are required in some locations. For heavier multi-storey structures piles may also be required even where the natural strata are present at shallow depth. The Wardell Armstrong report identified broad areas of zoning for piled and pad foundations.

The near surface soils are not anticipated to be shrinkable. A ground bearing ground floor slab may be suitable, depending on the depth of Made Ground present and any treatment of the Made Ground that can be undertaken.

## 8.2 Land Contamination

There is a moderate risk to various receptors from a number of potential sources identified, these are discussed in more detail below.

- Two electricity substations located within the market basement.
- Historical use of he site as a gas works

- Historical use of the site as a foundry
- Historical use of the site as an electrical works
- Historical use of the site as Depot and works
- Historical use of the site as cattle market.

The site is 100% hardstanding i.e. tarmac, paving and buildings; no visual evidence of contamination was noted during the site walkover. Given the age of the buildings it is anticipated that they will contain asbestos.

Investigations undertaken at the site in 2007 and 2008 have confirmed that concentrations of metals, semi-metals and non-metals recorded across the Site were not considered to present a significant possibility of significant harm to long term human health. The investigations identified visual and olfactory evidence for hydrocarbon contamination at numerous site investigation locations. However, the maximum recorded concentrations of petroleum hydrocarbons, PAH, SVOC and VOC are below the relevant screening criteria for the majority of samples taken from across the Site. The exceptions to this are samples from the May Day Green and Markets Basement.

At the time of the 2008 investigation, the contaminated Made Ground within the May Day Green hotspot was scheduled for removal as part of the redevelopment and therefore was not considered to present a significant risk to long-term human health.. If these materials area to be left insitu as part of the current development a detailed quantitative risk assessment would be required to establish the risk to human health and environmental receptors.

The Wardell Armstrong report recommended further assessment in the form of a detailed quantitative risk assessment is required to establish the risk posed by identified contamination within the Markets Basement and southern CEAG hotspots to human health and environmental receptors. This should also include generation of remedial targets if required. This additional assessment should be documented in a separate remediation strategy report for the proposed development.

## 8.3 Ground Gas

No sources of ground gas on or in the vicinity of the site. Gas monitoring was undertaken as part of the Wardell Armstrong investigation. It recorded a worse case gas screening value of 0.06l/h and classified the site as a CIRIA Characteristic Situation 2.

No radon protective measures are considered necessary.

## 8.4 Summary

The aim of this report was to assess the potential geotechnical and geo-environmental issues at the proposed development site. Two hydrocarbon hotspots of contamination have been identified from the Preliminary Risk Assessment. To enable the knowledge of the contaminating potential and land quality of this site to be developed further detailed risk assessment would be required.

In general, where any new building is proposed an intrusive investigation should be carried out so that geotechnical parameters and sub surface ground conditions can be determined to assist in the design of the structure. Any potential abnormal geotechnical risks identified in this report should be properly investigated so that the actual level of risk and any remedial measures required can be determined. A number of site investigations have previously been undertaken at the site for the redevelopment. It is recommended that the client investigates ownership of these reports.

# 9 Limitations and Uncertainties

## 9.1 General

It should be noted that the levels of risk identified in this report are perceived risks based on the information reviewed. No physical investigation or testing has been carried out; actual risks can only be assessed following a physical investigation of the site. Further work, including physical investigation, laboratory testing and ground gas monitoring may be required by the appropriate regulators to confirm actual conditions.

This report has been prepared by Robson Liddle with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the Client.

The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true representative data with respect to site conditions.

The information reported herein is based on the interpretation of data collected during the site investigation, pertaining specifically to the soil samples retained from the identified locations. Should additional information become available that may influence the opinions expressed in this report, Robson Liddle reserves the right to review such information and, if warranted, to alter the opinions accordingly.

The evaluation and conclusions do not preclude the existence of other site conditions and contamination, which could not reasonably have been revealed by the site investigation works undertaken at the time of writing. This report should be used for information purposes only and should not be construed as a comprehensive characterisation of all site conditions or potential contaminants.

This report has been prepared solely for the use of the client, and may not be relied upon by other parties without written consent from Robson Liddle.

Robson Liddle disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

## 9.2 Site Specific

No access was available to the office blocks to the north of the site.

# 10 General Notes

This report will be prepared for the exclusive use of the client named in the document and copyright will subsist with Robson Liddle Limited. Prior written permission must be obtained to reproduce all or part of the report. It will be prepared on the understanding that you will disclose its contents to parties directly involved in the current investigation, preparation and development of the site. Further copies may be obtained with the client's written permission from Robson Liddle Limited with whom a master copy of the document will be retained.

The report and /or opinion will be prepared for the specific purpose stated in the document and in relation to the nature and extent of proposals made available to us at the time of your enquiry. The recommendations should not be used for other schemes on or adjacent to the site without further reference to Robson Liddle Limited. The assessment of the factual data will be provided to assist the client and his Engineer and/or advisors in the preparation of their designs.

The report will be based on the ground conditions encountered in the exploratory holes together with the results of field and laboratory testing in the context of the proposed development. There may be special conditions, appertaining to the site, however, which may not be revealed by the investigation, and which may not be taken into account in the report.

Methods of construction and/or design other than those proposed by the designers or referred to in the report may require consideration during the evolution of the proposals and further assessment of the geotechnical data would be required to provide discussion and recommendation appropriate to these methods.

The accuracy of the results reported will depend upon the technique of measurement, investigation and test used and these values should not be regarded necessarily as characteristic of the strata as a whole. Where such measurements are critical, the technique of the investigation will need to be reviewed and supplementary investigation undertaken in accordance with the advice of the company where necessary.

Whilst the report may express an opinion on possible configurations of strata between or beyond exploratory holes, or on possible presence of a feature based on either

visual, verbal, written, cartographical, photographic or published evidence, this will be for guidance only and no liability can be accepted for its accuracy.

Ground conditions should be monitored during the construction of the works and the recommendations of the report re-evaluated in the light of these data by the supervising geotechnical engineers.

Any comments on groundwater conditions will be based on observations made at the time of the investigation, unless specifically stated otherwise. It should be noted, however, that the observations are subject to the method and speed of the boring, drilling or excavation and that groundwater levels will vary due to seasonal or other effects.

Unless specifically stated, the investigation will not take into account of possible effects of mineral extraction.

The economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, will depend on very many factors in addition to geotechnical considerations hence its evaluation will be outside the scope of the report.

