Low Moor Ironworks
New Works Road, Bradford, West Yorkshire:
Historic Buildings Record

October 2015
NGR: SE 15600 28597
Historic township: North Bierley

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CONTENTS

SUMMARY

An ironworks was established at Low Moor in 1791 (NGR: SE 15600 28597), which exploited local mineral reserves and for many years was a highly successful producer of cast and later wrought iron, as well as finished engineered goods, but its fortunes declined rapidly during the 20th century. The works occupied an extensive area but the present recording concerns three adjoining buildings off Long Row, one of which is a large former foundry, parts of which may survive from the 1791 works, and also the site of two now demolished blast furnaces. Recorded was carried out in September 2015 for the Trustees of the former T M Newburn Group, prior to the demolition of the buildings and their replacement by new industrial units.

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LIST OF BLACK AND WHITE PHOTOGRAPHS

Photo	Subject
1	Building 1: external view of phase 1 wall in west side
2	Building 1: internal view of phase 1 wall in west side
3	Doorway with basket arch in phase 1 wall, external view
4	Doorway with basket arch in phase 1 wall, internal view
5	Building 1: external view of phase 1 wall in west side
6	Building 1: internal view of phase 1 wall in west side
7	Building 1: external view of arched doorway in phase 1 wall in west side, with later phase to left
8	Building 1: internal view of phase 1 wall in west side, with former position of blast furnaces to left
9	Building 1: internal view of west side, showing former position of blast furnaces (steel stanchions) and columns
10	Building 1: internal view of large colonnade, west side
11	Building 1: detail of lower part of column, west side
12	Building 1/3: detail of bracket for roof truss over Building 3
13	Building 1: external view of west wall with tops of furnace openings at ground level
14	Building 1: internal view of west wall, with former openings to furnaces
15	Building 1: external view of west wall, north end, with straight joint and inserted colonnade
16	Building 1: external view of west wall, showing inserted colonnade
17	Building 1: external view of west wall, showing inserted colonnade
18	Building 1: internal view of west wall, showing inserted colonnade
19	Building 1: internal view of west wall, showing inserted colonnade
20	Building 1: external view of west wall, north end, showing arch slighted by inserted colonnade
21	Building 1: internal view of west wall, north end, showing arch slighted by inserted colonnade
22	Building 1: external view of south wall, showing arched former window and floor of modern building above
23	Buildings 1 and 3, from the south-west, with modern annex at right
24	Building 1: enclosed area at ground floor, by south wall, from the west
25	Building 1: enclosed area at ground floor, by south wall, from the east (former coke ovens to left?)
26	Building 1: interior view of south wall
27	Building 1: interior view of south-west corner
28	Building 1: interior view of south-east corner, with blocked window and corner flue
29	Building 1: interior view of south wall, showing inserted opening with column
30	Building 1 (left) and Building 2 (right), from the south-east
31	Building 1: external view of east wall, south end
32	Building 1: external view of east wall, south end
33	Building 1: internal view of east wall, south end
34	Building 1: interior view of one of two arched former openings in east wall, south end
35	Building 1: detail of iron “socket” in east wall, next to straight joint
36	Building 1: external view of east wall, now within Building 2
37	Building 1: external view of east wall, now within Building 2
38	Building 1: external view of east wall, now within Building 2, with mid-height arched windows
39	Building 1: external view of east wall, now within Building 2, with blocked, tall arched doorway
40	Building 1: external view of east wall, now within Building 2
41	Building 1: external view of east wall, now within Building 2
42	Building 1: external view of east wall, north end, now within Building 2

43 Building 1: internal view of east wall, from the south-west
44 Building 1: internal view of east wall
45 Building 1: internal view of east wall
46 Building 1: internal view of east wall
47 Building 1: external view of doorway at north end of east wall
48 Building 1: detail of external jamb of doorway at north end of east wall
49 Building 1: internal view of doorway at north end of east wall
50 Building 1: external detail of refractory jamb to blocked opening to former furnace, east wall
51 Building 1: internal view of blocked opening to former furnace, east wall
52 Building 1: internal view of north end
53 Building 1: internal view of east wall, from the north-west
54 Building 1: internal view of east wall, from the south-west
55 Building 1: internal view of west wall, from the north-east
56 Building 2: interior, from the south-west
57 Building 2: view up towards roof, from the south
58 Building 2: internal view of east wall, from the south-west
59 Building 2: wall bearing box in west wall
60 Building 3: internal view of south end
61 Building 3: internal view of south-west corner
62 Building 3: external view of west wall, south end
63 Building 3: internal view of west wall, south end
64 Building 3: interior at south end
65 Building 3: interior, from the south-east
66 Building 3: external view of west wall, north end
67 Building 3: external view of west wall, north end
68 Building 3: external view of north wall
69 Building 3: internal view of west wall, north end
70 Building 3: interior at north end

LOW MOOR IRONWORKS, NEW WORKS ROAD, BRADFORD, WEST YORKSHIRE:

HISTORIC BUILDINGS RECORD

1 Introduction

1.1 This report presents the results of historic building recording at part of the former Low Moor Ironworks, in Bradford, West Yorkshire. The work was carried out in September 2015 for the trustees of the former T M Newburn Group, prior to the redevelopment of industrial land at Long Row, and was commissioned via the architects Kilmartin Plowman and Partners Ltd.

