Manchester Iron Foundry, Kenyon Street, Manchester

Archaeological Excavation

Oxford Archaeology North

July 2016

Plot L Ltd

Issue No: 2016-17/1746
OA North Job No: L10925
NGR: 384420 398960

Document Title: MANCHESTER IRON FOUNDRY, KENYON STREET, MANCHESTER

Document Type: Archaeological Excavation

Client Name: PLOT L LTD

Issue Number: 2016-17/1746
OA North Job Number: L10925
National Grid Reference: 384420 398960

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SUMMARY

Plot L Ltd has devising proposals for the redevelopment of land situated in the Shudehill area of Manchester (centred at NGR 384420 398960). Known as Angel Gardens, the proposals allow for the erection of a multi-storey building and associated infrastructure and landscaping works, which will inevitably necessitate considerable earth-moving works.

At an early stage in the design process, Plot L Ltd commissioned Oxford Archaeology North (OA North) to undertake a desk-based assessment of the proposed development area, which identified a total of 11 non-designated heritage assets within the boundary of the proposed development. These included the site of the Manchester Iron Foundry, which was established within the eastern grounds of Arkwright's Mill in *c* 1840. This site was rebuilt as the iron works of Baxendale & Co, a firm of engineers and plumbers merchants, which occupied several premises in the Miller Street area during the late nineteenth and early twentieth century.

In the light of the conclusions drawn from the desk-based assessment, and in accordance with best practice as outlined in the National Planning Policy Framework paragraph 128, NOMA Plot L Ltd commissioned an archaeological evaluation of the site. This was undertaken by OA North in June and July 2014, and comprised the excavation of seven evaluation trenches that were placed across sites of potential archaeological interest, together with a larger excavation area targeted on the footprint of the Manchester Baths and Wash Houses. The evaluation demonstrated that well-preserved buried remains of the Manchester Iron Foundry survived *in-situ* which, following consultation with the Greater Manchester Archaeological Advisory Service, merited further archaeological investigation in advance of development.

The recommended further investigation was undertaken in December 2015 and January 2016, and allowed for excavation of a large proportion of the former foundry footprint. This provided a valuable opportunity to investigate the physical remains of a mid-nineteenth-century iron foundry, a class of monument is not particularly well-represented in the region's archaeological record. However, excavation revealed that the physical remains of the original foundry were rather fragmentary, having sustained disturbance and remodelling during the later nineteenth and twentieth centuries. There was similarly very little evidence for the layout of machinery in the original foundry, nor any firm indication for the location of the forges, although a structure that may possibly have represented the vestiges of a furnace were identified in the south-eastern extension to the foundry. Excavation of the northern part of the site, however, revealed the well-preserved remains of the housing for a single Cornish-type boiler. This is likely to have been used to raise the steam required to power different machinery in the iron works, such as drop-hammers, turning lathes and grinding tools. The flue system from the boiler appears to have utilised the chimney that served Shudehill Mill from the mid-1780s. The remains of flues from the boiler house at Shudehill Mill are of particular interest, but need to be considered together with the other elements of Shudehill Mill, which is presented in a separate report.

ACKNOWLEDGEMENTS

Oxford Archaeology North (OA North) would like to thank Plot L Ltd for commissioning and supporting the project. OA North is particularly grateful to Dan Brooks of Generate Land and Paul Gorge of Turner Townsend for their support. Thanks are also due to Norman Redhead, the Heritage Management Director with the Greater Manchester Archaeological Advisory Service (GMAAS). OA North is also grateful to the staff of the Local Studies Unit at Manchester Central Library, the Museum of Science and Industry in Manchester, and the Lancashire County Record Office, for their assistance with the historical research.

The excavation was directed by Graham Mottershead and Andy McGuire, with assistance from Lewis Stitt, Phil Cooke, and Sarah Mottershead. The report was written by Andy McGuire, and the illustrations were produced by Graham Mottershead and Mark Tidmarsh. The report was edited by Ian Miller, who was also responsible for project management.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF PROJECT

1.1.1 Plot L Ltd has devising proposals for the redevelopment of land situated in the Shudehill area of Manchester. Known as Angel Gardens, the proposals allow for the erection of a multi-storey building and associated infrastructure and landscaping works, which will inevitably necessitate considerable earth-moving works.

1.1.2 The archaeological potential of the site was highlighted by a desk-based assessment, which identified a total of 11 non-designated heritage assets within the boundary of the proposed development (OA North 2014). In accordance with best practice as outlined in the National Planning Policy Framework paragraph 128, NOMA Plot L Ltd commissioned an archaeological evaluation of the site at an early stage in devising the development design proposal. The evaluation was undertaken by OA North in June and July 2014, and comprised the excavation of seven evaluation trenches that were placed across sites of potential archaeological interest, together with a larger excavation area targeted on the footprint of the Manchester Baths and Wash Houses.

1.1.3 The evaluation trenching demonstrated that well-preserved buried remains of the Manchester Iron Foundry and an ancillary building associated with Shudehill Mill survived *in-situ*. The Manchester Foundry was established within the eastern grounds of Arkwright's Mill in *c* 1840. This site was rebuilt as the iron works of Baxendale & Co, a firm of engineers and plumbers merchants, which occupied several premises in the Miller Street area during the late nineteenth and early twentieth century.

1.1.4 It was concluded from the results of the evaluation that the buried remains of the former Manchester Iron Foundry merited further archaeological investigation in advance of the proposed redevelopment. It was intended that this would provide a detailed record of the buried remains to mitigate their damage or complete loss during ground works necessitated by redevelopment.

1.1.5 The excavation was undertaken in December 2015 and January 2016, and allowed for excavation of a large proportion of the former foundry footprint, in accordance with a Written Scheme of Investigation. This document was submitted to and approved by the Greater Manchester Archaeological Advisory Service (GMAAS), in their capacity as archaeological advisor to Manchester City Council, in advance of the excavation.

1.2 LOCATION, TOPOGRAPHY AND GEOLOGY

1.2.1 The study area (centred on NGR 384420 398960) is situated on the northern fringe of the city centre (Fig 1). The site lies on the north-eastern side of Miller Street, and to the south-east of the Co-operative Group's Headquarters Building (Plate 1). The site was cleared of buildings in the wake of the devastation caused by aerial bombing during the 1940s, and has been used as a cark park since the 1980s (Miller and Wild 2015).

1.2.2 ***Topography:*** topographically, the Manchester Conurbation as a region is within an undulating lowland basin, which is bounded by the Pennine uplands to the east and to the north. The region as a whole comprises the Mersey river valley, whilst the rivers Irwell, Medlock, and Irk represent the principal watercourses in Manchester (Countryside Commission 1998, 125). The study area lies on the east side of the valley of the River Irk, and the trend of the natural topography across the area falls from east to west towards the river. The study area incorporates a series of three stepped terraces, with the site of the mill and engine house occupying the middle terrace. This topography reflects the historical industrial use of the site, although it is likely to have been modified to some degree during the second half of the twentieth century.

1.2.3 ***Geology:*** the solid geology of the area comprises Carboniferous sedimentary material and a series of Permo-Triassic rocks, consisting mainly of New Red Sandstone. The overlying drift incorporates Pleistocene boulder clays of glacial origin, and sands, gravels, and clays of fluviatile/lacustrine origin (Hall *et al* 1995, 8).

Plate 1: Recent aerial view of the study area and its environs prior to the NOMA Regeneration, marking the boundary of the study area

2. METHODOLOGY

2.1 AIMS AND OBJECTIVES

2.1.1 Very few accounts exist of iron foundries in mid-nineteenth-century Manchester, and their importance on a local and regional platform is poorly represented in published histories of the town. The buried remains of the foundry within the development area certainly offered some potential to add fresh information on the development and layout of nineteenth-century iron foundries.

2.1.2 This is reflected in several of the initiatives for archaeological research of the industrial and modern periods stated in the current *Archaeological Research Framework for North West England* (Newman and McNeil 2007; McNeil and Newman 2007). In particular:

- *Initiative 7.21:* Inform 'an overview of the impact on the historic landscapes of the new towns of the Industrial Revolution and the new monument types developed within them' (Newman and McNeil 2007, 146);
- *Initiative 7.35:* 'Industry specific studies are needed for those industries that have received little archaeological attention' (McNeil and Newman 2007, 154);

2.1.3 More specific initiatives for archaeological research have been formulated recently by the *Historical Metallurgy Society* (Bayley *et al* 2008). Those initiatives that have been identified as high priority, and relevant to the present study area, include:

- 'the study of nineteenth-century ironworks, especially the foundry and forge sectors' (*op cit*, 69);
- 'to record adequately and fully publish all metallurgical-important sites whose preservation cannot be guaranteed' (*ibid*).

2.1.4 It was anticipated that the archaeological investigation may help to address the following research objectives:

- establish the plan form, function and chronology of the former Manchester Foundry;
- establish the function and chronology of the detached building that originally formed part of the Shudehill Mill complex.

2.1.5 In order to address the aims and objective outlined above, it was proposed that a single, open-area was targeted for excavation. The targeted area had maximum dimensions of 55 x 25m.

2.1.6 The work was carried out in line with current CIfA guidelines, and in line with the CIfA Code of Conduct. The principal objectives of the project were achieved via the following stages:

- ***Archaeological Excavation:*** the excavation of the targeted area, which investigated the buried remains of the former Manchester Foundry and a building that originally formed part of Shudehill Mill;
- ***Historical research:*** a limited programme of historical research was carry out to supplement the information gathered during the desk-based assessment for the site;
- ***Post-excavation and Report Production:*** the site records, finds and any samples from the excavation form a checked and ordered site archive as outlined in the English Heritage guideline document *Management of Archaeological Projects* (2nd edition, 1991);
- ***Archive Deposition:*** the results of the excavation will form the basis of a full archive to professional standards, in accordance with current English Heritage guidelines and the *Guidelines for the Preparation of Excavation Archives for Long Term Storage* (UKIC 1990). The project archive represents the collation and indexing of all the data and material gathered during the course of the project;

2.2 EXCAVATION

2.2.1 The excavation allowed for the intrusive investigation of the site of Manchester Iron Foundry. The modern surface was removed using a mechanical excavator fitted with a toothless ditching bucket operating under archaeological supervision. The same machine was then used to carefully define the extent of any surviving walls, foundations and other remains, after which all excavation was undertaken manually. All work carried out was consistent with the relevant standards and procedures provided by the Chartered Institute for Archaeologists (CIfA), and their code of conduct.

2.2.2 All information identified in the course of the site works was recorded stratigraphically, using a system adapted from that used by the Centre for Archaeology Service of English Heritage. Results of the excavation were recorded on *pro-forma* context sheets, and were accompanied with sufficient pictorial record (plans, sections and digital photographs) to identify and illustrate individual features.

2.2.3 A full and detailed photographic record of individual contexts was maintained and similarly general views from standard view points of the overall site at all stages of the excavation were generated. Photography was undertaken using high-resolution digital cameras, and all frames will include a visible, graduated metric scale. Photographs records will be maintained on special photographic *pro-forma* sheets.

2.2.4 The precise location of the trenches, and the position of all archaeological structures encountered, was surveyed by EDM tacheometry using a total station linked to a pen computer data logger. This process generated scaled plans and sections within AutoCAD, which were then subject to manual survey enhancement. The drawings were generated at an accuracy appropriate for 1:20 scale, and all information was tied in to Ordnance Datum.

2.3 ARCHIVE

2.3.1 The results of all archaeological work carried out will form the basis for a full archive to professional standards, in accordance with current English Heritage guidelines (*Management of Archaeological Projects*, 2nd edition, 1991), and in accordance with the *Guidelines for the Preparation of Excavation Archives for Long-Term Storage* (Walker 1990). The project archive represents the collation and indexing of all the data and material gathered during the course of the project. This archive will be provided in the English Heritage Centre for Archaeology format and a synthesis will be submitted to the CSMR (the index to the archive and a copy of the report).

2.3.2 The Arts and Humanities Data Service (AHDS) online database project *Online Access to index of Archaeological Investigations* (OASIS) will be completed as part of the archiving phase of the project.

3. BACKGROUND

3.1 INDUSTRIAL DEVELOPMENT OF MANCHESTER AND SHUDEHILL

3.1.1 The Shudehill area of Manchester lay on the east side of Long Millgate, on the north-eastern fringe of the medieval settlement. Documented from the early fourteenth century, Long Millgate is shown on the earliest known map of Manchester, dating to *c* 1650, which also shows several properties along Miller Street and Shudehill. Miller's Lane, the forerunner of Miller Street, is documented from the 1580s, and may have originated as a convenient link between the manorial corn mill and the eastern approach to the town via Shudehill and what is now Swan Street.

3.1.2 In 1621, Edward Mayes of Manchester bequeathed money for the purchase of land to be used for the benefit of the poor of the town. His trustees bought four acres on the south side of Miller's Lane in 1635, which were rented out and the profits distributed to the poor (Miller and Wild 2015). The charity also owned a row of cottages on the north side of this land in which they housed 20 poor families. In 1731, a scheme was launched to provide Manchester with a new workhouse, and a bill to advance the scheme was submitted to Parliament, but was aborted due to disagreements among the townspeople. However, the lord of the manor had proceeded to erect part of the workhouse on Miller's Lane, which was earliest building of this type in Manchester. These buildings are shown on a map produced by Casson and Berry in 1741, which also shows the west side of Shudehill lined with buildings as far as the junction with Miller's Lane (Plate 2).

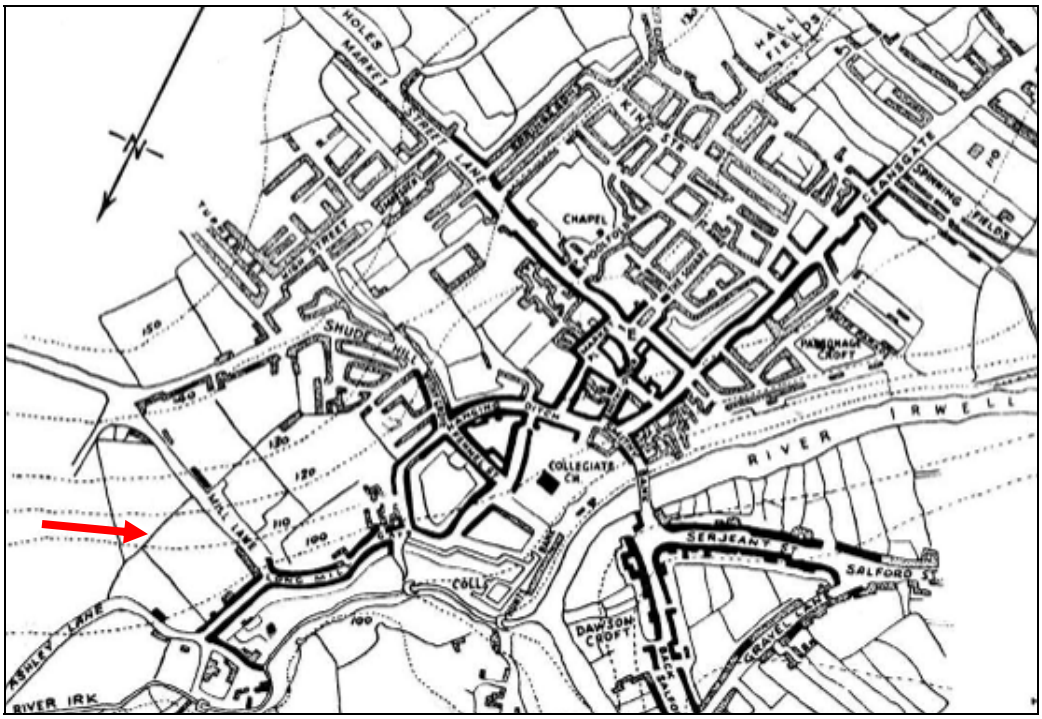

Plate 2: Copy of Casson and Berry's map of 1741, with arrow marking approximate location of the Manchester Iron Foundry

3.1.3 The onset of the rapid industrialisation centred on Manchester from the late eighteenth century resulted in a massive expansion of the town's population. The urban growth and resultant development of Shudehill during the second half of the century is captured on detailed plans of Manchester and Salford produced by William Green in 1787-94 (Plate 3) and Charles Laurent in 1793 (Fig 4). These maps show new streets to have been laid out across the area, and numerous buildings to have been erected. The new streets included Angel Street, which provided a link between Ashley Lane and Rochdale Road, and also afforded access to the church of St Michael and All Angels. The church was built in 1788, and was coupled with a new burial ground that was consecrated in 1787 (Miller and Wild 2015). The church was originally planned as a 'carriage church', which wealthy Mancunians could drive to from the city. However, with the purchase of the adjacent land by the Overseers of the Poor of Manchester in 1786 for the burial ground, and the absorption of this area into the city, the church instead predominantly served the new working-class population in the area. Situated in the centre of these new developments was Richard Arkwright's Shudehill Mill, which was established in 1780 (Plate 3).