# Appendix A

# Historic Maps


Groundsure INSIGHTS

**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** County Series Town Plan

**Map date:** **1889**

**Scale:** 1:500

**Printed at:** 1:1,000

N
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Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
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Revised N/A
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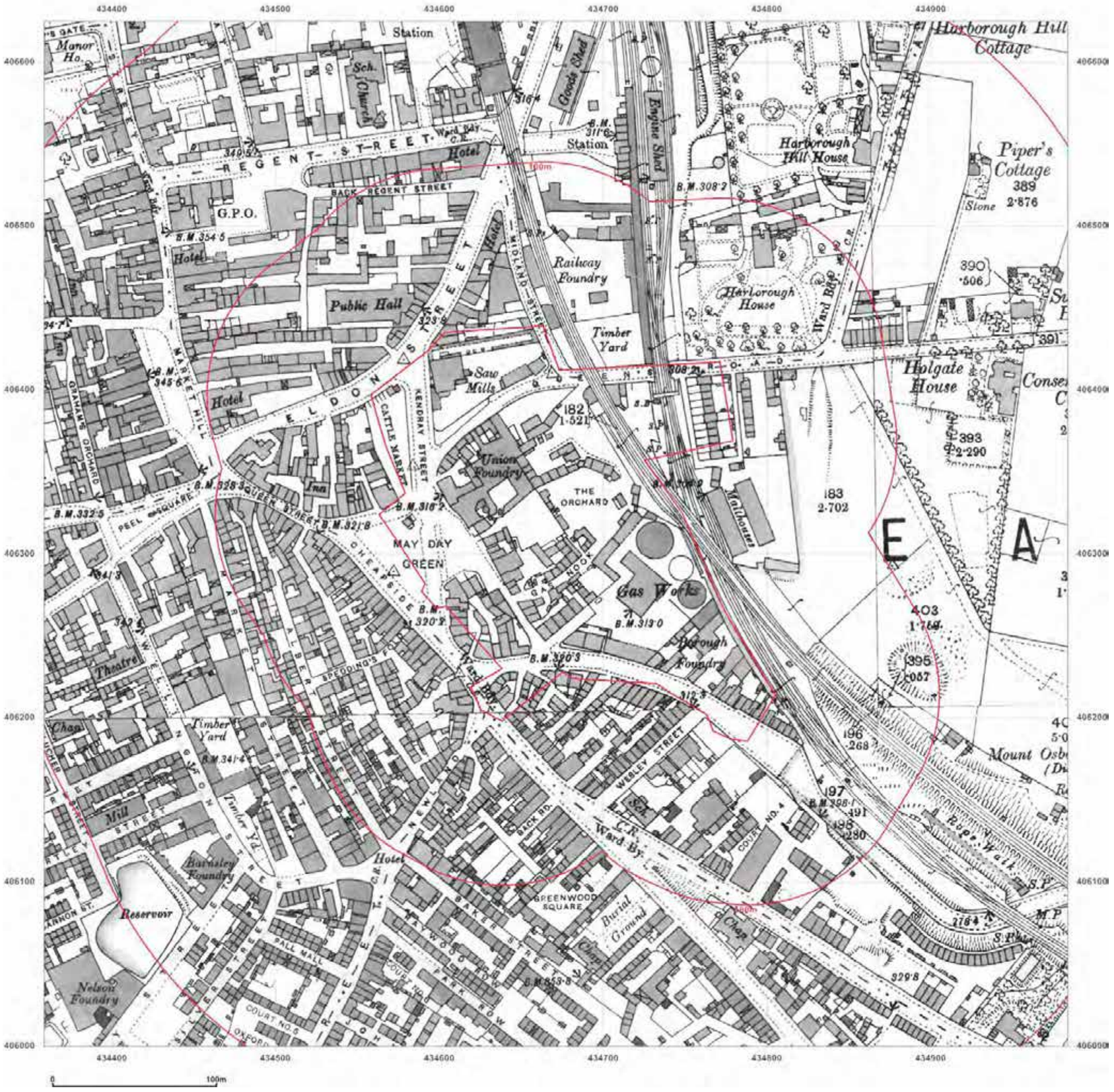


Groundsure INSIGHTS

**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** County Series

**Map date:** **1892-1893**

**Scale:** 1:2,500

**Printed at:** 1:2,500

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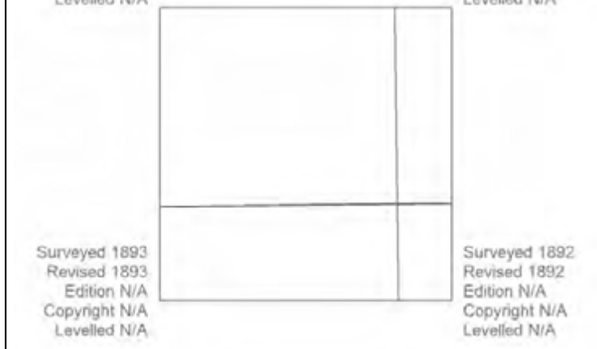


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**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** County Series

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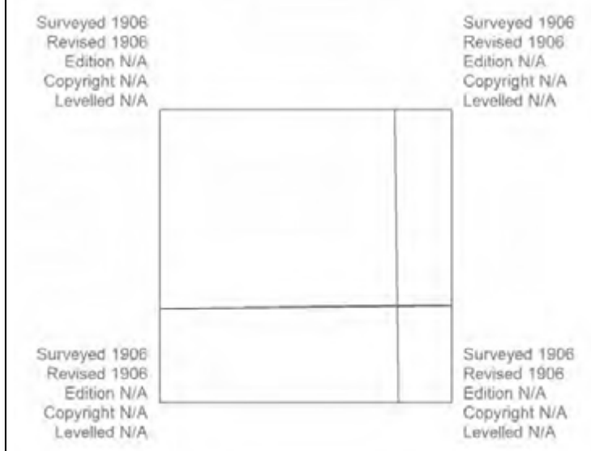


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**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** National Grid