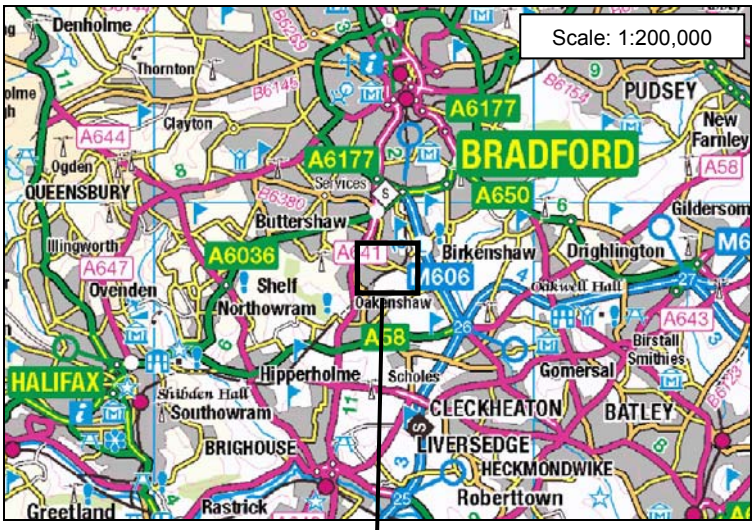
1.2 The ironworks at Low Moor was established in 1791 by a number of partners keen to exploit local reserves of high quality coal and ironstone, and their enterprise was centred around the production of cast iron from blast furnaces, and related activities, later including the production of finished wrought iron goods. At its peak the site covered an extensive area served by roads and its own network of tramways and railways, but decline set in in the early 20th century and widespread demolition and redevelopment mean that there are few visible traces to indicate the former scale of the works. However, the present recording concerns the core of the early ironworks, containing what may be part of the 1791 buildings and the site of two now demolished blast furnaces, though more obviously represented by a large, 19th century foundry building.

1.3 The recording work was carried out in accordance with a specification from the West Yorkshire Archaeology Advisory Service (WYAAS) (Appendix 1), and involved photographic and drawn surveys, as well as research into the buildings' background. This report will be submitted to the client, the West Yorkshire Historic Environment Record and the West Yorkshire Archive Service, and will be published on the internet via the OASIS project.