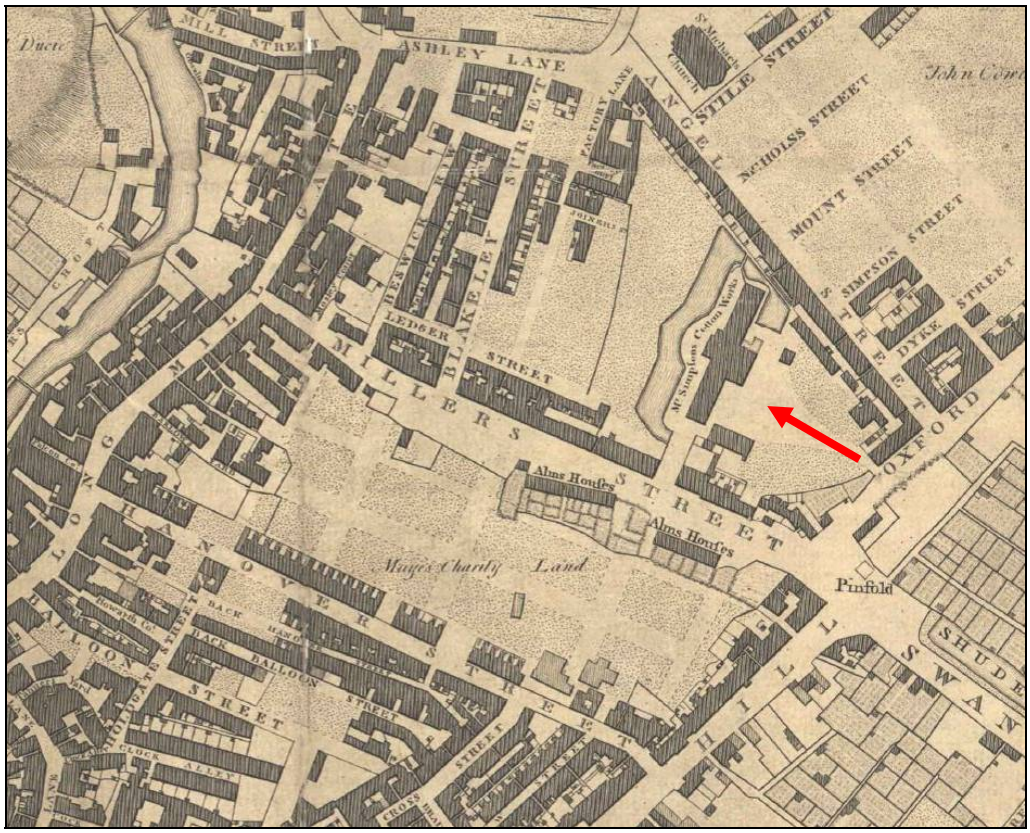

Plate 3: Extract from William Green's Map of Manchester and Salford of 1787-94, showing the early development of Shudehill. The map also shows Shudehill Mill, annotated as 'Mr Simpson's Cotton Mill', with arrow marking the position of the later Manchester Iron Foundry.

3.2 DEVELOPMENT OF THE MANCHESTER IRON FOUNDRY

3.2.1 The Manchester Iron Foundry appears to have originated from 1838-41, based on entries in trade directories for the period, with a directory for 1841 listing John and Henry Rowcroft as iron founders on Kenyon Street (Pigot and Slater 1841, 72). The footprint of the foundry is captured on the Ordnance Survey map of 1850 (surveyed in 1848), which depicts an irregular range of buildings situated at the north-western end of Kenyon Street, to the rear of the large Shudehill Mill. The Ordnance Survey identifies the works as an iron foundry, but provides little indication of the internal layout, other than annotating the position of a boiler at the northern end (Plate 4). The north end of the foundry also seems to have incorporated the detached chimney of Shudehill Mill, although this is not marked specifically by the Ordnance Survey.

Plate 4: Extract from the Ordnance Survey map of 1850

3.2.2 The footprint of the foundry in the mid-nineteenth century is also shown on Adshead's detailed plan of Manchester, which was surveyed in 1850 and published in 1851 (Plate 5). This shows the foundry to have had broadly the same layout as shown by the Ordnance Survey, although a few additions may be noted. In particular, a narrow rectangular range appears to have been added to the western side of the foundry, which extended northwards to the rear of the houses along Angel Street. A small building also appears to have been added to the eastern side of the foundry, at the end of Kenyon Street. The principal entrance to the foundry, as shown by Adshead, overlooked the central yard at the end of Kenyon Street. Adshead also annotates the southern part of the complex as a foundry, but the northern part is attributed to 'R Powell's Various Works', implying that the buildings were in multiple occupancy.

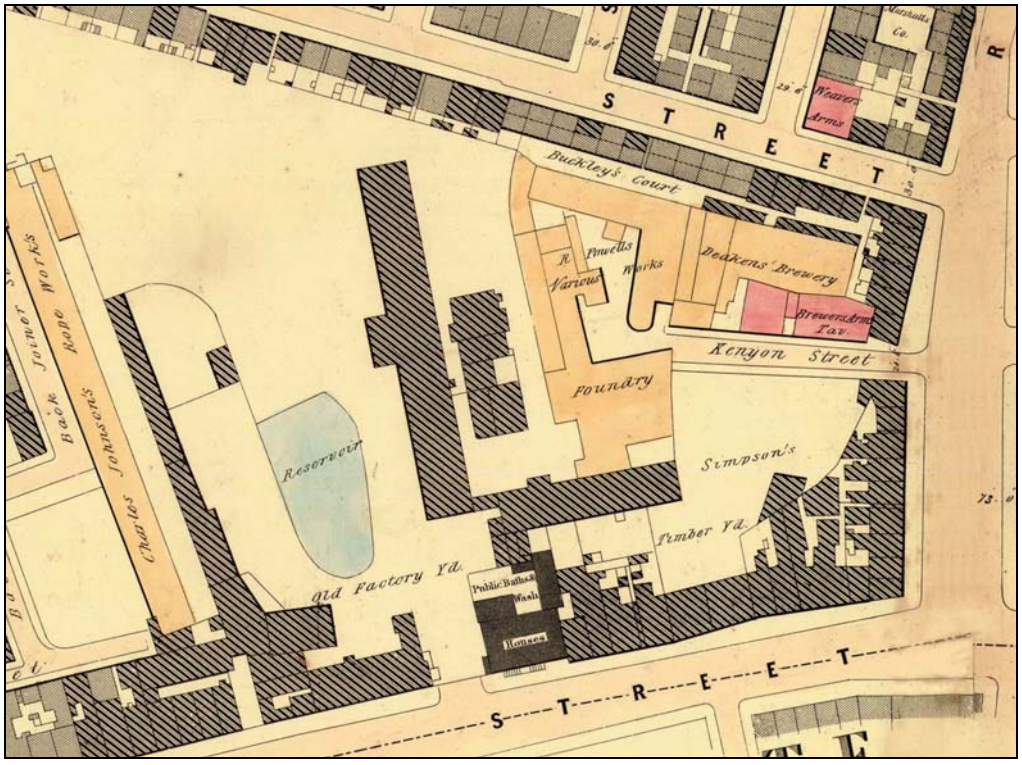

Plate 5: Extract from the Adshead's map of 1851

3.2.3 The detail provided by Adshead's maps is borne out by entries in trade directories. John Rowcroft, for instance, is listed in a trade directory for 1853 as a scale beam and weighing machinery manufacturer, iron founder and owner of a saw mill on Kenyon Street (Whellan 1853, 275). In contrast to many other iron founders in Manchester, Rowcroft does not appear to have carried out any brass founding. The same directory contains entries for several other businesses on Kenyon Street, which are likely to have been housed within 'Powell's Various Works'. These included Joseph Powell (engineer and paper-bowl manufacturer), Robert Powell & Co (manufacturers of hydraulic presses and turners in wood and metal), George and Samuel Bradshaw (engravers to calico printers), and William Kenyon (tin-plate worker).

3.2.4 Numerous craftsmen are similarly listed on Kenyon Street in a trade directory of 1863, including John Rowcroft, who is entered as occupying a 'grindery warehouse' and a saw mill on Kenyon Street, but is not described specifically as an iron founder (Slater 1863, 56). Conversely, however, Henry Wallwork is listed as an iron founder on Kenyon Street (*op cit*, 61); H Wallwork & Co was established as a firm of iron founders in 1856, and may have taken over the Kenyon Street foundry shortly after this date. Other craftsmen on Kenyon Street in 1863 included W Wilde (machine grinder), J Snowden (nail manufacturer), E Kenyon (tin plate worker), E Jones (wood turner), W Stott (joiner), S Smith (spindle maker), T Wilkinson (shuttle maker), (F Strahan (cabinet maker), P Grice (wood turner) and W Sherwin (ivory turner). Some of these businesses, however, may have occupied buildings on either side of Kenyon Street, beyond the boundary of the present study area.

3.2.5 Henry Wallwork is listed as an iron founder on Charter Street in a directory for 1877 (Slater 1877, 548); neither John Rowcroft nor the Kenyon Street foundry is listed. A directory for 1879 similarly contains no listing for an iron foundry on Kenyon Street, or in the immediate locale, although several 'turners of wood, ivory and metal' are listed on Kenyon Street, together with the Manchester Cop Tube Company (Slater 1879).

3.2.6 Subsequent directories, including an edition for 1895, lists only three entries for Kenyon Street, comprising a joiner's workshop, a wood turner and a lace tag maker (Slater 1895, 234). This suggests that the works may have fallen into partial disuse, and that the foundry had been abandoned. This is reinforced to some degree by the detail shown on the Ordnance Survey map of 1892, which does not attribute any function to any of the buildings occupying the site. However, the site was taken over in the late nineteenth century by Baxendale & Co, a firm of hardware manufacturers and suppliers that had been established in Salford in 1863 by Laban Baxendale and his future brother-in-law, Alfred Innes.

3.2.7 ***Baxendale & Co Ltd:*** Baxendale's returned the site back into use as an iron works, and the buildings are annotated as such on the Ordnance Survey map of 1908 (Plate 6). A series of photographs taken of the site during this period provide useful views across the interior of some of the buildings (Plates 7-12).

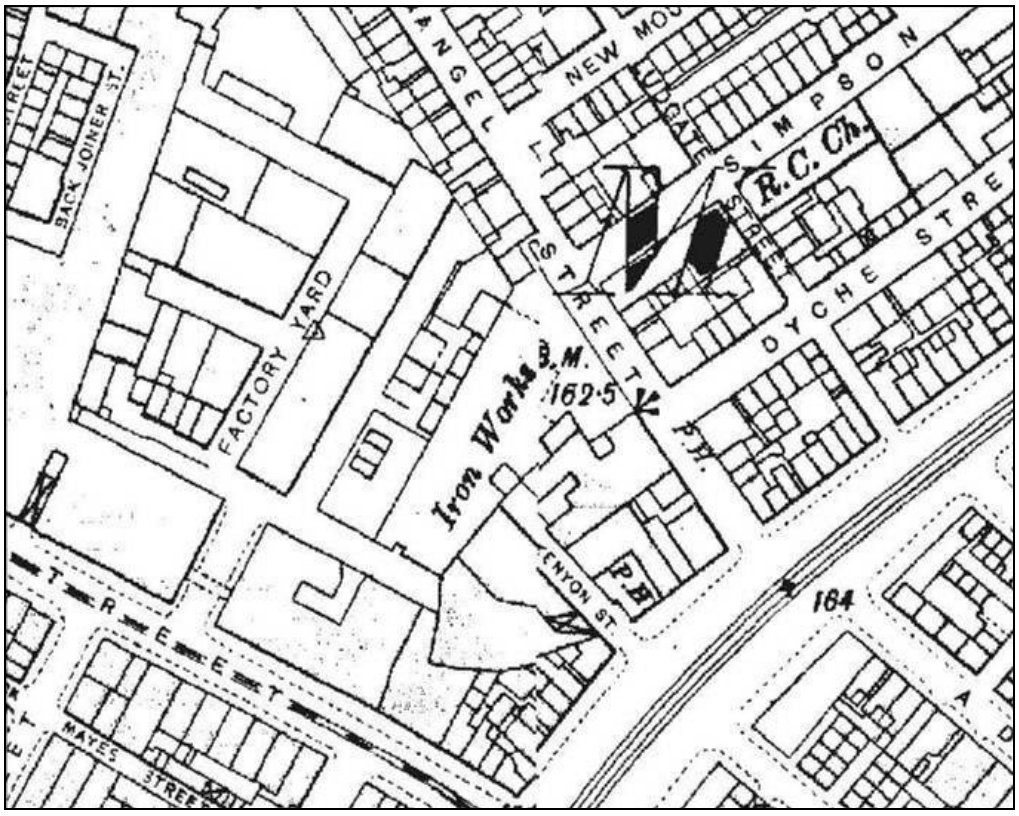

Plate 6: Extract from the Ordnance Survey map of 1908

Plate 7: Baxendale's Iron Foundry, Kenyon Street, 1903

Plate 8: Baxendale's Iron Foundry, Kenyon Street, 1903

Plate 9: Baxendale's Iron Foundry, Kenyon Street, 1903

Plate 10: Baxendale's Iron Foundry, Kenyon Street, 1903

Plate 11: Baxendale's Iron Foundry, Kenyon Street, 1903, with Simpson Street to the rear

Plate 12: Baxendale's Iron Foundry, Kenyon Street, 1903

3.2.8 The next edition of Ordnance Survey 25": 1 mile mapping of the area, published in 1922, marks the iron works as 'disused', with the same annotation appearing on the 1933 edition of mapping. However, the detail provided by Goad's insurance plan of 1937 shows that the buildings had been returned to use for warehousing purposes. However, the buildings were destroyed completely during the extensive aerial bombing that took place across Manchester on the 22 and 23 December 1940.

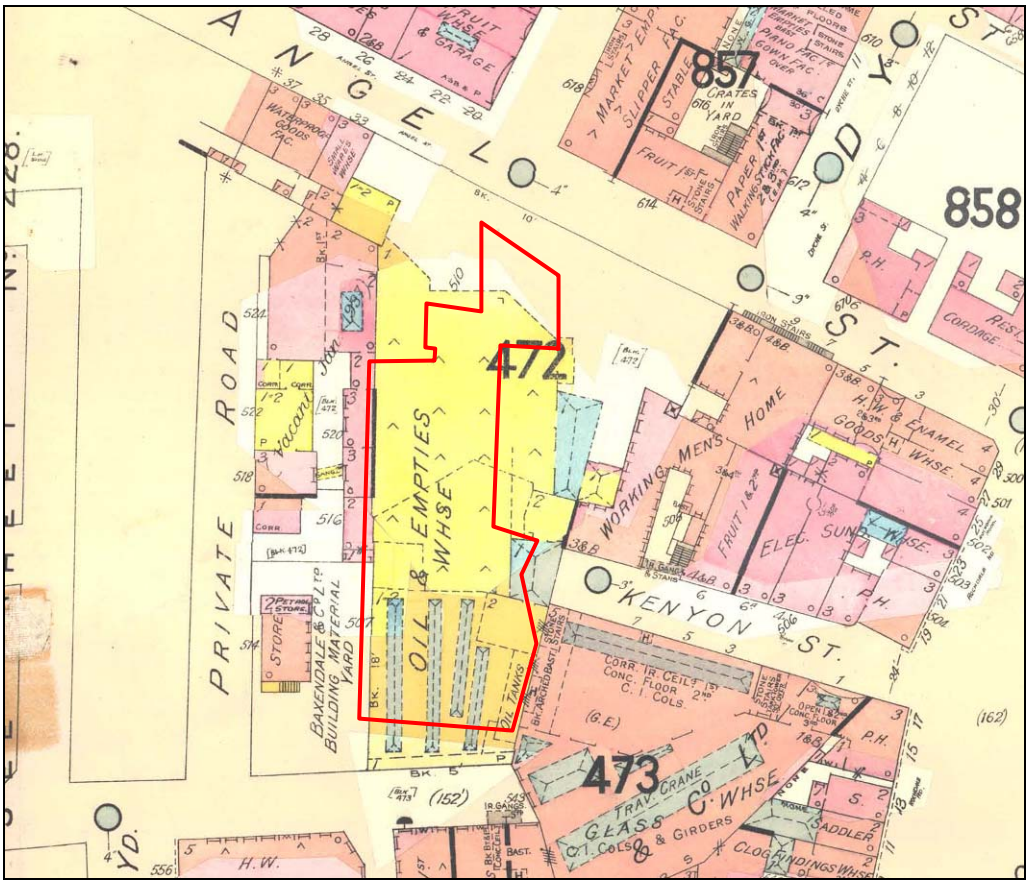

Plate 13: Extract from Goad's insurance plan of 1937, marking the excavation area

3.2.9 The Town and Country Planning Act of 1944 permitted Manchester Town Planning Committee to make compulsory purchases of areas it wished to redevelop. One area comprised '6.61 acres of land bounded by Miller Street, Rochdale Road, Angel Street, and Dantzic Street, of which 4.38 acres have been cleared. In addition, nearly half an acre has been cleared under the Housing Acts and only seven buildings remain on the site. The area has been zoned for general industrial development' (*Manchester Guardian*, 18 September 1946).