**Map date:** **1960**

**Scale:** 1:2,500

**Printed at:** 1:2,500

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Edition N/A
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Surveyed 1960
Revised 1960
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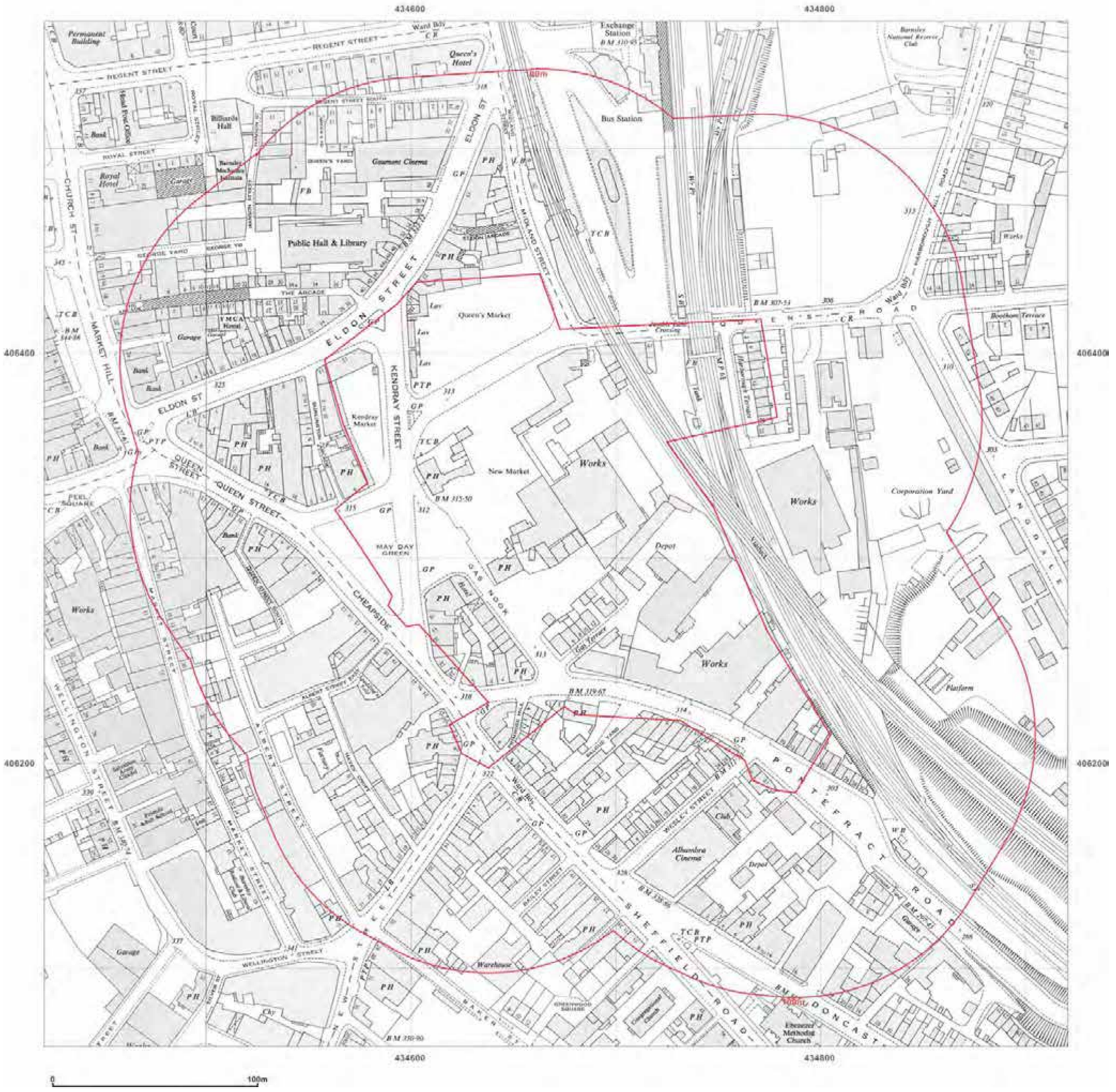


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**Site Details:**

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**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** National Grid

**Map date:** **1961**

**Scale:** 1:1,250

**Printed at:** 1:2,000

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Edition N/A
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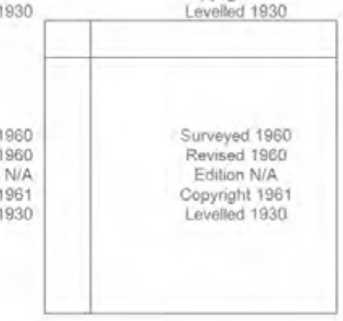

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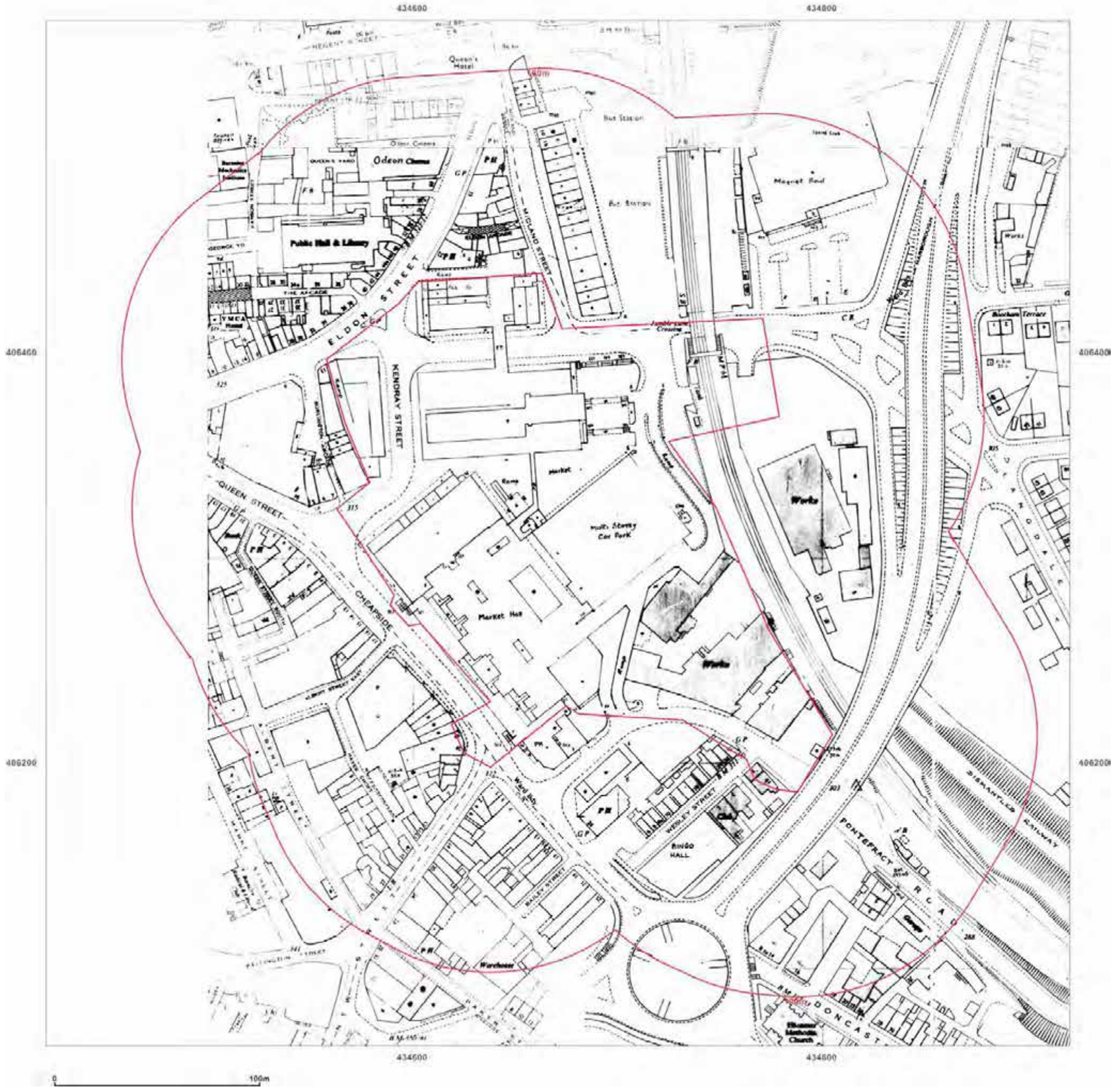