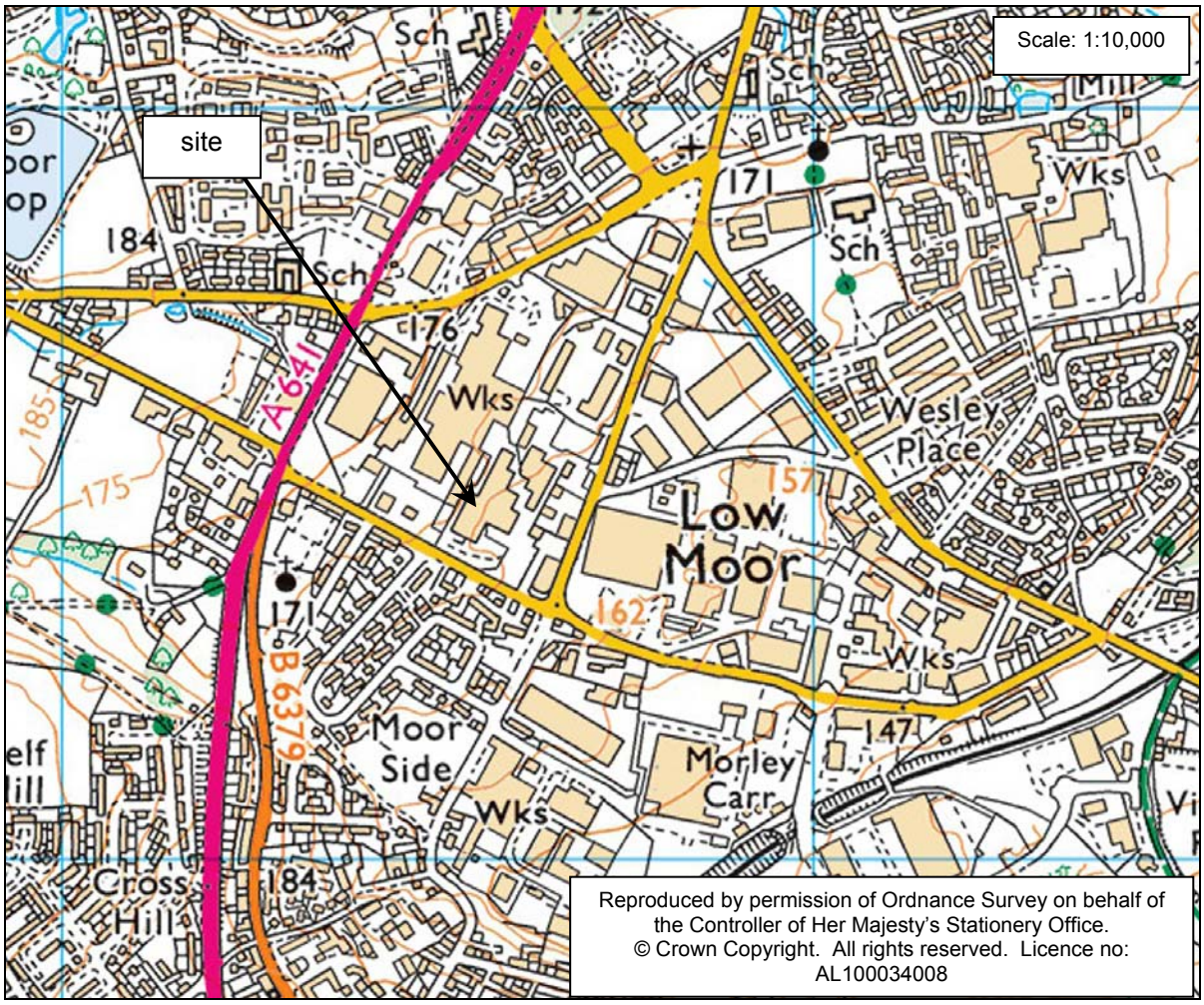
2 Location and current use

2.1 The site lies within an industrial estate on the north side of New Works Road, to the west of Long Row, about 4km south of Bradford city centre (figures 1 & 2). The national grid reference for the site is SE 15600 28597, and its height above Ordnance Datum (sea level) is approximately 163m.

2.2 The buildings recorded form three parallel, adjoining ranges orientated south-south-west to north-north-east (hereafter south to north, for simplicity), with other industrial buildings adjoining on two sides (figure 3). They have become disused in recent years but appear to be generally structurally sound. Building 1 contains some of the earliest and most significant fabric within the group.



1: Location map (i)



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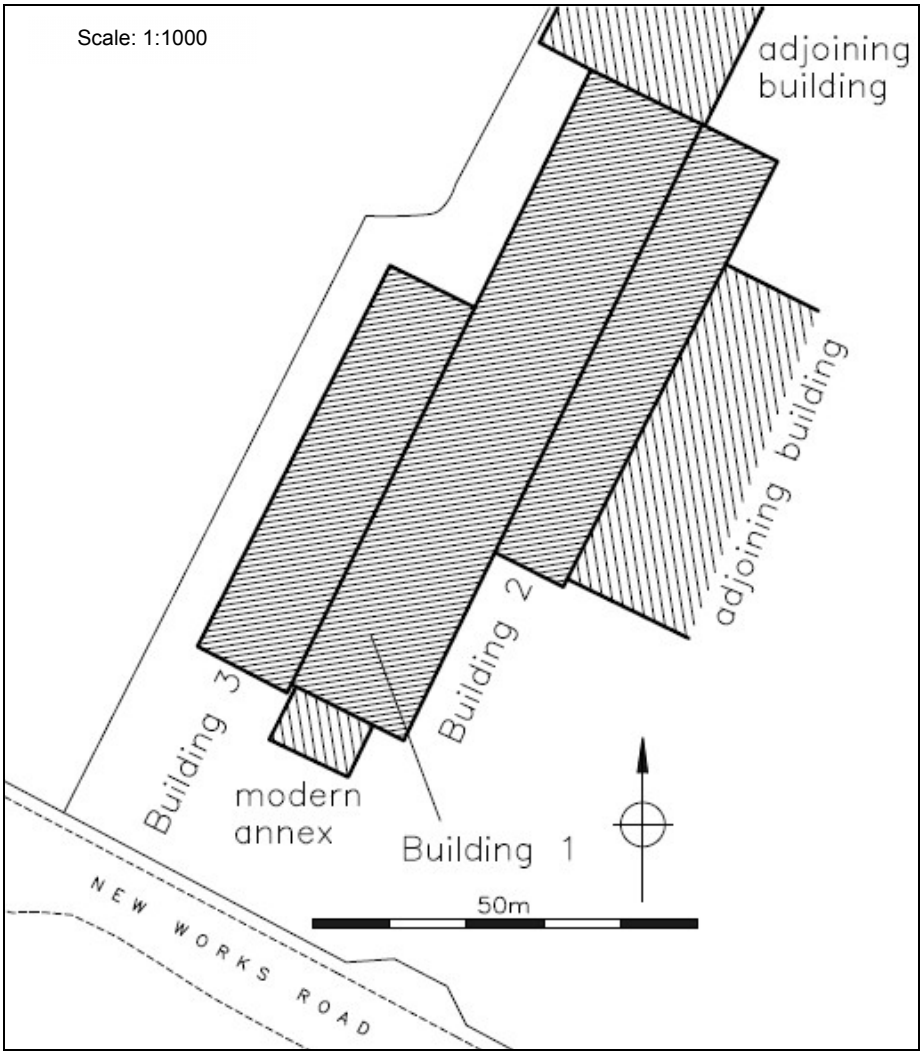
2: Location map (ii)