3.2.10 Despite this apparent aspiration for redeveloping the study area in the 1940s, it is evident that this did not take place, as the 1951-2 Ordnance Survey map shows the area as almost completely clear of buildings, and the 1966 Ordnance Survey map shows just a few warehouses within the study area, which eventually became a car park in the 1980s.

3.3 PREVIOUS ARCHAEOLOGICAL WORKS

3.3.1 The footprint of the Manchester Iron Foundry was subject to limited intrusive site investigation in 2014, when it formed one of the targets for a programme of evaluation trenching. Three evaluation trenches (Trenches 5, 6 and 7) were placed across the footprint of the foundry.

3.3.2 Trench 5 was aligned north/south, measured 25.8m x 2m, and was excavated to a maximum depth of 1.9m. The trench was placed along the slope between the upper and lower terraces of the current car park, and was thus much deeper in the centre than at the ends. The southern end of the trench lay along the modern vehicle access ramp between the upper and lower terraces, and all buried remains in this area appear to have been removed when the site was landscaped. Excavation at the northern end of the trench revealed a brick surface (***502***), which was present across the width of the trench, and was exposed for a distance of at least 2m. The fabric of the surface comprised hand-made bricks, consistent with a mid-nineteenth-century date (Plate 20). Another brick surface (***504***) was revealed 1.4m to the south, and was similarly present right across the excavated trench for a distance of 5.1m. Surface ***504*** also comprised hand-made bricks, and is likely to have been of a contemporary date with surface ***502***. Both surfaces were laid on a bedding of cinders (***501***), and part of ***504*** was overlain by two flagstones (***503***). Surface ***504*** was cut by a pipe trench (***505***), which lay across the trench.

Plate 14: Brick surfaces at the north end of Trench 5, looking south-east

3.3.3 A concrete column base (***506***), measuring 0.9m x 0.78m and set in a levelling deposit of mixed rubble, was exposed at the southern end of surface ***504*** (Plate 21). The remains of a cast-iron column survived on top of the concrete base. This was evidently of a later date to brick surface ***504***, and presumably represented late nineteenth-century remodelling of the site.

*Plate 15: Column base **506**, looking south-west*

3.3.4 A series of re-used stone slabs (***507***), including a distinctive circular block with a chamfer around its base, were revealed to the south of column base ***506*** (Plate 22). These lay on top of the rubble levelling material surrounding the column base The deposition of these slabs indicated that they were *in-situ* rather than tumble within the rubble.

*Plate 16: Re-used stone blocks **507**, looking west*

3.3.5 A deeper slot was excavated to the east of stone slabs ***507*** to uncover a brick wall (***508***) that was aligned north-west/south-east beneath ***507***. Wall ***508*** was 0.27m wide, and comprised two courses of hand-made bricks bonded with lime-based mortar (Plate 17). This wall was probably an internal partition within the mid-nineteenth-century foundry. Abutting wall ***508*** was a surface (***509***) of very hard cement, which continued beneath the eastern edge of the trench. The upper surface of this surface appeared almost vitrified by heat. It continued 2m further to the south at an angle to the trench, disappearing into the eastern section, but was removed by machine to reveal the underlying deposits.

*Plate 17: Wall **508**, looking north*

3.3.6 Natural clay was (***513***) exposed in the southern part of the trench. This lay at a depth of 1.9m below the current ground surface in the centre of the trench, where the modern ground level started to fall towards the lower terrace; at the base of the slope to the south, on the lower terrace, the natural clay geology was exposed at a depth of 0.2m.

3.3.7 A large circular pit (***511***) was cut into the natural clay geology (Plate 18). This continued beneath the western edge of the trench, and below the mixed rubble around column base ***506***. Pit ***511*** had a maximum width of 1.16m and maximum length of 2.67m, and was filled with mixed fine black soot and sand, consistent with the materials employed for casting iron objects. The form of feature ***511***, together with the nature of the fill, suggests that it may have been the remains of a casting pit in the iron foundry.

*Plate 18: Possible casting pit **511**, looking south*

3.3.8 A circular structure ***512*** was identified to the south of pit ***511***. Cut into natural clay ***513***, structure ***512*** was of brick construction with a concrete capping, which may have been a later addition (Plate 19). It extended beneath both the western and eastern edges of the excavated trench, and measured 3.03m in diameter. Structure ***512*** was tentatively interpreted as a possible furnace base, although the surrounding clay did not exhibit characteristic heat discolouration. Several fragments of large crucibles were recovered from the overlying rubble.

*Plate 19: Structure **512**, looking south-east*

3.3.9 Trench 6 measured 9.35m x 2m, and was excavated to a maximum depth of 190mm. It was aligned north-west/south-east, and was placed across the footprint of the northern part of the Manchester Foundry on the upper terrace of the modern car park.

3.3.10 The well-preserved remains of a surface (***601***) composed on hand-made bricks was exposed immediately beneath the modern levelling material for the car park (Plate 20). The brick surface was present along the entire length of the excavated trench, and almost certainly represented a floor inside the foundry.

Plate 20: Brick surface revealed in Trench 6, looking west

3.3.11 Trench 7 measured 10.1m x 1.8m, and was excavated to a maximum depth of 210mm (Fig 9). It was aligned north-west/south-east on the upper terrace of the car park, and was placed across the footprint of a boiler house at the northern end of the iron foundry (Fig 5). The position of the trench also corresponded with the chimney for Arkwright's Mill, shown on Bancks & Co's map of 1831 (Fig 4).

3.3.12 A surface (***701***) composed of hand-made bricks was exposed along most of the trench at a depth of between 180mm and 200mm, immediately below the levelling material for the modern car park (Plate 21). This was very similar to surface ***601*** in Trench 6, and was almost certainly of a contemporary date. Surface ***701*** was cut in the central part of the trench by a modern concrete beam ***702***. Excavation further to the south-east revealed a thick deposit of mixed rubble (***700***), which contained fragments of chrysotile asbestos sheeting.

*Plate 21: Brick surface **701** excavated in Trench 7, looking north-west*

4. EXCAVATION OF THE MANCHESTER IRON FOUNDRY

4.1 INTRODUCTION

4.1.1 A large rectangular trench measuring 25m x 40m, and aligned south-west/north-east, corresponding with the footprint of the main block of the foundry complex shown on the sequence of historical mapping (Figs 3-11), was excavated across the upper terrace of the modern car park. The depth of excavation ranged from 0.05m at the north-eastern end, to 2m within the central area. A series of sondages were excavated subsequently, with the deepest reaching a depth of 4.00m below the current level of the car park. An area measuring between 10.00m x 25.00m at the north-eastern end of the trench had to be left unexcavated due to limited room for spoil within the confines of the car park. The trench was later extended north-eastwards by a further 10.00m x 8.50m in an attempt to reveal any buried remains of the northern extent of the foundry complex.

Plate 22: General view across the southern part of the excavated area

4.1.2 Across much of the excavated area, the uppermost surface consisted of 0.20m thick deposit of mixed hardcore and fine gravel (***001***), with patches of overlying tarmac. This overlay a surface of hand-made bricks (***002***) in the northern part of the trench, which had been identified in the initial evaluation trenches (*Section 3.4*, above). Immediately below this was a 0.40m levelling deposit of clinker and soot (***003***), with 0.40m of demolition material (***004***) overlying natural clay deposits below. Remains of structures relating to the foundry complex were observed below (***002***) and, unless stated, were cut into the natural clay.

4.2 THE EXTERIOR WALLS

4.2.1 The outer walls of the building were revealed at the north, west and east sides of the structure, with a small part of the south extant wall observed to the south-west, beyond the area of excavation. Wall ***005*** was 0.70m wide, and formed the western side of the building, as depicted on the Ordnance Survey map of 1850; the location of wall ***005*** corresponded closely to the exterior wall of the foundry shown on this map. The upper fabric of wall ***005*** comprised hand-made bricks, laid randomly and bonded with a hard, grey mortar (Plate 23).

*Plate 23: The western wall (**005**) of the iron foundry*

4.2.2 A single header course was observed within the east-facing elevation at a depth of 0.50m below the uppermost course, below which the bricks were bonded with a grey/brown sandy mortar and laid in English Garden Wall bond. A single step foundation course of headers was observed at a depth of around 1.00m, below which the fabric was poorly constructed, especially where flues (***113***-***115***) ran beneath. Several small buttresses (each measuring 0.25 x 0.20m) were also observed along the eastern face of wall ***005*** at regular intervals of around 3.00m. These occurred at around 19.00m from the northern extent, and coincided with a change in the general fabric of the wall. Here the bricks were bonded with a hard dark/grey mortar, indicative of late nineteenth-century repair, and the eastern elevation displayed a rough un-pointed finish.

4.2.3 Wall ***122*** was located approximately 16.00m from the northern extent of wall ***005***, and 3.50m from the south-eastern face. This wall may have served as part of the eastern, exterior wall during the mid-nineteenth century. Wall ***122*** was observed on a north-east/south-west alignment for 8.50m, with the northern extent truncated. At 0.60m south of this truncation, the wall extended north-west for 2.00m (Plate 24).

4.2.4 This extension was 0.35m wide and was observed to a depth of roughly 2.00m along the north eastern face. At its southern extent, wall ***122*** turned roughly 90 degrees and continued on a south-eastern alignment for 4.00m. The general fabric of ***122*** comprised three courses of hand-made bricks laid in an English Garden Wall style and bonded using a light brown/grey mortar. A foundation course was noted along the south-east and north-west elevations at a depth of roughly 0.50m.

*Plate 24: Wall **122***

4.2.5 Wall ***123*** was observed 2.50m south-east of ***107*** and ran for a distance of 14.00m. This wall had been heavily modified over time and may have been an exterior wall of a later annexe observed in OS mapping from 1892. Much of the northern 3.50m was heavily truncated along the north-western face and suffered partial collapse during excavation. Beyond this, the elevation remained intact and displayed two main phases. The initial phase highlighted a fabric comprising two stretcher courses of hand–made brick bonded using a brown sandy mortar. At 7.50m south of the northern extent, wall ***123*** had been remodelled with an additional course added to the north-western face. Here the wall was 0.45m wide, and the component bricks were bonded using a dark grey/black cement. The southern extent of wall ***123*** had been constructed over flue ***120***, and was truncated thereafter.

4.2.6 Wall ***130*** was aligned roughly north/south, and formed a portion of the eastern wall after the expansion of the foundry into the south-eastern area of the complex. Wall ***130*** was observed for 3.70m with a maximum width of roughly 0.75m. The fabric of ***130*** comprised six courses of hand-made brick, laid in an English Garden Wall style. The three western courses consisted of bricks measuring 0.23m x 0.115m x 0.075m and bonded using a light white/brown sandy mortar. The three eastern courses were only observed for 2.00m with the bricks measuring 0.22m x 0.11m x 0.07m and bonded using a mid-grey/brown sandy mortar. These two phases of construction may highlight the addition of external buildings to the south-east face of wall ***130***. These buildings were not part of the foundry complex, but can be observed on OS mapping from 1892. Wall ***130*** was truncated by a modern service 0.20m south of wall ***131***, but was observed to continue north and south through the baulk.

4.3 THE BOILER

4.3.1 This structure was aligned roughly north/south and consisted of two, brick built, side flues (***109*** and ***110***), with a central, brick-lined recess (***111***) between (Plate 25). Three exterior walls (***106***, ***107*** and ***108***) formed the eastern, southern and western boundary walls of the complex, respectively. The location of this structure corresponds broadly with the footprint of a building labelled 'Boiler' on the ordnance Survey map of 1850 (Fig 6), and was observed to a maximum depth of 3.00m.

4.3.2 Wall ***106*** was 0.36m wide and observed for 4.90m, truncated to the northern extent and abutting external wall ***107*** to the south and flue ***109*** to the west. The general fabric of wall ***106*** comprised two outer courses of randomly laid hand-made bricks with a single, stretcher course of highly degraded refractory brick forming the internal (western) face. The bricks (0.23 x 0.11 x 0.07m) were mainly bonded using a grey/brown sandy mortar.

Plate 25: The excavated remains of the boiler

4.3.3 The eastern face of wall ***106*** was largely obscured, but for the upper course where additional, east-facing extensions were observed. These consisted of two 0.36m brick projections bordering a 0.65 x 0.40m sandstone block with a central, rectangular recess of 0.27 x 0.18m. The two brick projections were one-course high, bonded with dark grey/black cement and situated at the northern extent of wall ***106*** and 2.00m to the south. The sandstone block abutted the southern projection. Later observations saw the sandstone block to be 'absorbed' within the outer and upper course of wall ***106***, the fabric of which comprised a hard grey mortar and may suggest a later phase of construction.

4.3.4 Wall ***107*** was 2.10m long and formed the connecting wall between external walls ***106*** and ***108***. The general fabric of wall ***107*** was similar to ***106***, with a single, stretcher course of refractory bricks forming the northern face and three stretcher courses of hand-made bricks to the south. The bricks were mainly bonded using a grey/brown sandy mortar but the two central courses of wall ***107*** highlighted evidence for blocking or repair work using a hard grey mortar. A large concrete structure seemed to truncate the western extent of ***107***. Later wall ***119*** abutted the south face.

4.3.5 The northern face of ***107*** was noted to absorb ***111*** at 0.50m from the upper limit of the wall. At this point the northern face receded back 0.45m, creating a 0.50m wide flue, running west between wall ***107*** and side flue ***110***. In addition, two foundation steps were also observed at 0.75m and 0.85m down the southern face. This extended the width of wall ***107*** from 0.50m to 0.70m, possibly as an attempt to accommodate the change within the internal structure.

4.3.6 Wall ***119*** was observed to abut the southern face of wall ***107*** at roughly 1.00m below the walls upper extent. Wall ***119*** was 0.50m wide and ran south-west from the face of wall ***107*** for 1.40m where the wall seemed to terminate. The fabric of wall *119* comprised hand-made bricks laid in an English Garden Wall style and bonded using a hard, grey, cement-like mortar.

4.3.7 Wall ***108*** formed the western boundary wall of the complex, and consisted of a single, stretcher course of refractory brick. Wall ***108*** was observed to abut the eastern wall of a square chimney (***112***) for 4.00m, after which it widened to three courses and continued north through the baulk.

4.3.8 The internal structure of the complex comprised two side flues (***109*** and ***110***) the construction of which formed a 0.85m brick-lined recess (***111***). The fabric of ***109*** and ***110*** comprised five courses of hand-made bricks to create two 0.60m wide platforms. The upper surface of both platforms comprised three stretcher courses of refractory brick with specially moulded, refractory brick mountings, edging ***111***. These mountings measured 0.30 x 0.25m, with a maximum height of around 0.18m. In cross-section these were pentagonal, square based and used differing vertices to create a concaved, inner surface. Both ***109*** and ***110*** were aligned north/south and continued beyond the northern edge of the excavated area.

4.3.9 Recess ***111*** was fully excavated for 1.00m up to the north face of ***107*** and comprised a brick floor between ***109*** and ***110***. The fabric of the floor comprised seven courses of roughly laid hand-made and refractory bricks. No mortar was observed but the interior faces of the recess were heavily soot stained. Recess ***111*** continued north through the baulk at a depth of 1.00m from the surface of ***109***/***110*** and south (then west) into ***107***, where a depth of 1.50m was recorded.