Groundsure INSIGHTS

**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** National Grid

**Map date:** **1975-1977**

**Scale:** 1:1,250

**Printed at:** 1:2,000

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Revised N/A
Edition N/A
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**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** National Grid

**Map date:** **1977-1982**

**Scale:** 1:1,250

**Printed at:** 1:2,000

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Surveyed N/A
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Edition N/A
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**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** National Grid

**Map date:** **1984-1987**

**Scale:** 1:1,250

**Printed at:** 1:2,000

N
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| | |
|---|---|
| Surveyed 1963<br>Revised 1986<br>Edition N/A<br>Copyright 1986<br>Levelled 1963 | Surveyed 1960<br>Revised 1986<br>Edition N/A<br>Copyright N/A<br>Levelled 1963 |
| Surveyed 1960<br>Revised 1983<br>Edition N/A<br>Copyright 1984<br>Levelled 1963 | Surveyed 1963<br>Revised 1987<br>Edition N/A<br>Copyright 1987<br>Levelled 1963 |



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**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** National Grid

**Map date:** **1988-1993**

**Scale:** 1:1,250

**Printed at:** 1:2,000

N
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Surveyed 1959
Revised 1987
Edition N/A
Copyright 1988
Levelled 1963

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

Surveyed N/A
Revised N/A
Edition N/A
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Surveyed N/A
Revised N/A
Edition N/A
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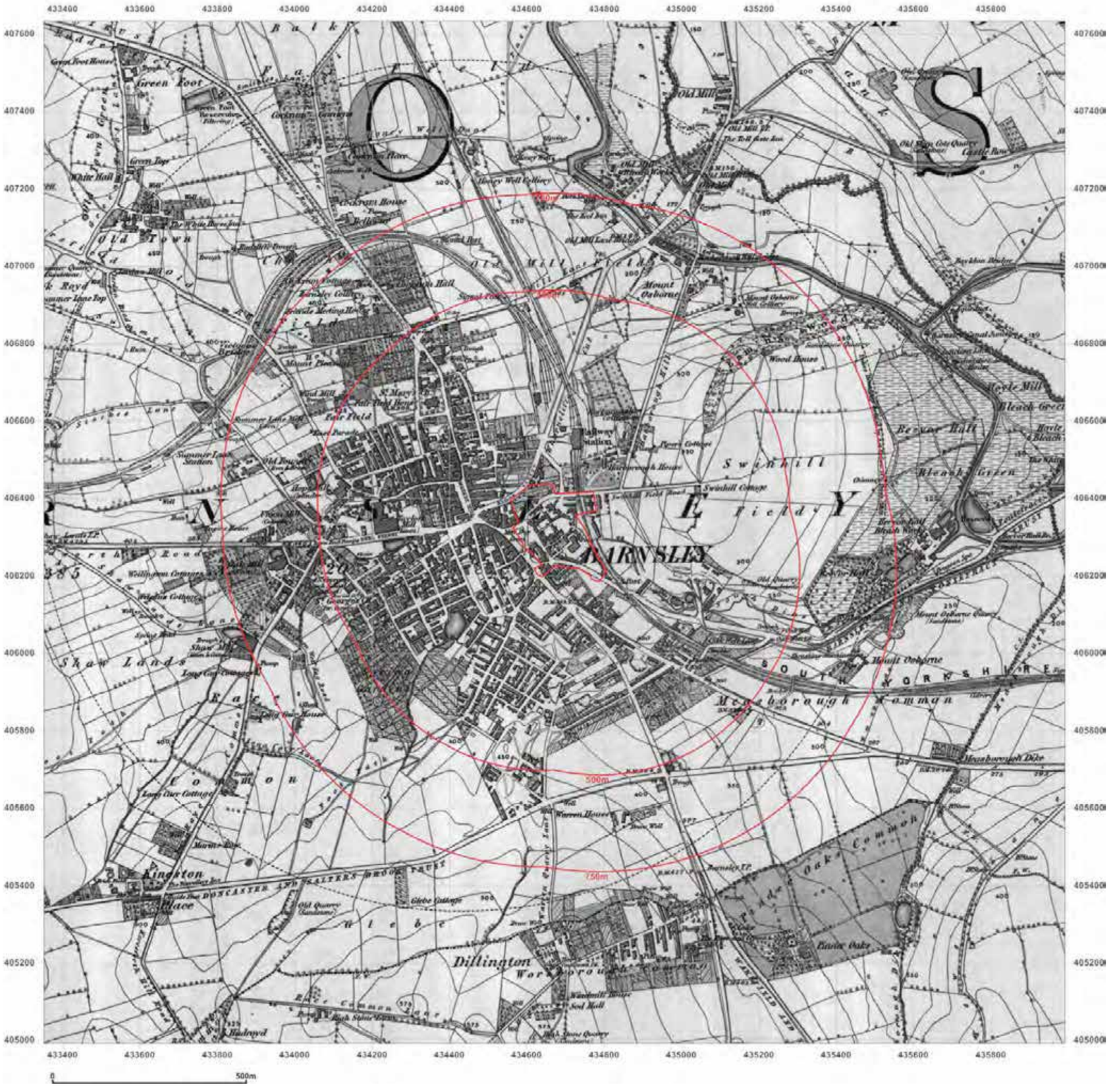