3: Site plan

3 Planning background

3.1 None of the buildings recorded have been listed as having special architectural or historic interest, and the only part of the former ironworks that has been so protected is the grade II "Office Building" lying to the north of this site, at NGR: SE 15622 28564[1].

3.2 Planning consent for "23,000 sq ft of new industrial B2/B8 units and associated works" has been granted by the City of Bradford Metropolitan District Council[2]. In response to the application, the planning authority's advisor (the West Yorkshire Archaeology Advisory Service) requested a programme of archaeological work relating to the site, and condition 19 of the consent requires that "no demolition or development shall take place within the application site until the applicant, or their agents or successors in title, have secured the implementation of a programme of architectural or archaeological recording..."

[1] National Heritage List no: 1132938
[2] application number 14/02246/MAF

The present recording is intended to satisfy the first part of such a programme (in accordance with the WYAAS specification of August 2015), and further work in the form of recording of sub-surface remains is expected to be carried out under a second such specification, though at the time of writing, that second phase is not thought to have been instructed.

4 Previous investigative work

4.1 As a site of considerable interest to industrial archaeologists (see West Yorkshire Historic Environment Record PRN 3794), the history of the Low Moor Ironworks have been researched and documented by a number of individuals, with the most prominent being Charles Dodsworth[3] and Gary Firth[4]. However there has not been a comprehensive survey of historic remains at the site, so that the precise extent of these has yet to be established, and no detailed record of the buildings which this study concerns has been undertaken.

5 Historical background

A note on iron manufacture

5.1 The smelting of iron (or other metallic) ore in a blast furnace appears to have developed in the late medieval period, using charcoal as a fuel, and water power as a means of delivering the air blast which is crucial to achieving the high temperature necessary. The substitution of charcoal with coke (made by slow combustion of coal in clamps) was introduced by Abraham Darby in 1709, and steam power was used to generate the blast from 1775. Later developments included the "hot blast" technique, in which the air supply was pre-heated.

5.2 The furnace itself is a vertical structure lined with refractory material, with a heath at its base, and ore, coke and limestone are introduced at the top, while a blast of air is forced upwards through them as they descend, so that the iron melts and can be let out through a tap hole in the hearth at intervals. This is in the form of "pig iron", which needs further processing before it can be used: for cast iron, the pigs are melted again in a cupola furnace, while for wrought iron, they are "puddled", ie melted in a special furnace to burn off remaining carbon, and then hammered to produce a "bloom". This intermediate material is then rolled into bars, up to three times, with the quality of the material increasing according to the number of rolling episodes. Wrought iron has now been almost entirely replaced by steel.