4.4 SHUDEHILL MILL CHIMNEY AND FLUES

4.4.1 This group of features comprised a large, square chimney (***112***) and three vaulted flues (***113***, ***114*** and ***115***). The location of these features roughly corresponds to the flue and chimney system for Shudehill Mill, seen on Laurent's map of 1793 (Fig 4) and Bancks & Co's map of 1831 (Fig 5).

4.4.2 The northern and eastern walls of the chimney (***112***) measured 1.00m in width and were observed for 2.00m and 3.00m, respectively. At the southern and western extent, a large concrete obstruction (7.00 x 4.00 x 1.70m) truncated or obscured any further remains. The chimney fabric comprised eight courses of hand-made bricks, laid in an English Garden Wall style. The bricks (0.23 x 0.11 x 0.07) were bonded using a white, lime based mortar. Further excavation revealed that chimney ***112*** terminated at a depth of 3.85m where the walls sat on natural blue/grey clay. No structural base was observed. Below 1.70m it was also noted that the internal recess of ***112*** comprised 1.65m of finely banded, heat-affected sand & ash above 0.50m of soot.

4.4.3 The three arched flues comprised ***113*** to the north-west and ***115*** to the south-east, with ***114*** between. All three were aligned roughly north-east/south-west, with their northern extent continuing through the baulk and their southern extent, south-west beneath *005*. Their fabric comprised two, single-skin, stretcher courses of hand-made brick, with a 0.45m central recess. In general, this recess was bridged by a single course, segmented arch. Bricks were bonded using a white, lime based mortar.

4.4.4 At 2.00m north of ***005***, the south-eastern side of flue ***114*** had been truncated to accommodate a later flue (***120***). Flue ***115*** also displayed heavy truncation by ***120*** and other, later features. The southern section of flue ***115*** was also noted to have been reinforced with an additional course around the vaulting, creating a possible platform. The northern half of flue ***115*** ran below wall ***116*** and brick surface ***117***. Beyond the eastern face of ***116***, ***115*** had no vaulting present.

4.4.5 Wall ***116*** was a 0.36m wide, aligned north-east/south-west and seemingly built to accommodate the flue beneath. The wall was observed for 4.5m, terminating at the southern end and continuing north-east through the baulk. At the southern terminus, wall ***116*** turned east, roughly 90 degrees and terminated after 0.20m. The fabric of the wall comprised hand-made bricks laid in an English Garden Wall style and bonded with a hard, light grey, cement-like mortar. ***117*** and ***118*** were observed to abut ***116*** to the east and west, respectively.

4.4.6 Structure ***118*** consisted of two 0.50m long sections of brick wall and were observed to abut the western face of ***116***, roughly 0.50m and 2.00m south of the trench edge. These were 0.25m wide and aligned south-east/north-west, spanning the gap between ***116*** and ***114***. Their fabric comprised two stretcher courses of hand-made bricks which were bonded using a hard dark grey/black cement, indicative of the late nineteenth century.

4.4.7 Structure ***117*** was a brick surface, observed to be overlaying ***115*** and abutting the eastern face of ***116*** for 0.50m before continuing northwards through the baulk. The surface measured 0.50 x 1.60m with truncation affecting the eastern edge. Surface ***117*** comprised three, east/west-aligned stretcher courses of hand-made bricks, bordering a single, side laid, header course to the south. A single course depth was noted with all bricks measuring 0.23 x 0.115 x 0.07m. No mortar was observed.

4.5 CENTRAL FLUE SYSTEM

4.5.1 This series of structures were located towards the centre of the excavated area and comprised two major flue systems (***120*** and ***121***). Flue ***120*** ran roughly north/south across the centre of the site, with flue ***121*** running beneath, along a north-east/south-west alignment (Plate 26). At its southern extent, flue ***121*** branched into three flues which terminated within a brick platform. Flue ***121*** was bounded to the north and south-west by wall ***122***.

*Plate 26: The remains of flue **121***

4.5.2 Flue ***120*** was observed for 12.00m and comprised stone flags (0.90m x 1.00m) over two, single-skin stretcher courses of hand-made brick with a 0.65m recess between. The bricks were bonded using dark grey/black cement. The northern extent of flue ***120*** had been deliberately incorporated into the earlier flue of ***114***, with the western wall neatly blocking the vaulted recess. The southern extent of flue ***120*** passed below wall ***123*** and may have continued beyond. Deposits within this area displayed a high iron content, which subsequently fused much of the stratigraphic sequence, making it impossible to excavate without removing any observable features. These concreted deposits were observed for 1.20m and lay directly above the natural clay.

4.5.3 A number of possible features were observed above these concreted deposits, along the eastern excavation boundary. The uppermost of these was surface ***132***, which consisted of a series of granite sets occupying an area of 2.10m x 2.70m, possibly continuing east beneath the surface of the car park (Plate 27). The initial 1.20m (west/east) comprised sets measuring 0.24m x 0.24m. The sets to the east of these measured 0.15m x 0.10m. All of the granite sets were aligned north/south. 0.45m below and 0.40m west of ***132*** was surface ***133***, comprising a series of sandstone sets measuring 0.20m x 0.20m. Surface ***133*** lay within the upper surface of the concreted deposits and was observed to run for 3.50m, before continuing north through the baulk. The southern edge of surface ***133*** formed a northwards curve and was demarcated using edging stones measuring 0.20m x 0.07m.

*Plate 27: Surface **132***

4.5.4 At 4.00m north of the juncture with ***123***, the western wall of flue ***120*** was strengthened by an additional stretcher course. This extended the width of the eastern wall to 0.25m and coincided with the area that ***121*** ran beneath. The construction of flue ***121*** was generally similar to ***120***, with a stone-capped surface overlying parallel, hand-made, brick walls and a 0.65m central recess. The fabric differed slightly, comprising two 0.25m wide walls with a single header course supporting the stone flags above. Bricks were generally bonded using a brown/grey, sandy mortar.

4.5.5 Between 3.50m and 5.50m from the north-east face of wall ***122***, ***121*** divided into three smaller flues (***121a-c***). These flues shared the same construction as ***121*** minus any observable capping, but were smaller in size with a 0.35m central recess. The eastern flue (***121a***), terminated at 0.20m east of wall ***122*** and 1.65m east of the central flue (***121b***). This terminated at the face of ***122***, roughly 1.50m from the south-east terminus.

4.5.6 The eastern elevation of ***121b*** was constructed using a single stretcher course widening to a single header course (0.25m) at 1.50m north east of ***122***. The continuation of this wall curved eastwards and was truncated 0.50m west of ***121a***. The western elevation was truncated at 2.30m north east of the terminus. The area between ***121b*** *and* ***121c*** was bridged by a brick structure of similar construction to the original flue system. This extended north east for around 3.20m where this platform had been truncated. The western elevation of ***121a*** was truncated at roughly 2.00m north of the terminus. The western flue (***121c***), terminated at the corner/juncture formed by the south-east and north-east elevations of ***122***. This flue seemed to have been heavily modified over time with much of the western elevation having been removed and the central recess blocked at 2.00m, 3.50m and 5.00m from the flue's southern extent. This remodelling comprised hand-made bricks bonded with dark grey/black cement. This remodelling was also apparent around the central area where flue ***121*** divided into three and seems to have been a later blocking phase within the flue system.

Plate 28: Wall ***122*** *and flue* ***121***

4.6 SOUTH-EASTERN EXTENSION

4.6.1 This area contained three main features associated with later phases of the foundry's expansion. These were located to the east and south east of flue ***122*** and comprised; structure ***124***; brick floor ***125*** with associated boundary walls ***126*** and ***127***; and possible furnace base ***128***.

4.6.2 Structure ***124*** was comprised of several brick platforms (***124a-c***) located 3.50m south-east of wall ***122*** and to the immediate north east of wall ***126*** (Plate 29) The southern edge of this structure (***124a***) abutted the north-east face of wall ***126*** for 4.00m. Structure ***124a*** had a base fabric comprising three stretcher courses of hand-made bricks bonded using a mid, brown/grey mortar. At the north-western extent, this feature had undergone later remodelling. This took the form of three additional courses in the final 0.60m, creating a change in alignment to north-east/south-west. This continued north-east for roughly 1.00m, where it seemed to have been truncated but may have continued as far as ***124b***. This later extension was bonded using dark grey/black cement. Structure ***124b*** was located 1.20m north east of (*124a*) and was aligned north-west/south-east.

*Plate 29: Structure **124***

4.6.3 The fabric of ***124b*** comprised five courses of hand-made brick bonded with a light, brown/grey mortar. The northern three stretcher courses spanned an area 1.30m x 0.30m with a single header course to the south spanning 1.00m x 0.25m. 0.70m south-east of ***124b*** was ***125c***. This shared the same alignment as ***124b***, and was observed for roughly 3.00m before continuing south-east through the baulk. The base fabric comprised five stretcher courses, similar in construction to ***124a***. The south-eastern extent observed two additional courses in height. These were bonded using dark grey/black cement.

4.6.4 Structure ***124*** was also bounded to the north and east by features ***137*** and (***138***). Feature ***137*** was a stone-lined, V-shaped drainage channel. This was stone-capped in places and aligned south-east/north-west. Feature ***137*** was observed for 8.00m, continuing south-east through the baulk and terminating (possibly truncated) at roughly 0.50m from the south-east extent of flue ***122***.

4.6.5 Wall ***138*** was observed for 1.50m and was constructed over the south-eastern extent of ***126***. Wall ***138*** was aligned north-east/south-west, and had a fabric comprising two stretcher courses of hand-made brick bonded using dark grey/black cement. This wall may have been contemporary with the remodelled brickwork observed throughout ***124***.

4.6.6 To the south of ***124*** was brick floor ***125*** (Plate 30). This floor surface was roughly 5.85m x 4.00m, and was truncated at the southern and eastern extents. The whole surface was observed to be a single-brick course in height and comprised hand-made bricks (0.23m x 0.11m x 0.07m) possibly bonded using a black mortar. The western end of the floor surface saw bricks laid side down, sharing the same alignment as ***127***. This pattern continued east for 2.30m where the floors pattern changed to stretcher coursing aligned north-east/south-west.

*Plate 30: General view across the south-eastern extension, showing brick floor **125***

4.6.4 Walls ***126*** and ***127*** bounded the northern and western extent of ***125***. Wall ***126*** was aligned roughly south-east/north-west, and was observed for 5.85m with the western extent turning onto a south-west/north-east alignment for 1.20m. The fabric comprised three courses of hand-made bricks laid in an English Garden Wall style and bonded using a light grey/brown mortar. Wall ***126*** was observed to a maximum height of 1.10m and was laid directly onto the surrounding clay. At 1.20m and 2.00m from the eastern extent of ***126*** two iron fittings were observed, 0.25m from the southern face. These fittings rose vertically from the floor surface and may have been part of a sliding door mechanism.

4.6.5 Wall ***127*** was a 3.30m long wall, aligned south-west/north-east, and comprised two stretcher courses of hand-made bricks, bonded using a dark grey/black cement. The southern extent of wall ***127*** was built over a square, stone pillar pad (0.45m x 0.45m x 0.20m).

4.6.6 Located to the immediate west of wall ***127***, and abutting the southern extent of the wall, was structure ***128***. This was a circular in plan with a fabric comprising hand-made bricks (0.225m x 0.105m x 0.065m) bonded with a light, grey/brown mortar. The whole structure had a diameter of 3.00m with an outer, header course. Much of the surface of ***128*** was obscured by mortar, and where observed, the central coursing was fairly random.

4.6.7 A brick-built pillar base (***129***) was observed to the south of ***125***. This was much later in construction and comprised two, single stretcher courses of machine-made 'frogged' bricks (0.23m x 0.115m x 0.08m), bonded with a light brown/grey cement-like mortar and surrounding a central recess (0.60m x 0.25m), containing fragments of degraded ironwork. Bricks were marked 'W. Higgins & Son'. The orientation of ***129*** matched that of ***130*** to the south-east.

4.6.8 At 0.35m east of ***129*** was wall ***131***. This was orientated east/west and comprised a single stretcher course of hand-made bricks measuring 0.23m x 0.11m x 0.065m and bonded using dark grey/black cement. Wall ***131*** was observed for 2.29m from the western face of ***130***. At 0.15m east of the western extent, wall ***131*** turned 90 degrees and extended south for 0.47m.

4.7 NORTHERN TRENCH EXTENSION

4.7.1 During the final phase of planned works, the limit of excavation was extended northwards by 10.00m. This created an area 10.00m x 8.50m and highlighted several features; including possible machine bed ***134***, wall ***135a-d*** and brick floor ***136***. Wall ***135*** was aligned north-west/south-east, and was observed for 8.20m and may have been the southern elevation for a series of buildings within this area of the foundry complex. The full extent of ***135*** was constructed using hand-made bricks, however, several phases were observed within the fabric. Wall ***135a*** was located to the north-east edge of the trench and was observed for roughly 3.50m, continuing south-east through the baulk. The fabric of ***135a*** comprised two stretcher courses and a single course of side lain stretchers along the northern face. These were bonded using a light grey/brown sandy mortar. This wall was observed to extend north-east at the western extent, and 3.20m south-east of the western extent. These arms continued north-east through the baulk.

4.7.2 Wall ***135b*** was observed to abut the southern face of ***135a***. This wall was observed for 5.30m and continued south-east through the baulk where it may have turned south-west (observed within the edge of excavation and had been heavily truncated). Wall ***135b*** comprised two stretcher courses bonded with dark grey/black cement. At the south-eastern extent, several large stone blocks measuring 0.75m x 0.15m x 0.45m were incorporated into the fabric of the wall.

4.7.3 The southern face of ***135b*** was excavated to a depth of 0.96m (eight courses). This face had been painted and contained several small beam slots with remnants of the wooden beams within them. It was also noted that some of the brickwork, north-west of the stone blocks had been heat affected.

4.7.4 Wall ***135c*** was a 0.85m long, and bridged the gap between the terminal ends of ***135b*** and ***d***. Wall ***135c*** was constructed using the same fabric as ***135b***. Wall ***135d*** ran for 2.20m from ***135c***. The lowest three courses were bonded using a white, lime-based mortar, with the upper courses stepping in 0.05m from the southern face. This later phase of construction comprised three stretcher courses of hand-made brick, bonded using a light grey/brown sandy mortar similar to that used in ***135a***.

4.7.5 Brick floor ***136*** was observed abutting the south face of ***135c*** and ***d*** (Plate 31). The floor was roughly 3.00m x 5.00m with the south-eastern edge showing signs of truncation, and the north-western end continuing beyond the excavated area. The floor comprised hand-made bricks, laid in stretcher courses and aligned north-east/south-west. A mortar could not be determined due to heavy soot staining and areas of iron mineralisation obscuring much of the floor surface. An L-shaped beam slot was observed at 0.25m from the south face of ***135*** (Plate 31). This measured 0.90m x 0.23m, and had fragments of timber within the recess.

*Plate 31: Brick floor **136***

4.7.6 Immediately south of the stone blocks within wall ***135a*** was a series of three iron beams (***134***). These beams measured 2.11m x 0.31m x 0.14m. All three were aligned north-west/south-east, with the first positioned 0.25m from the southern face of ***135a***. The second was positioned 0.70m from the first and the third 0.70m south of the second.

5. DISCUSSION

5.1 OVERVIEW OF THE IRON FOUNDING INDUSTRY

5.1.1 The technique of metal working by melting and casting was established in Britain about 4000 years ago and Cornwall provided one of the few European sources of the tin required to make bronze (Coles and Harding 1979). Working of wrought iron followed by the mid-first millennium BC, but the production of cast iron did not occur until the fifteenth century and was initially limited to simple items such as grave slabs, fire backs and cannon balls (Gale 1969).

5.1.2 The main growth in casting of ferrous metals came with the industrial revolution. A series of technical breakthroughs in the eighteenth and nineteenth centuries enabled cast iron, and later steel, to be produced in large quantities at a much lower cost than wrought iron (Gales 1969, Tweedale 1986). These rapid technological advances were driven by the demands of the industrial age and the need for reliable metal components for steam engines, textile production, mining, machinery, ships, railways and armaments. The widespread use of iron castings for agricultural, domestic and architectural uses also contributed to the growth of the industry in the nineteenth century.