Groundsure INSIGHTS

**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** County Series

**Map date:** **1850**

**Scale:** 1:10,560

**Printed at:** 1:10,560

N
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Surveyed N/A
Revised N/A
Edition N/A
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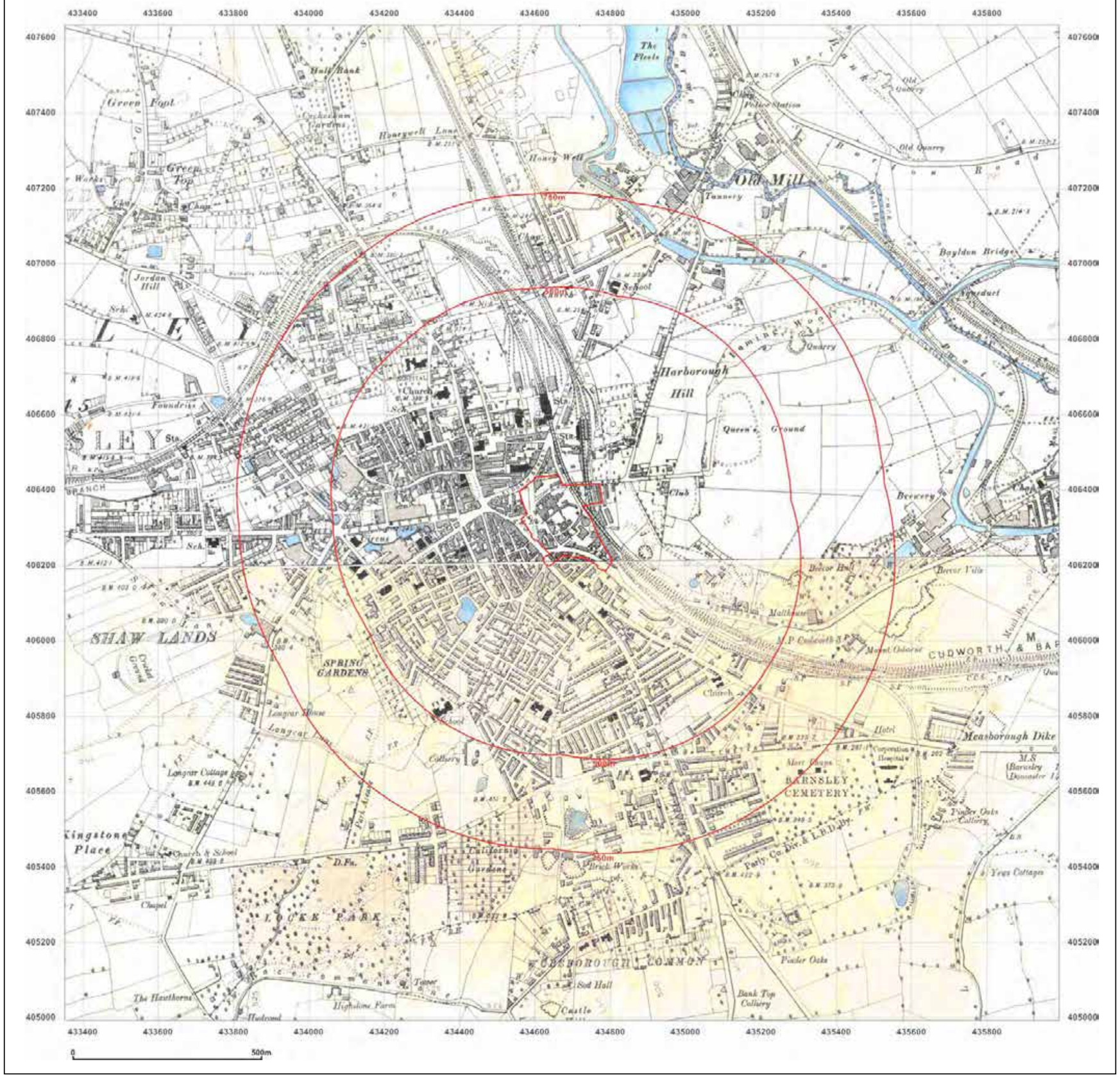


Groundsure INSIGHTS

**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** County Series

**Map date:** **1890**

**Scale:** 1:10,560

**Printed at:** 1:10,560

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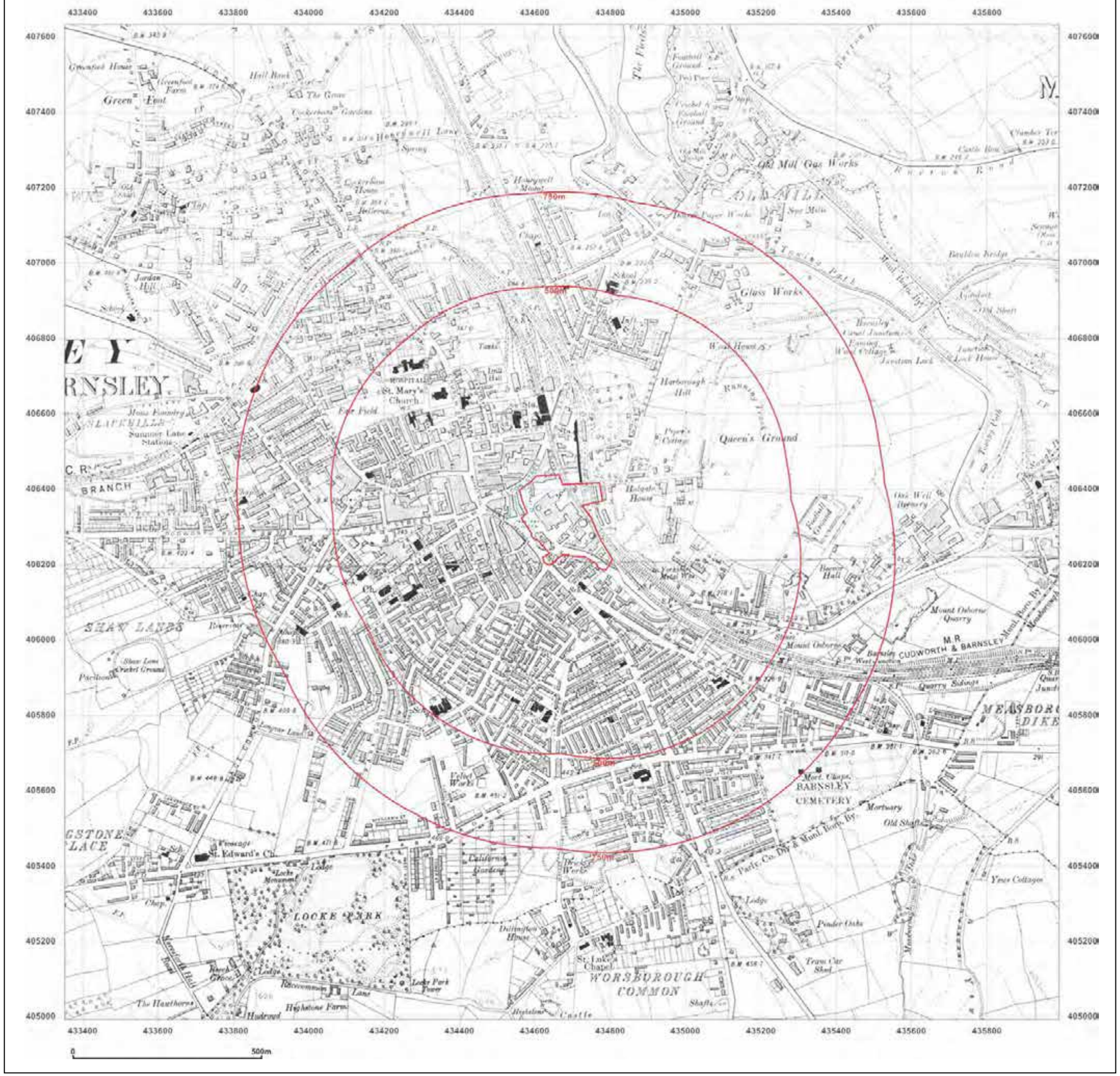