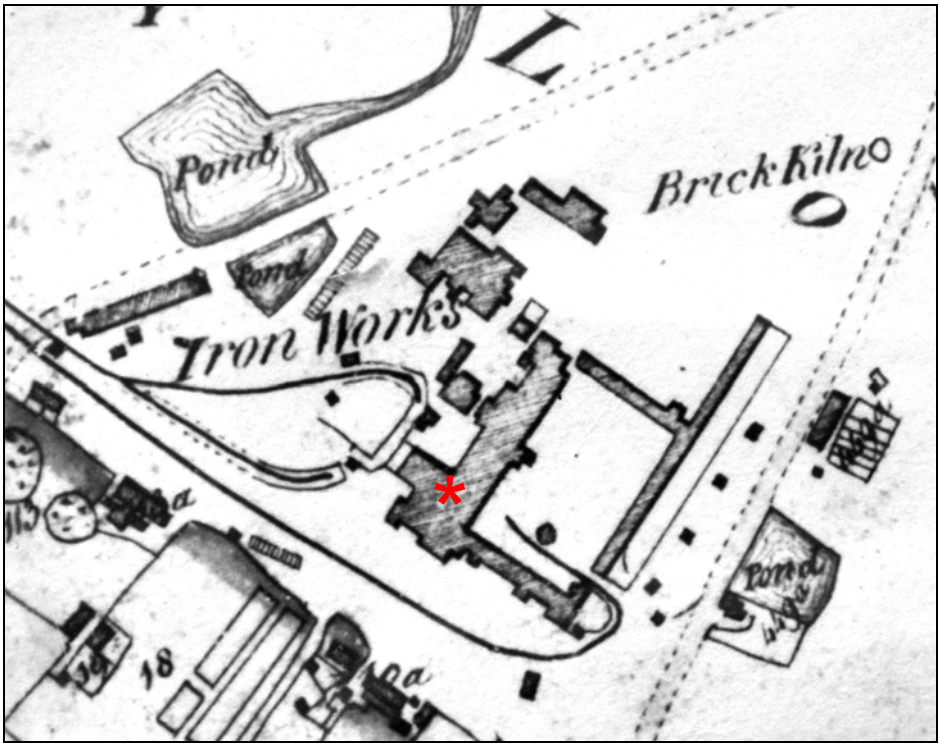
[3] 1971 "The Low Moor Ironworks, Bradford" in *Industrial Archaeology* Vol 8, No.2, pp122 - 164
[4] 1977 "Origins of Low Moor Ironworks 1788 – 1800" in *Yorkshire Archaeological Journal* Vol 49, pp127 - 139

5.3 Industrial exploitation of mineral reserves in the Low Moor area began as early as the 14th century, but during the 18th century a great intensification of coal mining took place under the ownership of the Royds Hall estate, by its proprietor Edward Rookes Leedes, although his business failed and he became bankrupt in 1781. In 1789 his estate was acquired by a consortium of entrepreneurs including Joseph Dawson, whose enthusiasm and particular expertise seems to have provided the impetus for them to begin smelting deposits of ironstone using blast furnaces, a process then undergoing rapid adoption and development nationally, and the Low Moor Company joined a small number of other concerns in Bradford and Leeds involved in this process.

5.4 The company engaged the services of Edward Smalley to oversee the construction of blast furnaces and casting shops from 1790, Smalley having been involved at similar works at Wigan, and he brought with him from there the stonemason Thomas Woodcock, who would be responsible for building at Low Moor. The furnaces were operated by "cold blast", air forced into them by a reciprocating steam engine, and were ready for operation by 1791, with the production in the early years being largely goods for local markets including the burgeoning textile mills and collieries of the West Riding; armaments were added to the inventory in the 1790s with the outbreak of the Napoleonic wars. In 1801 the company established a forge to produce wrought iron in addition to castings and their derivatives, and benefited from the high quality of the coke produced from its own "Better Bed" coal deposits.

5.5 The earliest map of the ironworks known to survive dates from 1811 and was made by George Leather (figure 4). This shows that the buildings recorded in 2015 formed the focus of the works (see red asterisk) and although they have clearly undergone considerable change since then, the essential linear form of Building 1 is easily recognizable. On its west side is a substantial wing which is believed to represent the two blast furnaces, served by a tramway loop to provide fuel and iron ore.

5.6 Another map of the works, made in 1829 (figure 5), shows the building in more detail, albeit without the tramway to the west, and the complexity of the site is apparent from this: no doubt there was constant addition and alteration and probably demolition taking place, to adapt to changing processes and demands. However, the large size of the present Building 1 is again notable, together with its various appendages.