5.1.3 The industry continued to expand during the first half of the twentieth century, as engineering requirements increased and the development of motorised vehicles resulted in new markets for cast products. Standardisation of hydraulic fittings just prior to the First World War led to increased output of brass castings (Tyler 1921); while the development of aluminium alloys around the same time soon resulted in successful outlets in the electrical industry, motor-boat and art casting markets. Aluminium alloys provided a lighter or cheaper alternative to other metals (Mortimer 1931), an advantage that continues to the present day.

5.1.4 In broad terms, iron foundries can be divided into four main categories:

- ***Integrated Works:*** integrated works undertook mining, blast furnace production of pig iron, coke making and sometimes castings production. Several large facilities were already in existence by the late eighteenth century, some of which were massive concerns, often employing several thousand workers, the majority of which worked in the mines (Gale 1969, McCombe 1982, Chapman 1981). Pig iron was mainly produced for sale to external customers, with some retained for internal foundries that re-melted the pigs in cupolas or air furnaces for casting work;
- ***Captive Foundries:*** this type of foundry was frequently owned by a manufacturing company, which usually undertook a variety of production processes. The foundry may have been in the same building as other manufacturing processes, such as coating, plating or assembly activities, or on a separate site from which castings are shipped to the main manufacturing facility;

- ***Medium and High Production Foundries:*** foundries where some or all of the production process is automated are primarily a twentieth-century development. However, even in the nineteenth century, markets such as the textile sector that required large numbers of similar castings, led to the automation of mould production (McCombe 1984). In general, such foundries were well-organised and managed;
- ***Jobbing Foundries:*** these foundries took on batch and special order work, are the most common type although their overall output was a much smaller proportion. They ranged in size from a single work bay with a small furnace and a few employees, to much larger operations with three to six different production lines and as many as a hundred employees. Jobbing foundries often produced several types of alloys. The small foundries commonly found in urban areas can be assumed to be of this type, and the majority of closed sites were probably iron foundries using cupola melting.

5.1.5 The Manchester Iron Foundry was almost certainly established as a 'jobbing foundry', supplying a wide range of ironwork and castings to the plethora of textile mills and works in the city.

5.2 THE EXCAVATION OF THE MANCHESTER IRON FOUNDRY

5.2.1 The archaeological investigation has provided a valuable opportunity to investigate the physical remains of a mid-nineteenth-century iron foundry in Manchester city centre. This class of monument is not particularly well represented in the region's archaeological record, although an example broadly comparable to the Manchester Iron Foundry was excavated in Rochdale in recent years (OA North 2009). However, excavation revealed that the physical remains of the mid-nineteenth century Manchester Iron Foundry were rather fragmentary, having sustained disturbance and remodelling during the later nineteenth and twentieth centuries. There was similarly very little evidence for the layout of machinery in the original foundry, nor any firm indication for the location of the forges, although a structure that may possibly have represented the vestiges of a furnace were identified in the south-eastern extension to the foundry.

5.2.2 The well-preserved remains of the housing for a single Cornish-type boiler were exposed in the northern part of the site. The location of this boiler corresponds closely to that shown on the Ordnance Survey map of 1850. This is likely to have been used to raise the steam required to power different machinery in the iron works, such as drop-hammers, turning lathes and grinding tools. The flue system from the boiler appears to have utilised the chimney that served Shudehill Mill from the mid-1780s. The remains of flues from the boiler house at Shudehill Mill are of particular interest, but need to be considered together with the other elements of Shudehill Mill, which is presented in a separate report.

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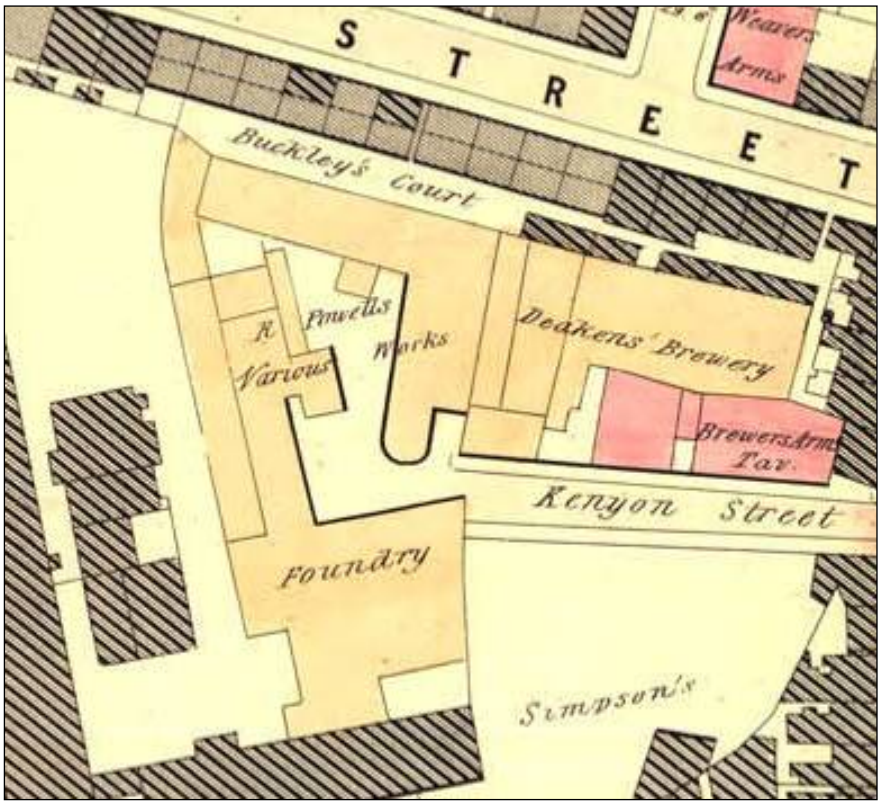
APPENDIX 1: WRITTEN SCHEME OF INVESTIGATION

November 2014

Oxford Archaeology North

NOMA PLOT L, ANGEL SQUARE, MILLER STREET, MANCHESTER



ARCHAEOLOGICAL EXCAVATION

WRITTEN SCHEME OF INVESTIGATION

Proposals

The following Written Scheme of Investigation is offered in response to a request from NOMA Plot L Ltd for an archaeological excavation in advance of the proposed development of Angel Square as part of the NOMA Regeneration in the Shudehill area of Central Manchester.

1. BACKGROUND

1.1 CIRCUMSTANCES OF PROJECT

1.1.1 NOMA Plot L Ltd has devising proposals for the redevelopment of land situated in the Shudehill area of Manchester (centred at NGR 384420 398960). The proposals allow for the erection of a multi-storey building and associated infrastructure and landscaping works, which will inevitably necessitate considerable earth-moving works.

1.1.2 The archaeological potential of the site was highlighted by a desk-based assessment produced by OA North in March 2014, which identified a total of 11 non-designated heritage assets within the boundary of the proposed development. In accordance with best practice as outlined in the National Planning Policy Framework paragraph 128, NOMA Plot L Ltd commissioned an archaeological evaluation of the site at an early stage in devising the development proposal. The evaluation was undertaken by OA North in June and July 2014, and comprised the excavation of seven evaluation trenches that were placed across sites of potential archaeological interest, together with a larger excavation area targeted on the footprint of the Manchester Baths and Wash Houses. In addition, the footprint of the engine house for the former Shudehill Mill, which straddles the north-western boundary of the development area, was also been subject to archaeological investigation; this forms part of a separate programme of works, and the archaeological mitigation of this significant heritage asset is addressed in a separate Written Scheme of Investigation.

1.1.3 The evaluation trenching demonstrated that well-preserved buried remains of the Manchester Iron Foundry and an ancillary building associated with Shudehill Mill survived *in-situ*, although the sites of the small brewery and workers' housing in the eastern part of the development area have been subject to considerable disturbance. It was concluded from the results of the evaluation that the buried remains of the former Manchester Iron Foundry and the ancillary building associated with Shudehill Mill merit further archaeological investigation in advance of the future redevelopment of the site. This would aim to make a detailed record of the buried remains to mitigate their damage or complete loss during ground works necessitated by redevelopment. The site of the Manchester Baths and Wash Houses was subject to complete archaeological excavation during the evaluation programme, and does not require any further archaeological investigation.

1.1.4 This Written Scheme of Investigation (WSI) has been formulated in consultation with GMAAS, and provides for an appropriate scheme of intrusive archaeological investigation. It allows for the full excavation of buried remains of archaeological interest that lie within the footprint of the proposed development.

1.2 OXFORD ARCHAEOLOGY

1.2.1 Oxford Archaeology is an educational charity under the guidance of a board of trustees with over 35 years of experience in archaeology, and can provide a professional and cost-effective service. We are the largest employer of archaeologists in the country (we currently have more than 300 members of staff), and can thus deploy considerable resources with extensive experience to deal with any archaeological obligations you or your clients may have. OA is an Institute for Archaeologists Registered Organisation (No 17). We have offices in Lancaster and Oxford, trading as Oxford Archaeology North (OA North) and Oxford Archaeology South (OA South) respectively, enabling us to provide a truly nationwide service.

1.2.2 All proposed works will be compliant with existing heritage management documents, specifically EH's *Management of Research Projects in the Historic Environment* (*MoRPHE*) (EH 2006) and *Management of Archaeological Projects* (*MAP 2,* EH 1991), the Chartered Institute for Archaeologist's (CIfA's) *Standards and Guidance for Archaeological Excavation* (IfA 2007), and, for the purposes of archiving, the guidelines prepared by the Museums and Galleries Commission (1992), the United Kingdom Institute for Conservation (Walker 1990) and the Archaeological Archives Forum (2007).

1.2.3 OA North has unrivalled experience in the assessment, evaluation and excavation of former industrial and associated residential sites, particularly in the context of Manchester. In recent years, OA North has excavated the remains of several large nineteenth- and twentieth-century iron works in the Manchester area, including those as part of the Rock Triangle Development in Bury (Miller 2010), and the extensive River Street Iron Works in Rochdale, which was excavated in advance of development for a new transport interchange. More recently, acting on behalf of Manchester City Council and Manchester City Football Club (MCFC), OA North excavated the remains of the expansive Bradford Ironworks in East Manchester, together with the remains of the adjacent Bradford Colliery (Miller 2011).

2. AIMS AND OBJECTIVES

2.1 ACADEMIC AIMS

2.1.3 The main aim of the investigation, given the nature of the proposed scheme, will be expose and record the buried remains of archaeological interest within the specified area, and generate a complete record of the remains to mitigate their ultimate loss as part of the proposed development.

2.1.4 Very few accounts exist of iron foundries in mid-nineteenth-century Manchester, and their importance on a local and regional platform is poorly represented in published histories of the town. The buried remains of the foundry within the development area certainly offer some potential to add fresh information on the development and layout of nineteenth-century iron foundries. This is reflected in several of the initiatives for archaeological research of the industrial and modern periods stated in the current *Archaeological Research Framework for North West England* (Newman and McNeil 2007; McNeil and Newman 2007). In particular:

- *Initiative 7.21:* Inform 'an overview of the impact on the historic landscapes of the new towns of the Industrial Revolution and the new monument types developed within them' (Newman and McNeil 2007, 146);
- *Initiative 7.35:* 'Industry specific studies are needed for those industries that have received little archaeological attention' (McNeil and Newman 2007, 154);

2.1.3 More specific initiatives for archaeological research have been formulated recently by the *Historical Metallurgy Society* (Bayley *et al* 2008). Those initiatives that have been identified as high priority, and relevant to the present study area, include:

- 'the study of nineteenth-century ironworks, especially the foundry and forge sectors' (*op cit*, 69);
- 'to record adequately and fully publish all metallurgical-important sites whose preservation cannot be guaranteed' (*ibid*).

2.1.4 It is anticipated that the archaeological investigation may address the following research objectives:

- establish the plan form, function and chronology of the former Manchester Foundry;
- establish the function and chronology of the detached building that originally formed part of the Shudehill Mill complex.

2.1.5 In order to address the aims and objective outlined above, it is proposed that a single, open-area will be targeted for excavation (Plate 1; Figure 1). The excavation area will have maximum dimensions of 55 x 25m.

2.2 OBJECTIVES

2.2.1 The following programme has been designed to preserve by record any archaeological deposits or features that may be present that will be impacted on by the proposed development. The information will be finally disseminated through the deposition of the archive at The Museum of Science and Industry in Manchester, and a final report at the Greater Manchester Historic Environment Record.

2.2.2 The work will be carried out in line with current IfA guidelines, and in line with the IfA Code of Conduct. The principal objectives of the project may be achieved via the following stages:

- ***Archaeological Excavation:*** the excavation of the targeted area, which will investigate the buried remains of the former Manchester Foundry and a building that originally formed part of Shudehill Mill (Plate 1);
- ***Historical research:*** a limited programme of historical research will be carry out to supplement the information gathered during the desk-based assessment for the site;
- ***Post-excavation and Report Production:*** the site records, finds and any samples from the excavation programme outlined below will form a checked and ordered site archive as outlined in the English Heritage guideline document *Management of Archaeological Projects* (2nd edition, 1991). Following compilation of the project archive a report will be produced;
- ***Archive Deposition:*** the results of the excavation will form the basis of a full archive to professional standards, in accordance with current English Heritage guidelines and the *Guidelines for the Preparation of Excavation Archives for Long Term Storage* (UKIC 1990). The project archive represents the collation and indexing of all the data and material gathered during the course of the project;
- ***Dissemination:*** in addition to the deposition of the project archive and a copy of the final report with the Greater Manchester Historic Environment Record, the results obtained from the archaeological excavation will be disseminated to the wider public in a manner proportionate to their significance, in accordance with Paragraph 141 of the *National Planning Policy Framework*.

2.2.3 In order to address the aims and objective outlined above, it is proposed that a single, open-area will be targeted for excavation (Plate 1; Figure 1). The excavation area will have maximum dimensions of 55 x 25m.

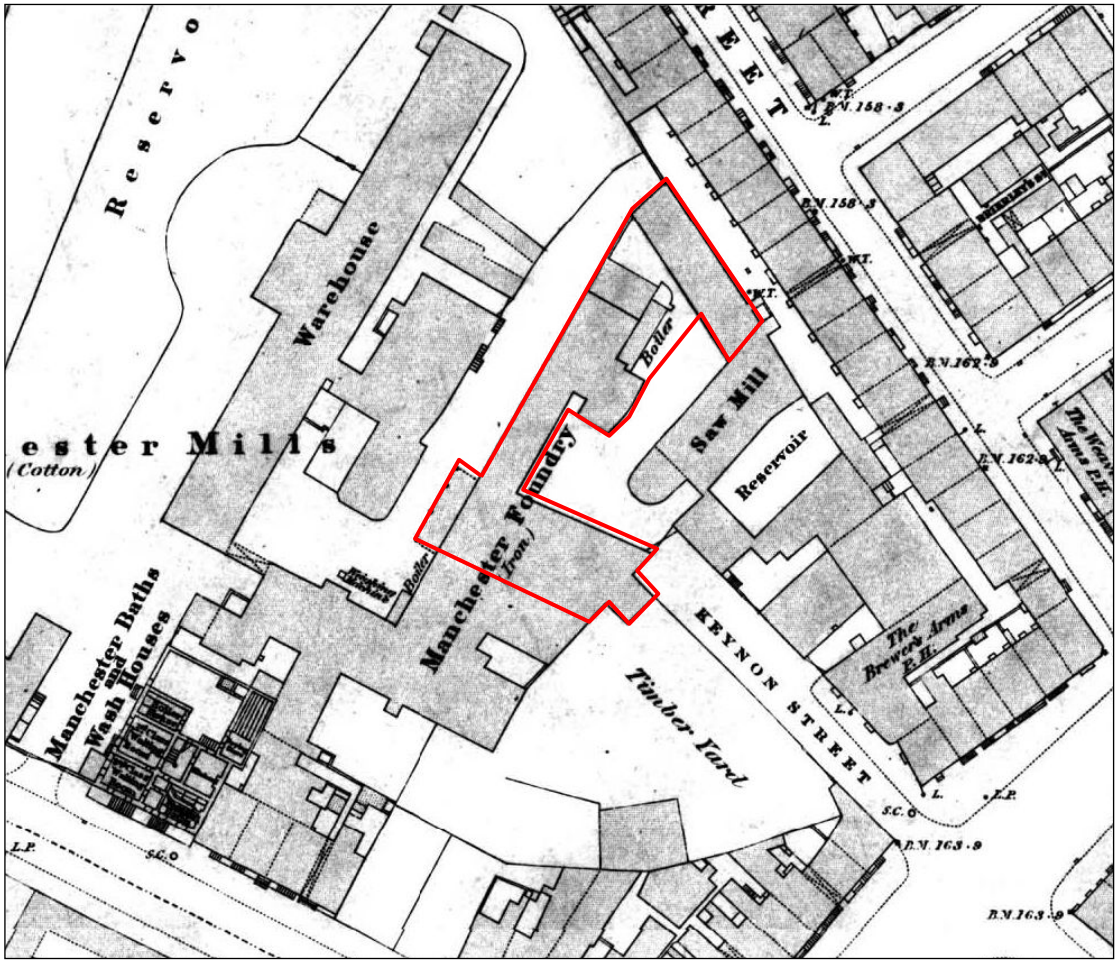


Plate 1: Location of the proposed development area (marked in red), superimposed on the Ordnance Survey map of 1850

3. METHOD STATEMENT

3.1 SITE SET-UP

3.1.1 The following work programme is submitted in line with the aims and objectives summarised above. As an initial stage in the programme of works, the area targeted for excavation will be marked out, enclosed by Herras fencing, and CAT-Scan survey will be carried out to locate any services present within the excavation area.