Groundsure INSIGHTS

**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** County Series

**Map date:** **1904**

**Scale:** 1:10,560

**Printed at:** 1:10,560

N
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Surveyed 1891
Revised 1904
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1890
Revised 1904
Edition N/A
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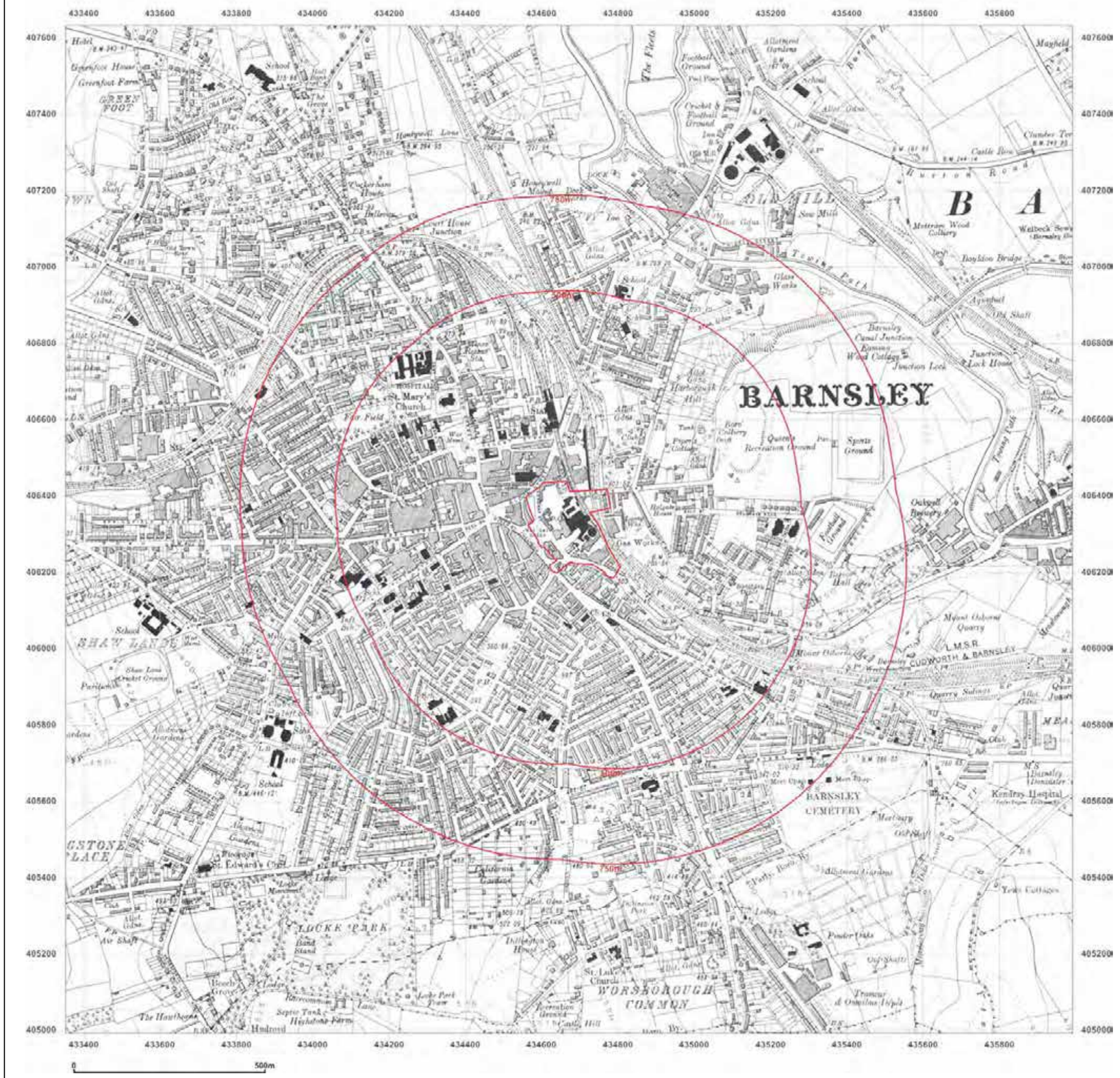


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**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** County Series

**Map date:** **1929**

**Scale:** 1:10,560

**Printed at:** 1:10,560

N
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Surveyed 1851
Revised 1929
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Revised 1929
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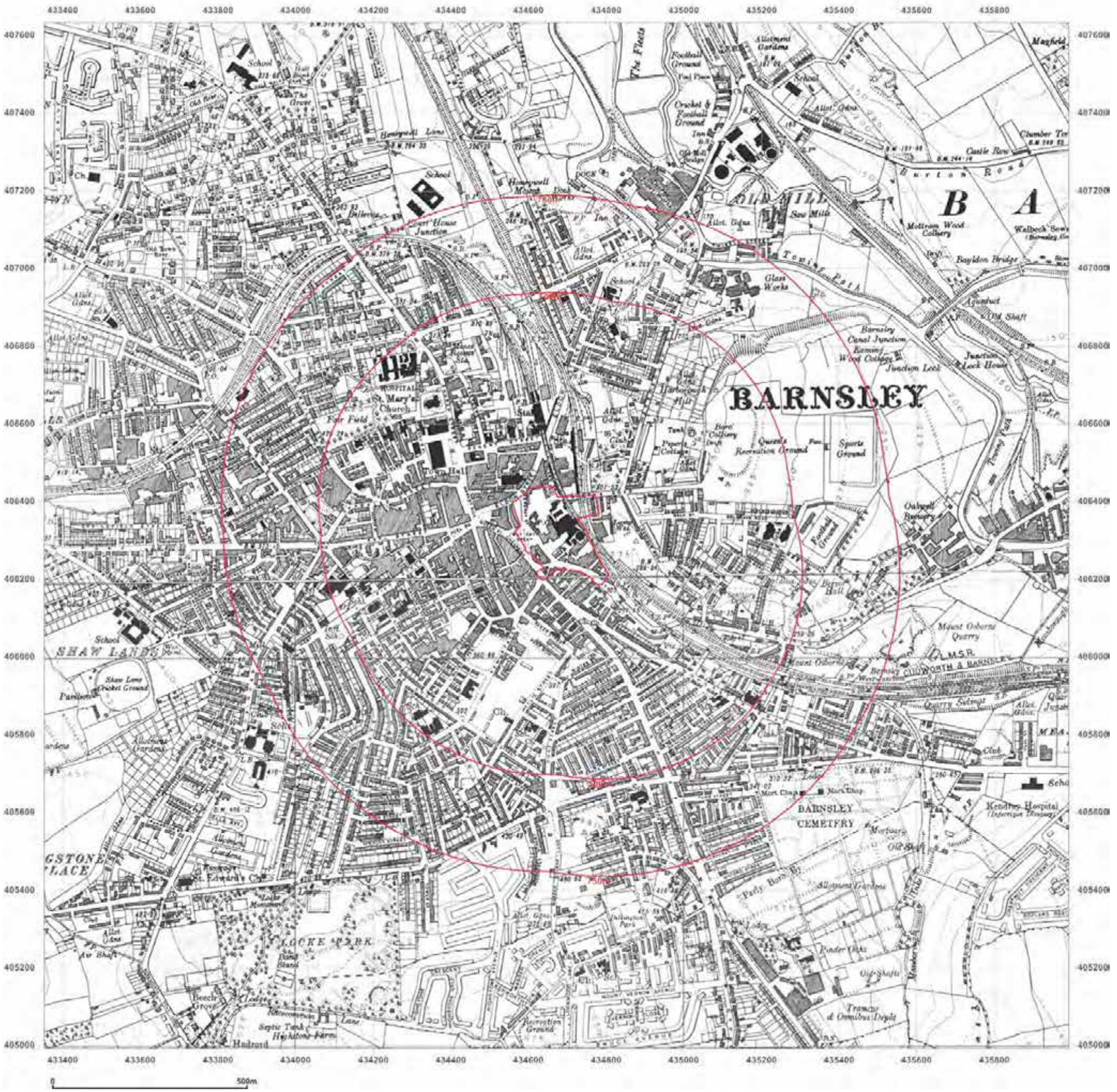