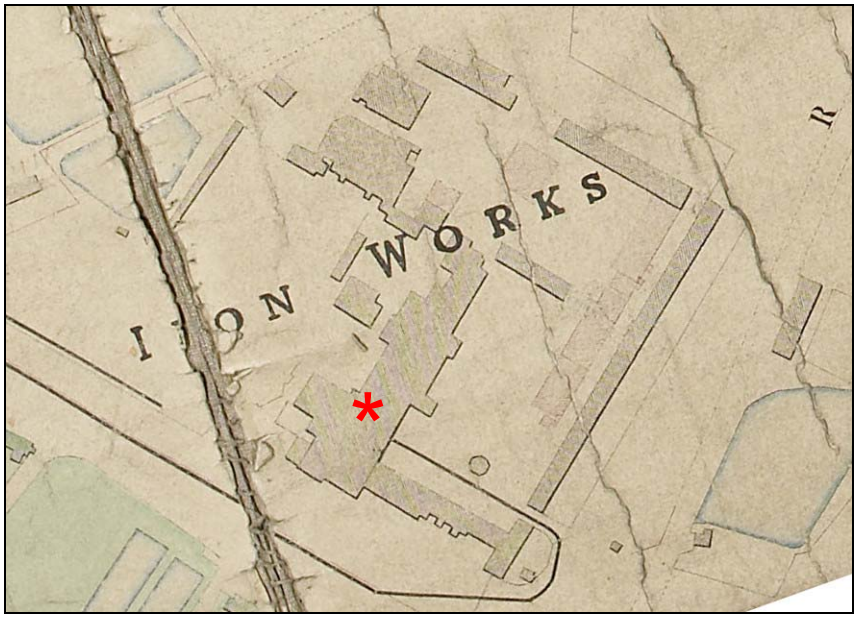


4: Leather's map, 1811[5]

5.7 There seems to have been a short lull in the company's prosperity at the end of foreign wars in the early 19th century, but it was soon followed by stimulating demand from the growth of urban gas lighting and more widespread industrial development, so that in 1835 construction of the "New Works" began, well to the south-east of the existing foundry and other areas, which incorporated two new blast furnaces. Dodsworth describes how this made a total of six such furnaces, implying that two had already been added to the original two at the 1790s site, though he does not make this previous expansion of facilities explicit[6].

5.8 The extent of the original ironworks or "Old Works" is shown on the Ordnance Survey 1:10560 map surveyed in 1847-50 (figure 6); the main foundry building is still evident as a complex structure, but again there is no clear indication of the purposes to which the various parts of it were put.

[5] *A Plan of an Estate the Property of the Low Moor Company… made in the year 1811 by George Leather* (copy held at Bradford Local Studies Library)
[6] Dodsworth, C 1971 p140

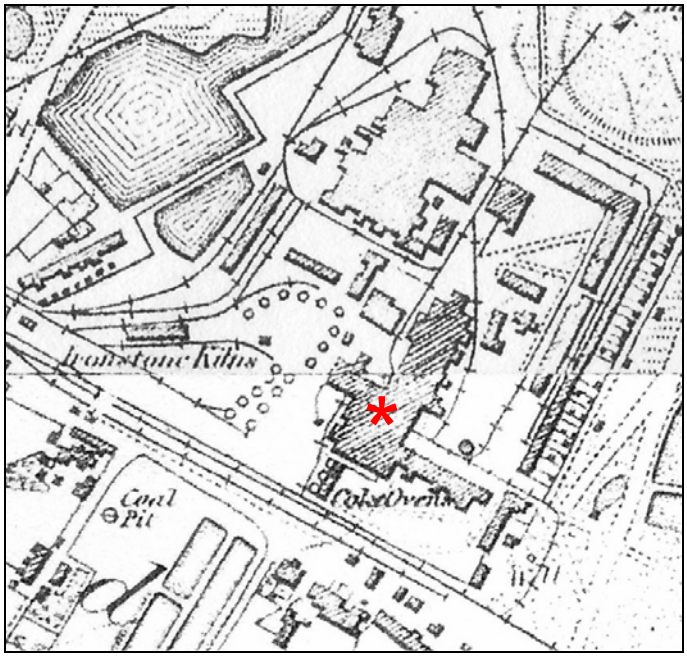


5: Fox's map, 1829[7]

5.9 Growth of the ironworks continued for much of the 19th century, but by the 1880s it was becoming apparent that in some respects the facilities there had become outmoded and uncompetitive as well as being poorly served by transport, in a world where there had been rapid progress in iron and steel technology. The resulting inefficiency and obsolescence were major concerns for the company, and it was decided to modernise the works in a number of ways and to streamline production to manufacture only the "Best Yorkshire Iron", in which it then already specialised. To this end, another detailed survey was undertaken, which provides a useful plan of the present Buildings 1, 2 and 3 (figures 7 & 8).

5.10 The most significant aspect of the 1888 plan is perhaps the location of the two square section blast furnaces, believed to represent the original ones of 1791, on the west side of the building, in a slightly different position from that shown by Dodsworth in his 1971 article (p130). The 1888 plan also labels the main building (Building 1 in this report) as a "moulding shop", a function which is also ascribed to the south end of Building 3, while around the perimeter of the building are a number of "cupolas" and "air furnaces". The former are vertical, small versions of the blast furnace, used for re-melting pig iron, while the latter are more strictly known as reverberatory furnaces and were used for melting metal using heat reflected from an overhead arch or sloping roof, usually to allow "puddling" (producing wrought iron from pig)[8]. The plan also shows coke ovens near the south end of the building, and various offices.