3.2 FIELDWORK

3.2.1 Excavation of the uppermost levels of modern overburden/demolition material will be undertaken by a machine fitted with a toothless ditching bucket to the top of the first significant archaeological level. It is envisaged that a *c* 20-tonne tracked excavator will be employed for this purpose. The work will be supervised closely by a suitably experienced archaeologist. Spoil from the excavation will stored in a stockpile adjacent to the excavation area. Machine excavation will then be used to define carefully the extent of any surviving structures and other remains. Thereafter, structural remains will be cleaned manually to define their extent, nature, form and function.

3.2.2 All information identified in the course of the site works will be recorded stratigraphically, using a system adapted from that used by the Centre for Archaeology Service of English Heritage.

3.2.3 ***Photography:*** a full and detailed photographic record of individual contexts will be maintained and similarly general views from standard view points of the overall site at all stages of the excavation will be generated. Photography will be undertaken using high-resolution digital cameras. All frames will include a visible, graduated metric scale. Photographs records will be maintained on special photographic *pro-forma* sheets.

3.2.4 ***Planning:*** the precise location of the excavated area, and the position of all archaeological structures encountered, will be surveyed by EDM tacheometry using a total station linked to a pen computer data logger. This process will generate scaled plans within AutoCAD, which will then be subject to manual survey enhancement. The drawings will be generated at an accuracy appropriate for 1:20 scale, but can be output at any scale required. Sections will be manually drafted as appropriate at a scale of 1:10. All information will be tied in to Ordnance Datum.

3.2.5 Human remains are not expected to be present, but if they are found they will, if possible, be left *in-situ* covered and protected. If removal is necessary, then the relevant Home Office permission will be sought, and the removal of such remains will be carried out with due care and sensitivity as required by the *Burials Act 1857*.

3.2.6 Any gold and silver artefacts recovered during the course of the excavation will be removed to a safe place and reported to the local Coroner according to the procedures relating to the Treasure Act, 1996.

3.2.7 ***Finds policy:*** finds recovery and sampling programmes will be in accordance with best practice (following current Institute for Archaeologists' guidelines) and subject to expert advice in order to minimise deterioration. OA North employs in-house artefact and palaeoecology specialists, with considerable expertise in the investigation, excavation, and finds management of sites of all periods and types, who are readily available for consultation. Finds storage during fieldwork and any site archive preparation will follow professional guidelines (UKIC).

3.3 HEALTH AND SAFETY

3.3.1 Full regard will be given to all constraints during the course of the project. OA North provides a Health and Safety Statement for all projects and maintains a Safety Policy. All site procedures are in accordance with the guidance set out in the Health and Safety Manual compiled by the Standing Conference of Archaeological Unit Managers.

3.3.2 OA North undertakes to safeguard, so far as is reasonably practicable, the health, safety and welfare of its staff and of others who may be affected by our work. OA North will also take all reasonable steps to ensure the health and safety of all persons not in their employment, such as volunteers, students, visitors, and members of the public (this includes trespassers).

3.3.3 OA North is fully familiar with and will comply with all current and relevant legislation, including, but not limited to:

- The Health and Safety at Work Act (1974);
- Management of Health and Safety at Work Regulations (1999);
- Manual Handling Operations Regulations 1992 (as amended in 2002);
- The Construction (Design and Management) Regulations (2007);
- The Control of Asbestos Regulations (2006);
- The Workplace (Health, Safety and Welfare) Regulations (1992);
- Construction (Health, Safety and Welfare) Regulations (1996);
- The Health and Safety (Miscellaneous Amendments) Regulations (2002);
- The Work at Height Regulations (2005);
- The Control of Substances Hazardous to Health Regulations (2002);
- The Health and Safety (First-Aid) Regulations (1981);
- The Regulatory Reform (Fire Safety) Order (2005);
- The Provision and Use of Work Equipment Regulations (1998);
- Lifting Operations and Lifting Equipment Regulations (1998).

3.3.4 OA North has professional indemnity to a value of £2,000,000, employer's liability cover to a value of £10,000,000 and public liability to a value of £15,000,000. Written details of insurance cover can be provided if required.

3.4 OTHER MATTERS

3.4.1 ***Project Monitoring:*** the aims of monitoring are to ensure that the archaeological works are undertaken within the limits set by the Written Scheme of Investigation, and to the satisfaction of the curatorial archaeologist at the Greater Manchester Archaeological Advisory Service (GMAAS). The curatorial archaeologist will be given at least five days' notice of when work is due to commence, and it is anticipated that there will be at least one formal monitoring meeting during the course of the excavation.

3.5 POST-EXCAVATION

3.5.1 Post-excavation work will comprise the following:

- checking of drawn and written records during and on completion of fieldwork;
- production of a stratigraphic matrix of the archaeological deposits and features present on the site, if appropriate;
- cataloguing of photographic material, which will be mounted appropriately;
- cleaning, bagging and labelling of finds according to the individual deposits from which they were recovered. Any finds requiring specialist treatment and conservation will be sent to an appropriate Conservation Laboratory. Finds will be identified and dated by appropriate specialists;
- assessment of any palaeo-environmental material and/or technological residues recovered will be undertaken, providing recommendations for further analysis.

3.6 ARCHIVE/REPORT

3.6.1 ***Archive:*** the results of all archaeological work carried out will form the basis for a full archive to professional standards, in accordance with current English Heritage guidelines (*Management of Archaeological Projects*, 2nd edition, 1991), and in accordance with the *Guidelines for the Preparation of Excavation Archives for Long-Term Storage* (Walker 1990). The project archive represents the collation and indexing of all the data and material gathered during the course of the project. This archive will be provided in the English Heritage Centre for Archaeology format and a synthesis will be submitted to the CSMR (the index to the archive and a copy of the report).

3.6.2 The Arts and Humanities Data Service (AHDS) online database project *Online Access to index of Archaeological Investigations* (OASIS) will be completed as part of the archiving phase of the project.

3.6.3 ***Report:*** a draft copy of a written synthetic report will be submitted for comment to the archaeological curator (GMAAS) for comment within eight weeks of completion of the fieldwork. The report will include:

- a title page detailing site address, NGR, author/originating body, client's name and address;
- full content's listing;
- a non-technical summary of the findings of the fieldwork;
- a description of the archaeological background;
- a detailed account of the historical development of the site, accompanied with map regression analysis;
- a description of the topography and geology of the study area;
- a description of the methodologies used during the fieldwork;
- a description of the findings of the fieldwork;
- detailed plans of the excavated trenches, showing the archaeological features exposed;
- an overall phased plan with sections of the excavated archaeological features;
- interpretation of the archaeological features exposed and their context within the surrounding landscape;
- specialist analysis reports on the artefactual/ecofactual/industrial remains from the site;
- appropriate photographs of specific archaeological features;
- a consideration of the importance of the archaeological remains present on the site in local, regional and national terms.

3.7 DISSEMINATION

3.7.1 The history and archaeology of the site will form part of future interpretative and engagement tools, notably digital, that are being designed as part of the wider NOMA Regeneration. This will enable the rich heritage of the site, and its setting amidst the adjacent listed buildings, to be disseminated to a wide range of people via a range of innovative techniques. The precise format will be devised in consultation with GMAAS once the results of the excavation are known, although may include audio walking tours and engagement events with local interest groups.

4. WORK TIMETABLE

4.1 A six-week period should be allowed to excavate and record the buried remains of archaeological interest within the targeted area. On the first day of the fieldwork, OA North will accurately locate through measured survey the exact position of the excavation area, which will then be scanned for live services with a CAT prior to any mechanical excavation.

4.2 A report will be submitted within eight weeks of the completion of the fieldwork.

5. STAFFING PROPOSALS

5.1 The project will be under the overall charge of **Ian Miller BA FSA** (OA North Senior Project Manager) to whom all correspondence should be addressed. Ian has over 20 years experience of commercial archaeology, and has a particular interest in the archaeology of the Industrial Period, and particular that of Greater Manchester and Lancashire. His role will be to ensure that the Written Scheme of Investigation is implemented within the framework of the Project Objectives. He will be responsible for all aspects of staff and resource logistics, ensuring the smooth running of the project programme. He will liaise with the Client and GMAAS with regard to progress, and will maintain relationships with other contractors.

5.2 The fieldwork is likely to be undertaken by **Graham Mottershead BA** (OA North Project Supervisor). Graham is an highly experienced field archaeologist, with over 20 years continuous experience of field archaeology. It is not possible to provide details of specific technicians that will be involved with the fieldwork at this stage, but all shall be suitably qualified archaeologists with proven relevant experience. It is anticipated that up to two technicians will be required for the initial stage of the fieldwork.

5.3 Assessment of any finds recovered from the excavation will be undertaken by OA North's in-house finds specialist **Christine Howard-Davis BA** (OA North Finds Manager). Christine has extensive knowledge of all finds of all periods from archaeological sites in northern England, and is a recognised expert in the analysis of post-medieval artefacts.