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**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** County Series

**Map date:** **1938**

**Scale:** 1:10,560

**Printed at:** 1:10,560

N
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Surveyed 1851
Revised 1938
Edition 1938
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Surveyed 1851
Revised 1938
Edition N/A
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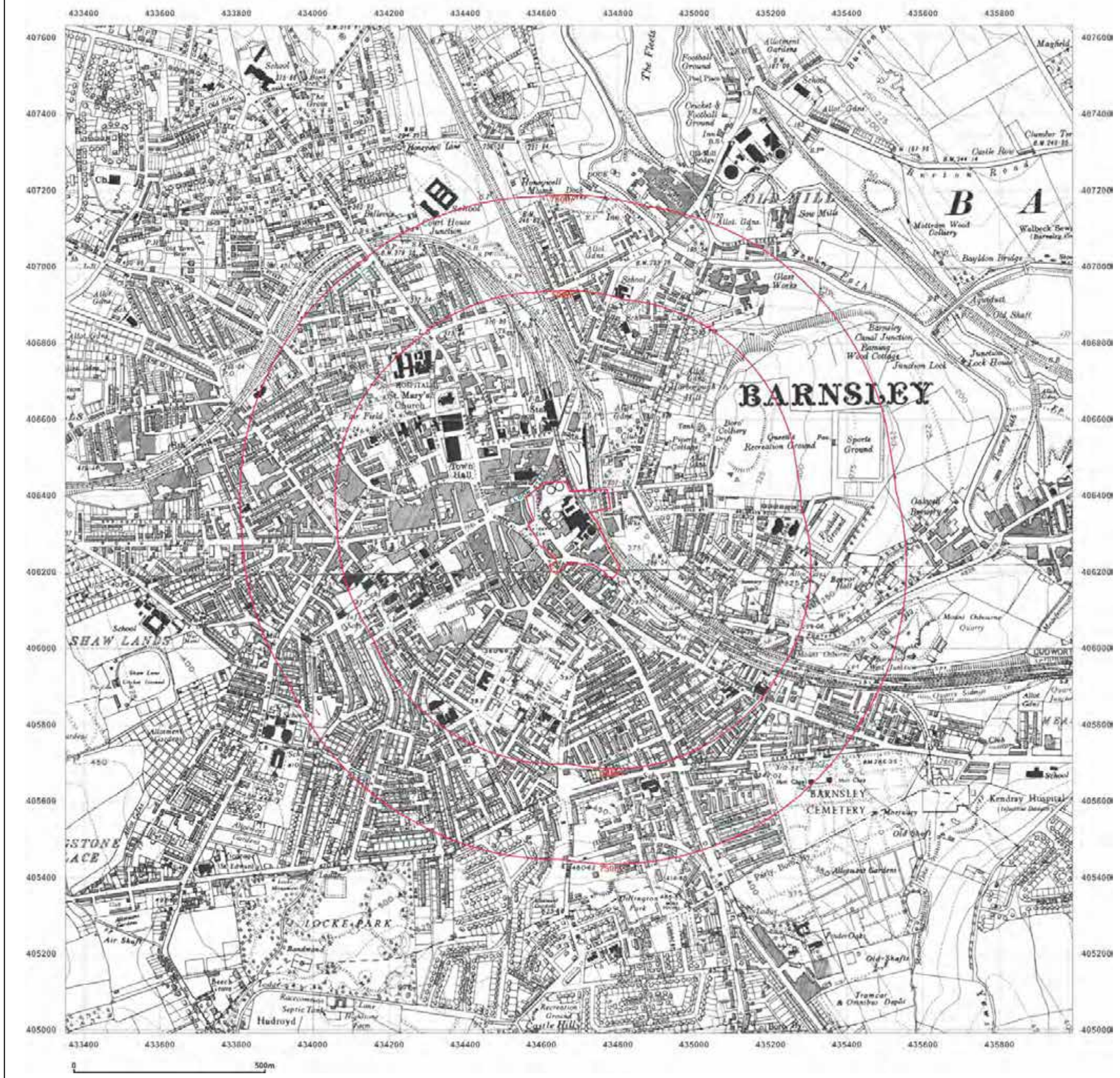


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**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** County Series