[7] *Fox's Map of Low Moor 1829* Made for the Low Moor Company; digital copy held by WYAS Bradford (WYB 394), original in private hands
[8] Jones, W 1996 *Dictionary of Industrial Archaeology*



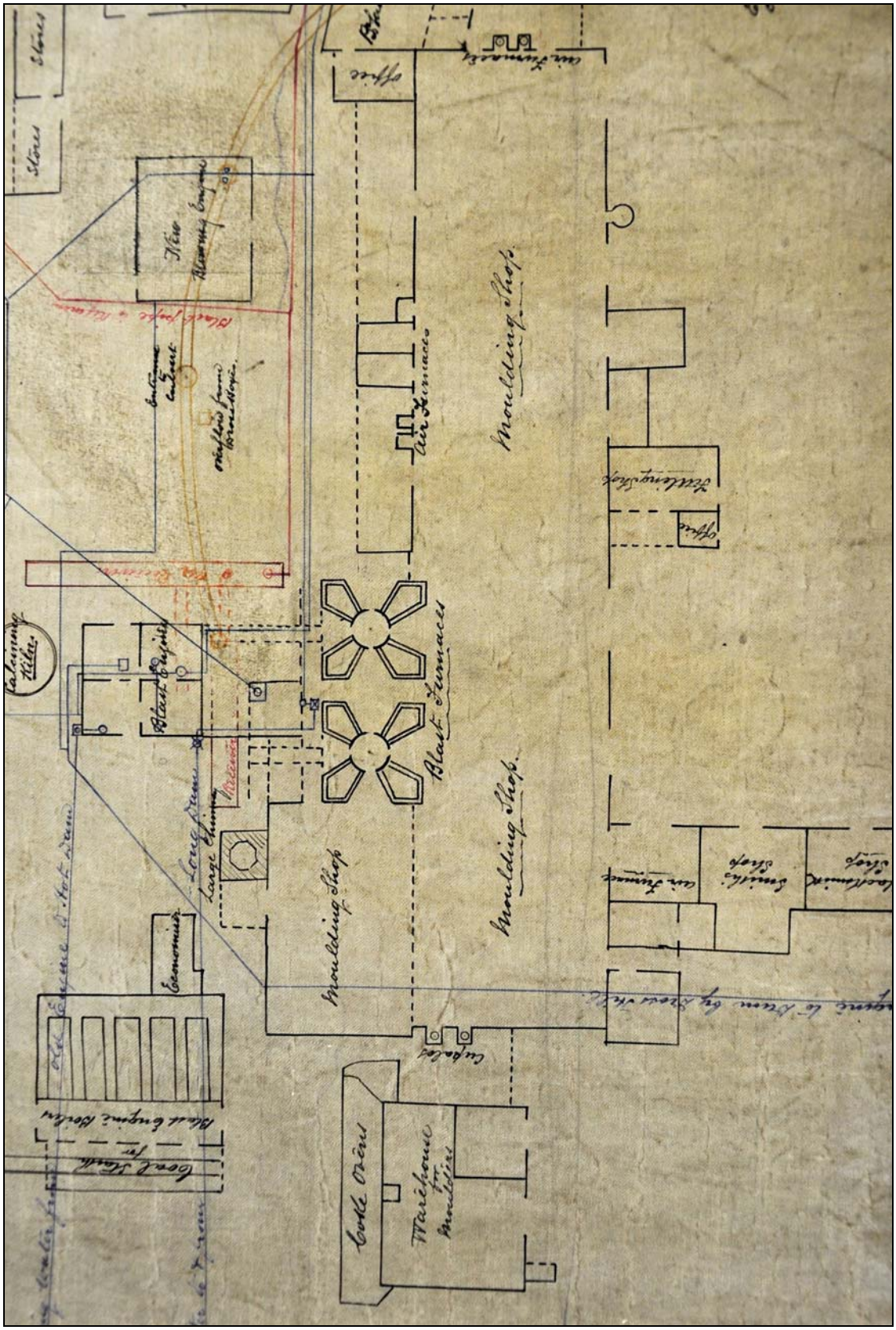
6: OS map, 1852/4[9]

5.11 Ordnance Survey maps at 1:2500 scale, from the 1890s, 1900s and 1930s, all show further changes to the buildings including the construction of Building 2, and the extension of Building 3 apparently at the expense of the blast furnaces, between 1905 and 1932 (figures 9 – 11).