ILLUSTRATIONS

FIGURES

Figure 1: Site location

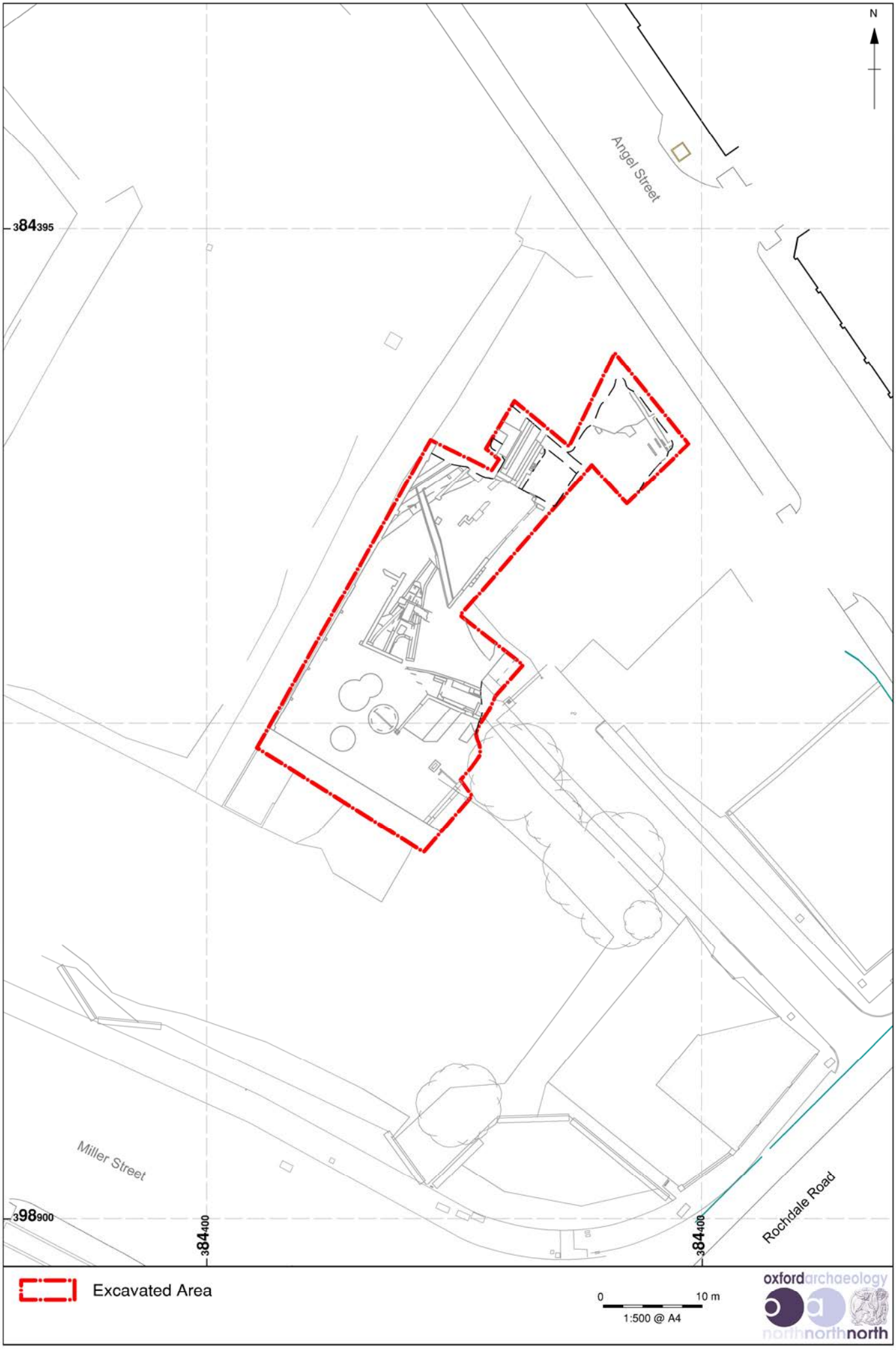


Figure 2: Location of the excavated area

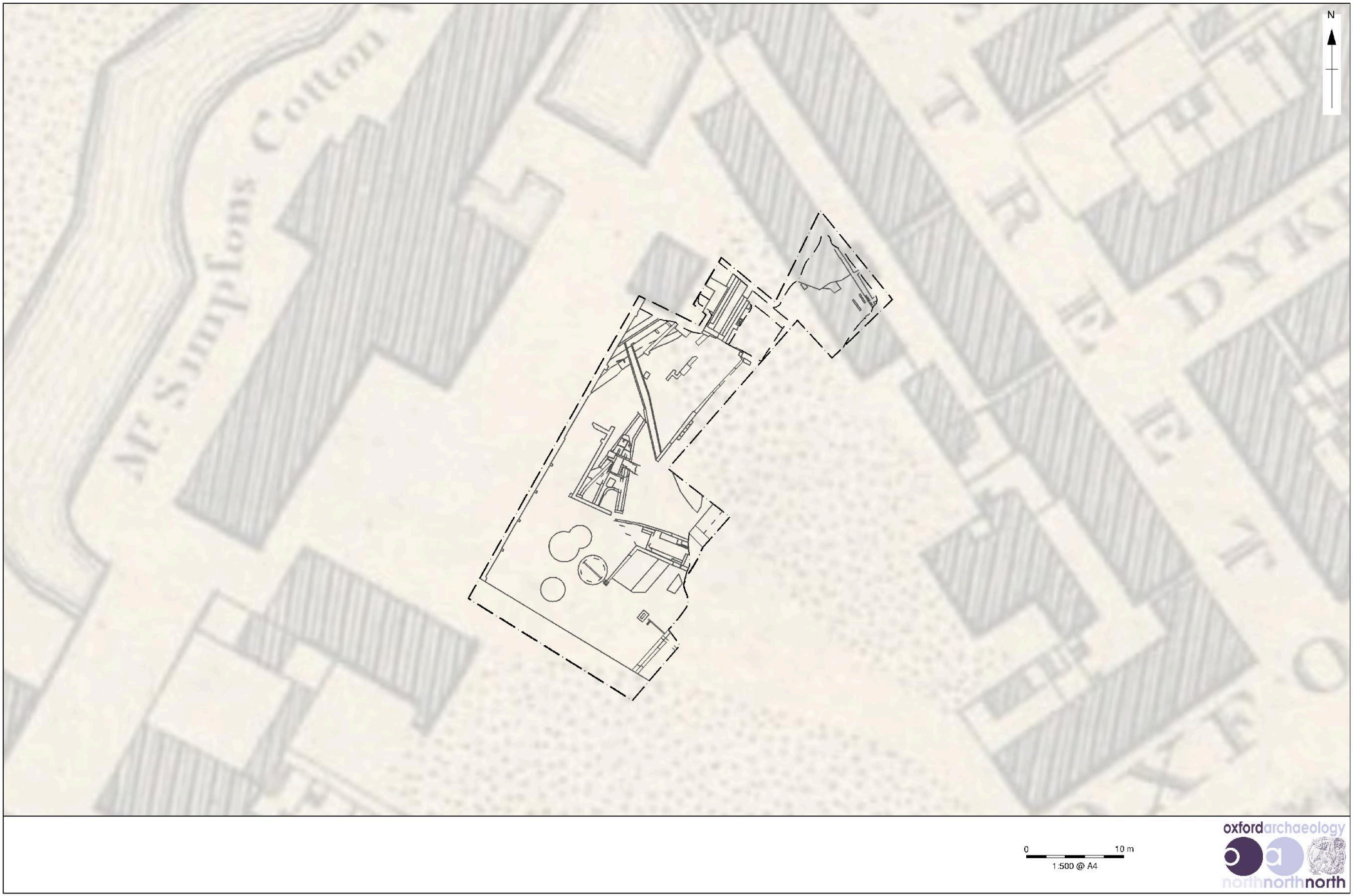


Figure 3: Excavation area superimposed on William Green's map of 1787-94

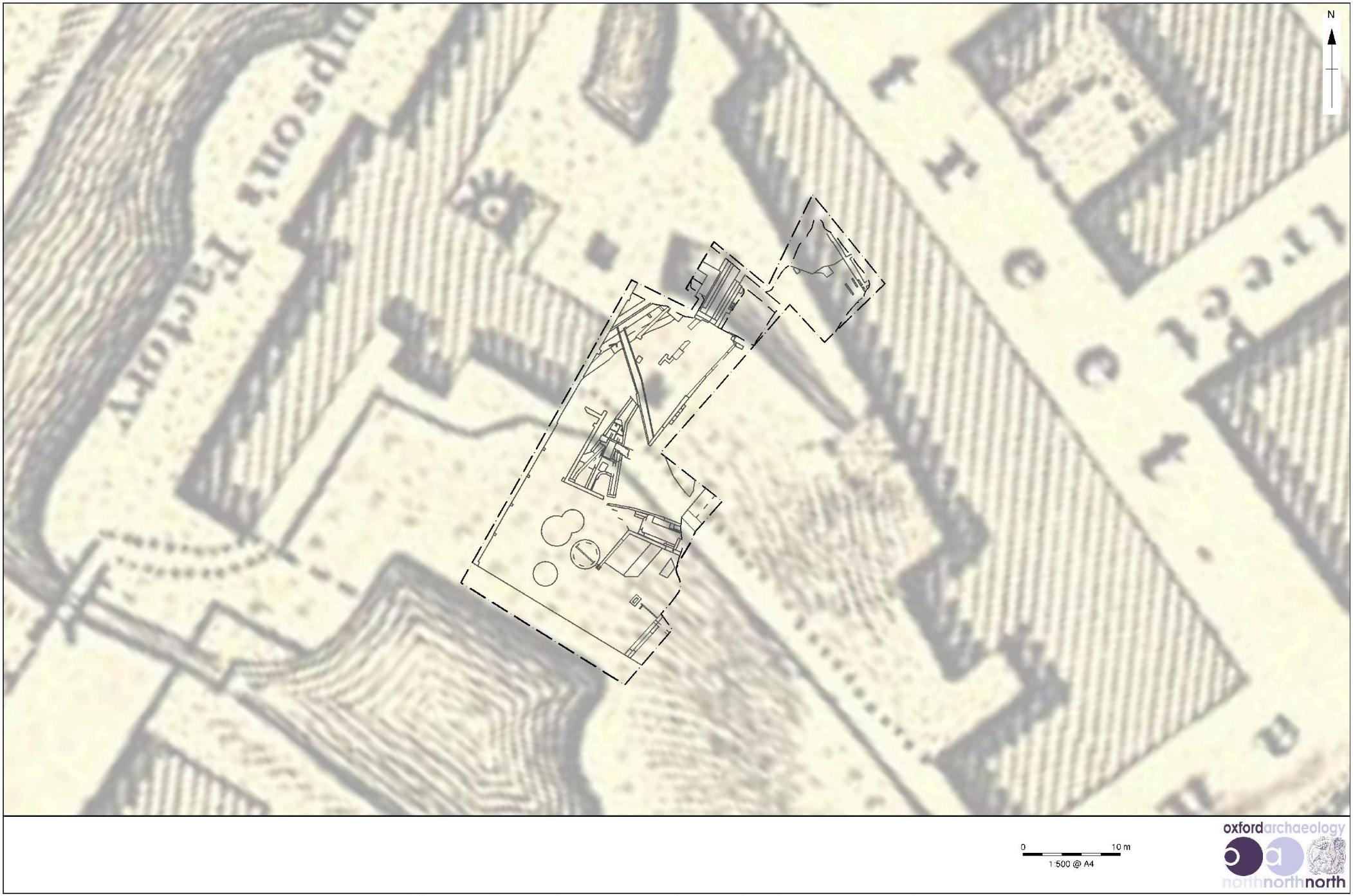


Figure 4: Excavation area superimposed on Laurent's map of 1793

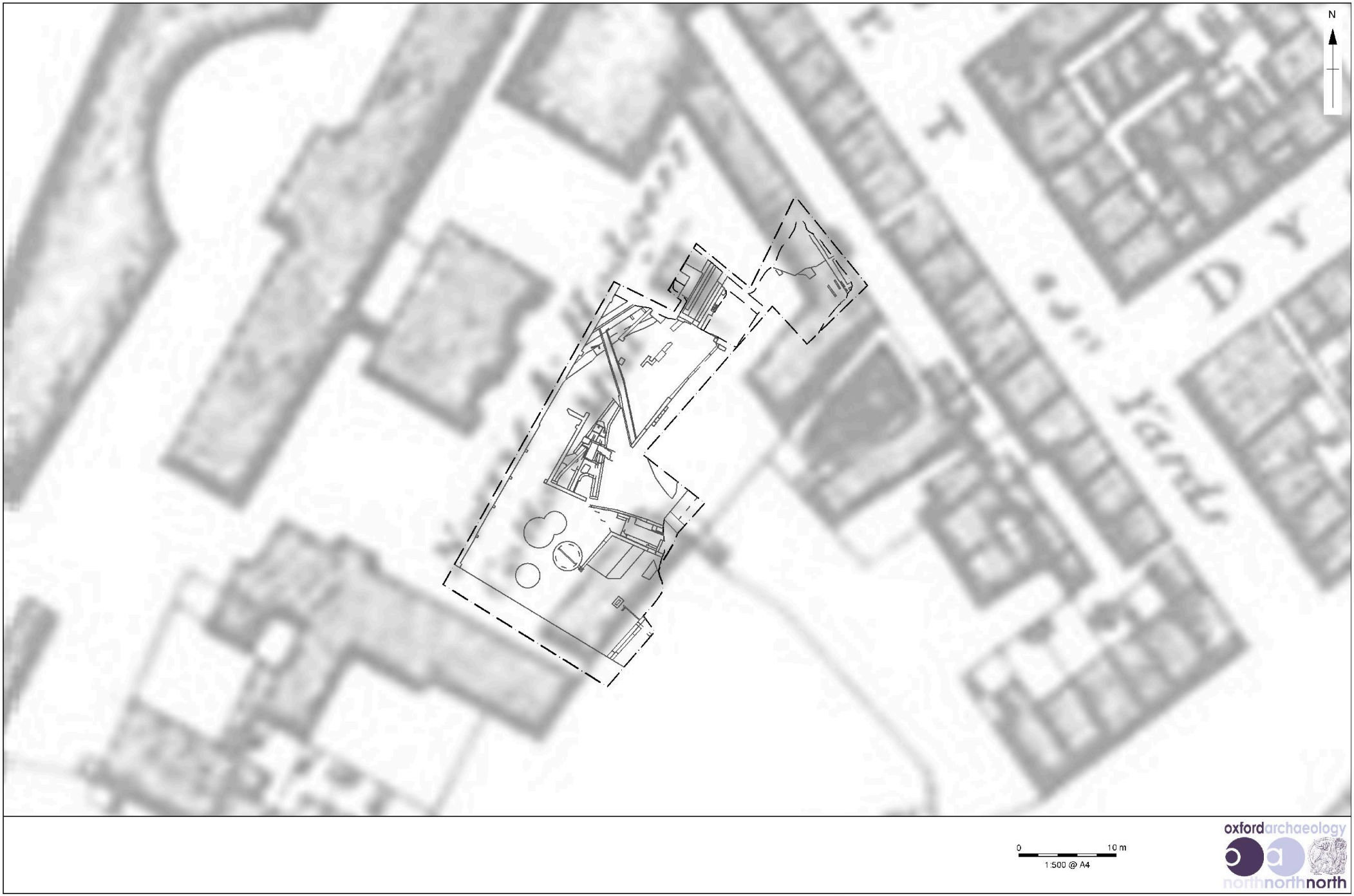


Figure 5: Excavation area superimposed on Bancks & Co's map of 1831

Figure 6: Excavation area superimposed on the Ordnance Survey map of 1850

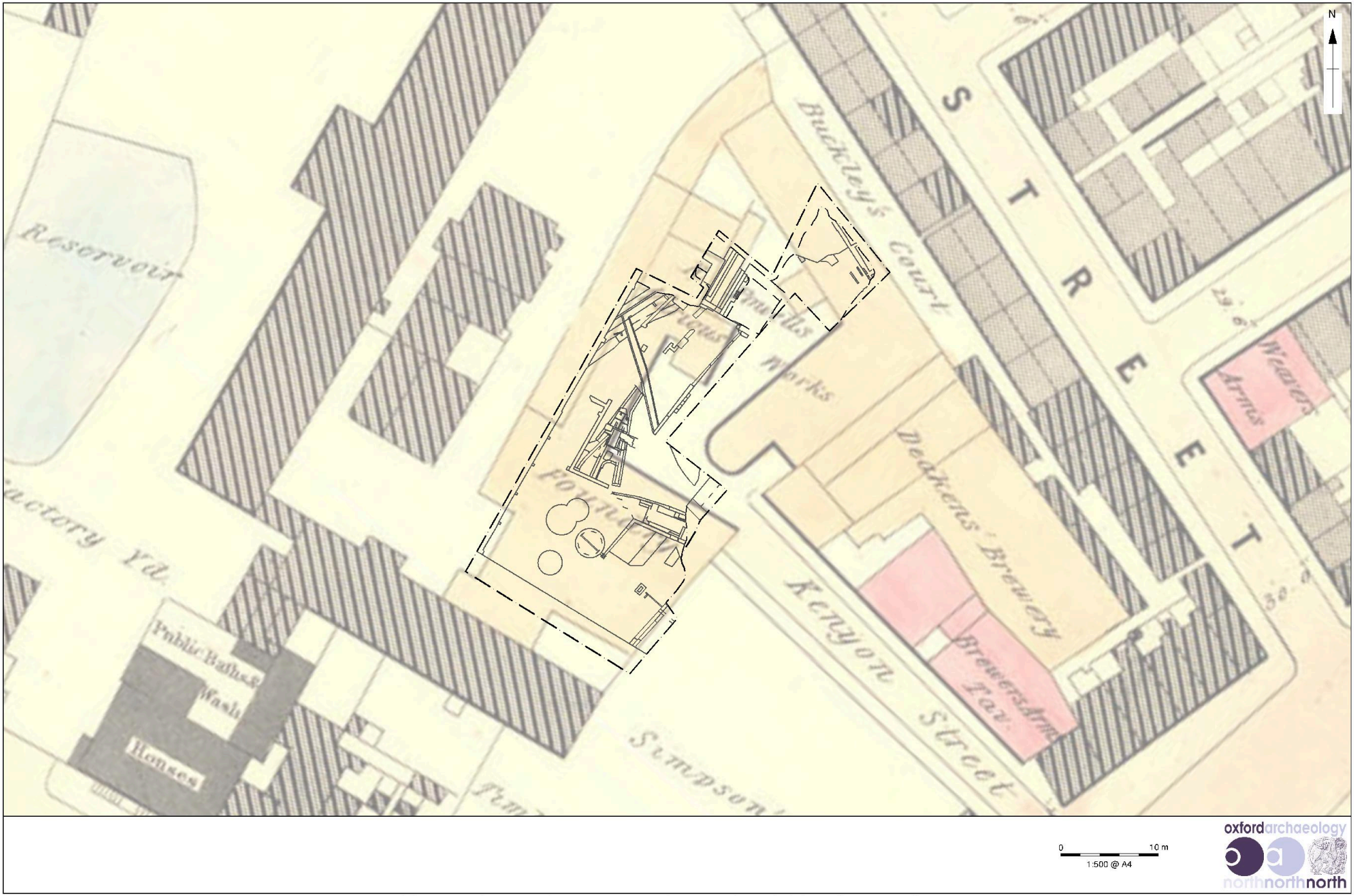


Figure 7: Excavation area superimposed on Adshead's map of 1850

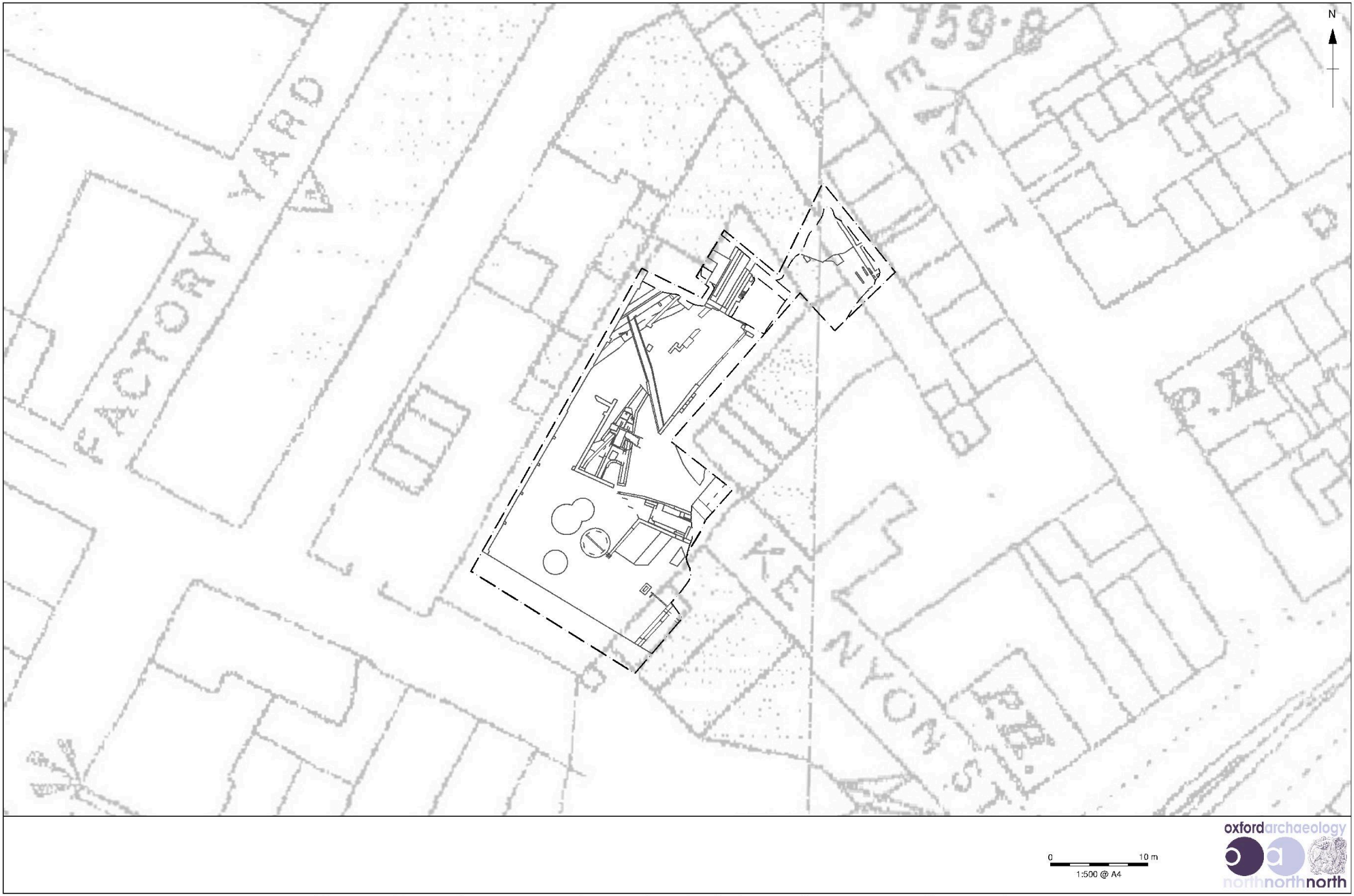


Figure 8: Excavation area superimposed on the Ordnance Survey 25":1 mile map of 1892