**Map date:** **1948**

**Scale:** 1:10,560

**Printed at:** 1:10,560

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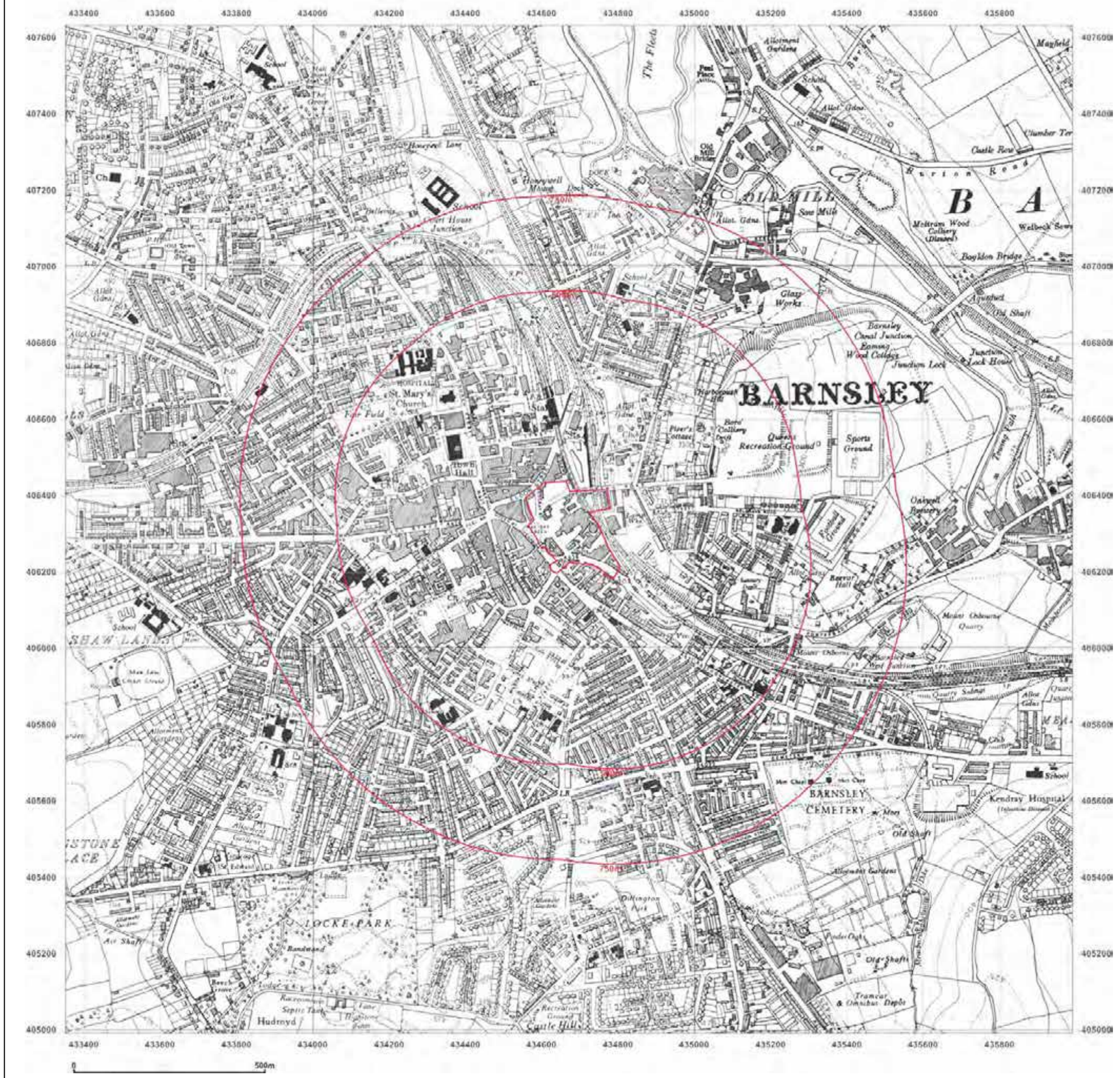


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**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** Provisional

**Map date:** **1951**

**Scale:** 1:10,560

**Printed at:** 1:10,560

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

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

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Revised 1951
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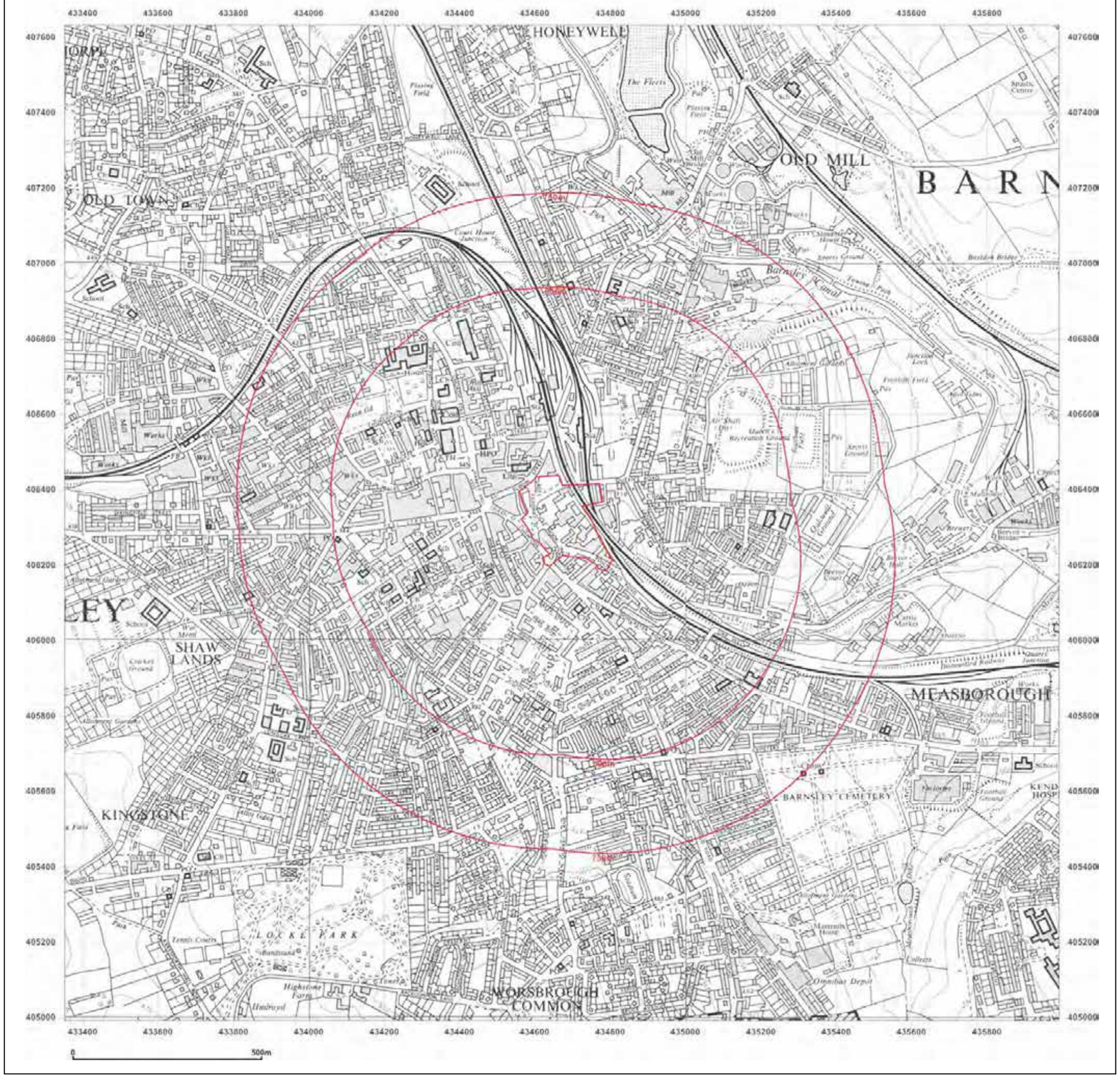


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**Site Details:**

BETTER BARNSLEY, S70 1DD

**Client Ref:** Better_Barnsley_Project
**Report Ref:** GS-2017329
**Grid Ref:** 434671, 406312

**Map Name:** Provisional

**Map date:** **1965-1966**

**Scale:** 1:10,560

**Printed at:** 1:10,560

N
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Surveyed 1966
Revised 1966
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1966
Revised 1966
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1965
Revised 1965
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