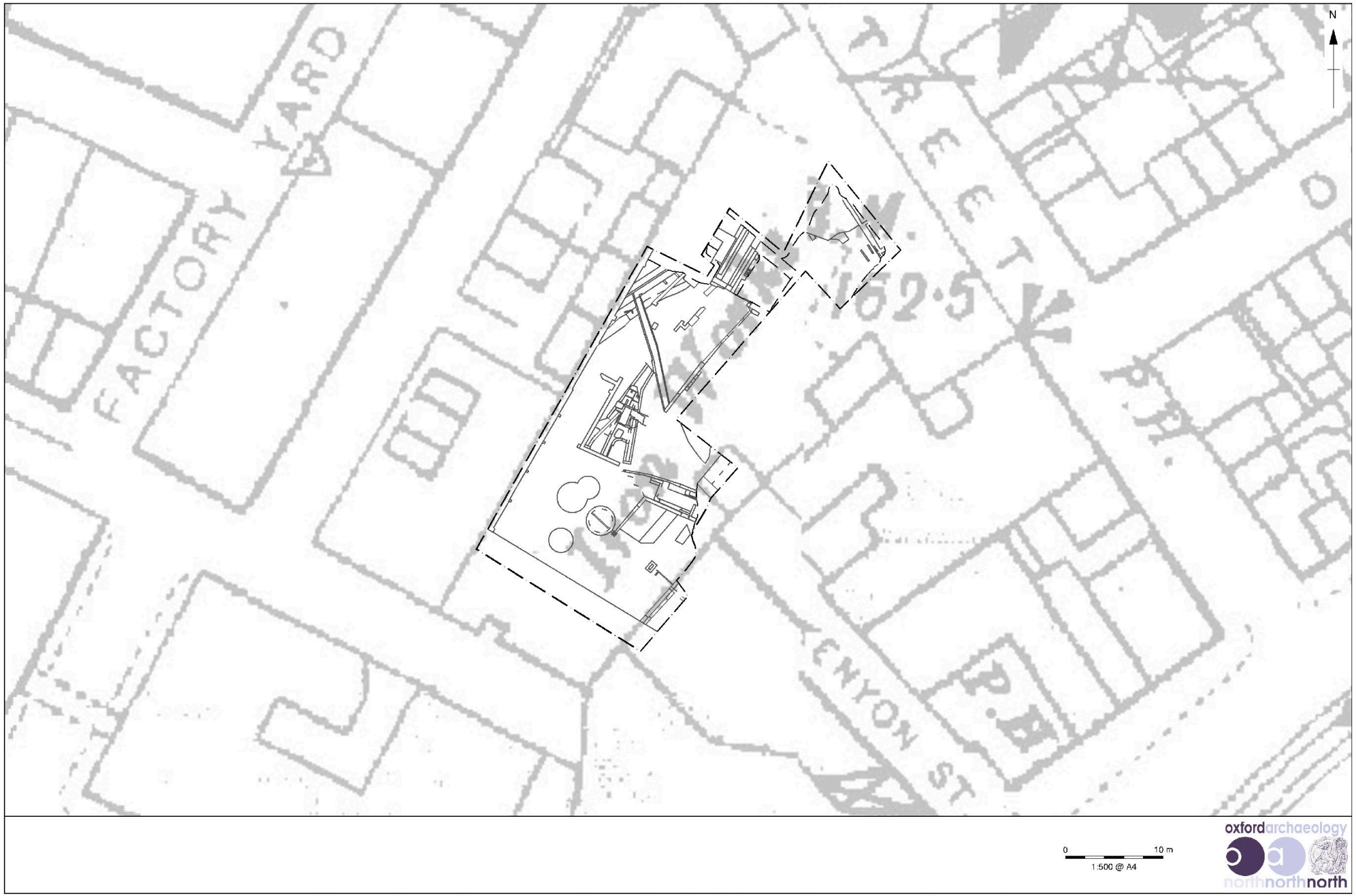


Figure 9: Excavation area superimposed on the Ordnance Survey 25":1 mile map of 1908

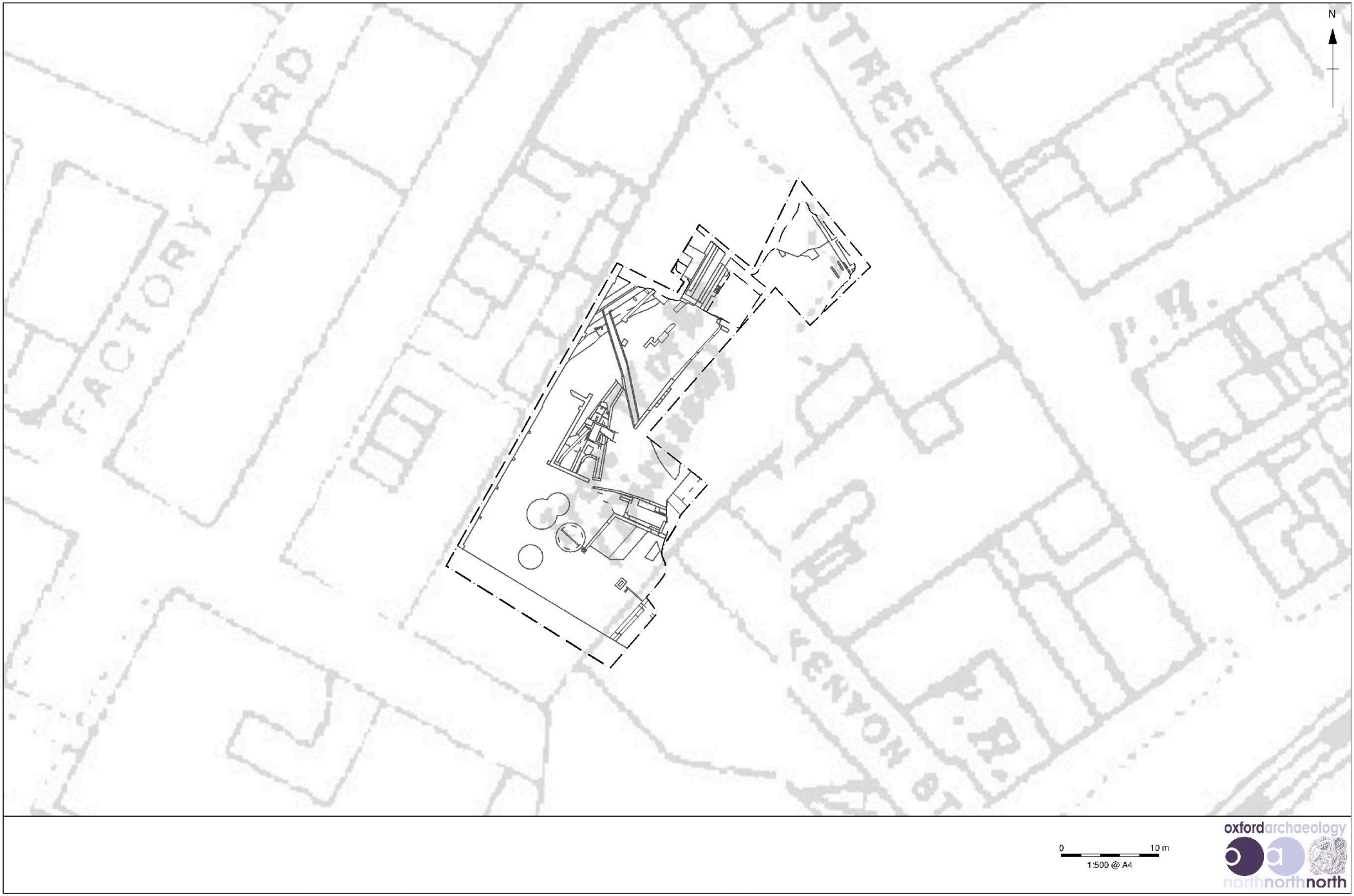


Figure 10: Excavation area superimposed on the Ordnance Survey 25":1 mile map of 1922

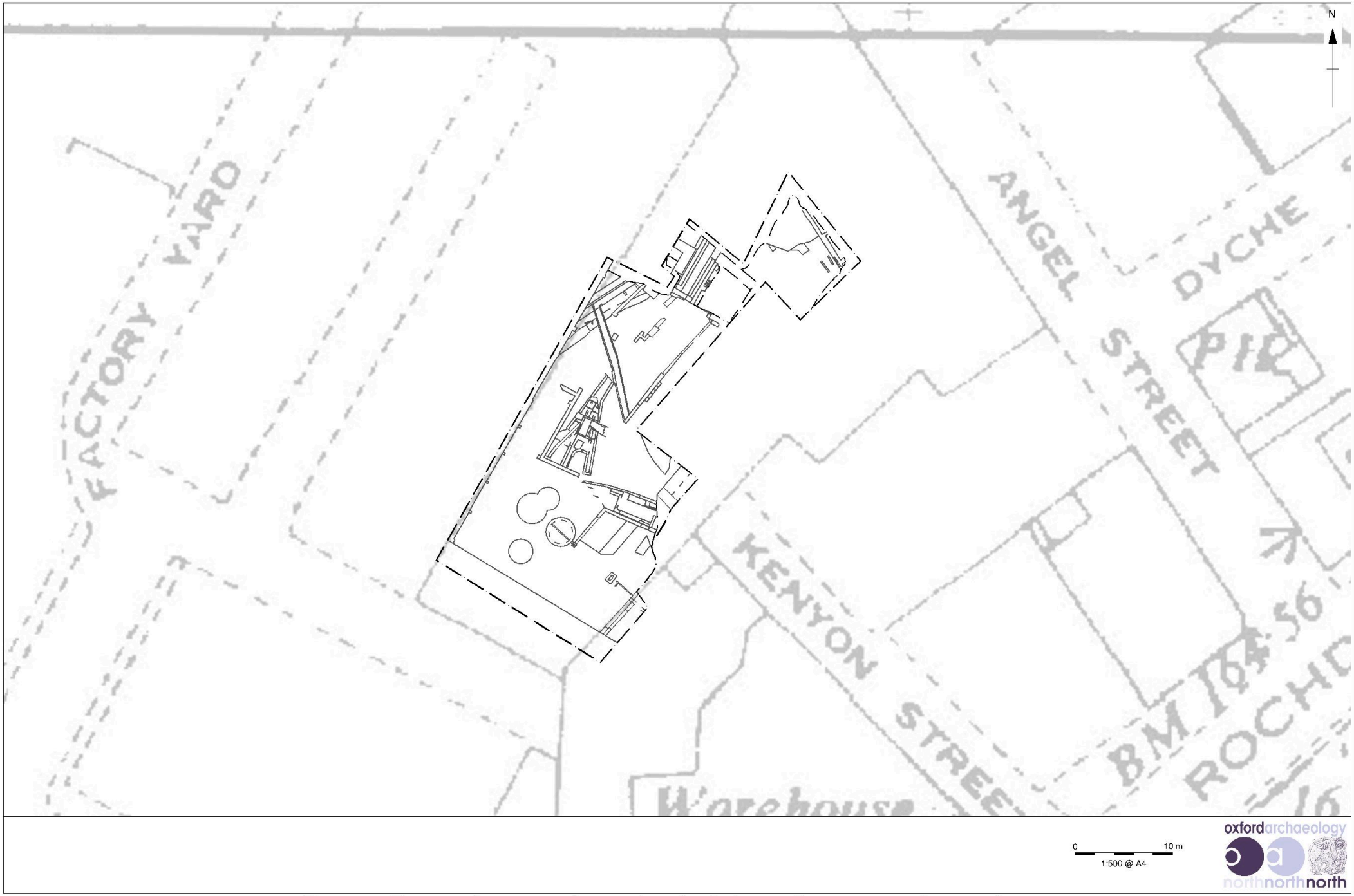


Figure 11: Excavated area superimposed on the Ordnance Survey 25":1 mile map of 1951-2

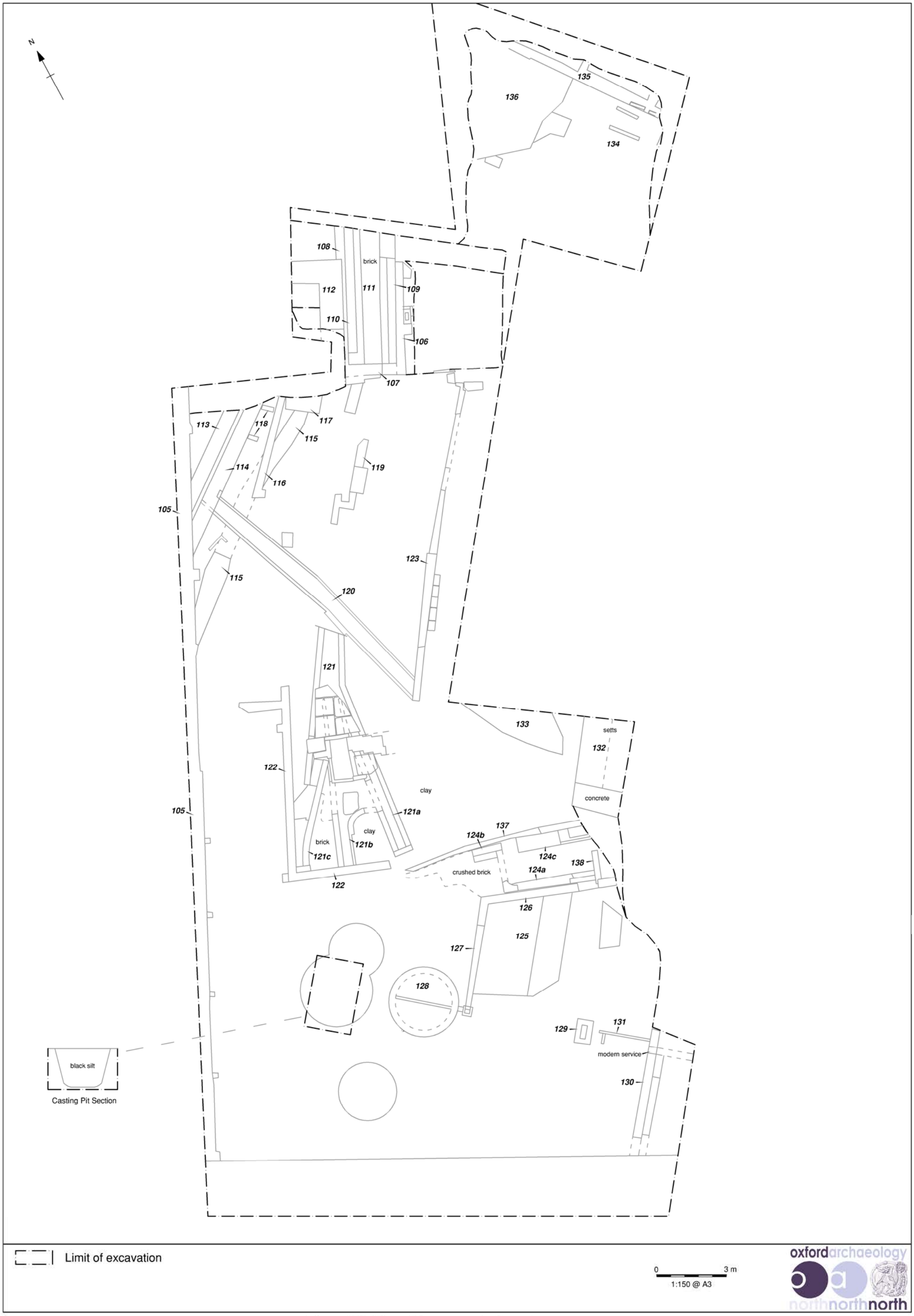


Figure 12: Plan of the excavated remains

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