5.12 There are also some photographs of the site from about 1906 which are valuable in showing Buildings 1 and 3: the interior of the former was then known as the "Old Foundry", and a view from the north-east corner shows a busy workshop with casting moulds in the floor and a number of hand-operated jib cranes, as well as piers alongside the outer walls for a travelling crane (figure 12).

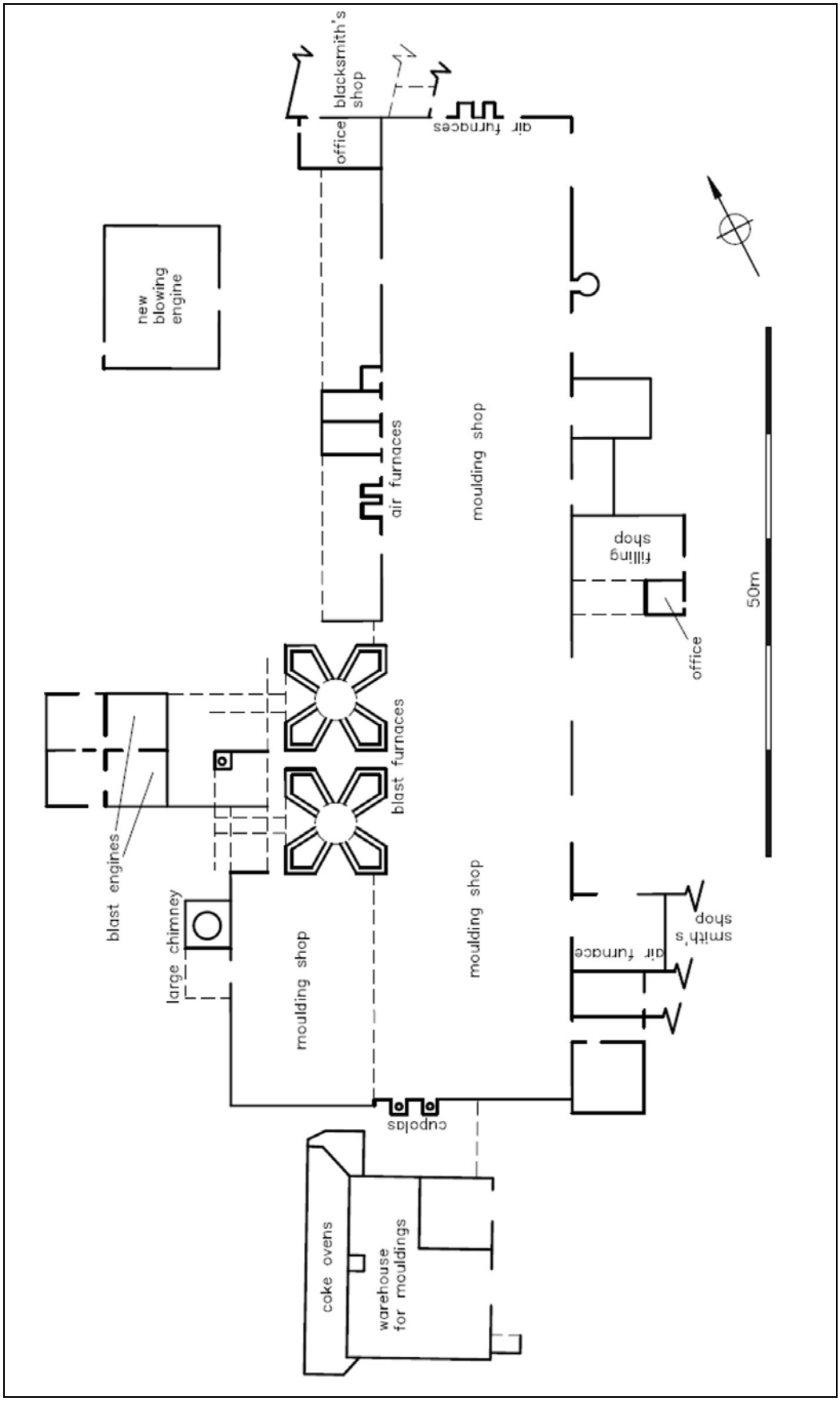
5.13 Another view from the same source shows the pair of blast furnaces on the west side of building 1 (figure 13); their general appearance (brickwork with outer iron or steel ties), suggests that if this is the site of the 1791 furnaces, those in the photograph have undergone considerable rebuilding since then, though the square section is suggestive of an early date. There is also a photograph of the same date which shows the group of buildings from the south-east, beyond the octagonal counting house (now demolished), which is a very distinctive part of the scene (figure 14).

[9] Ordnance Survey 1:10560 map, Yorkshire sheets 216 & 231, surveyed 1847-50

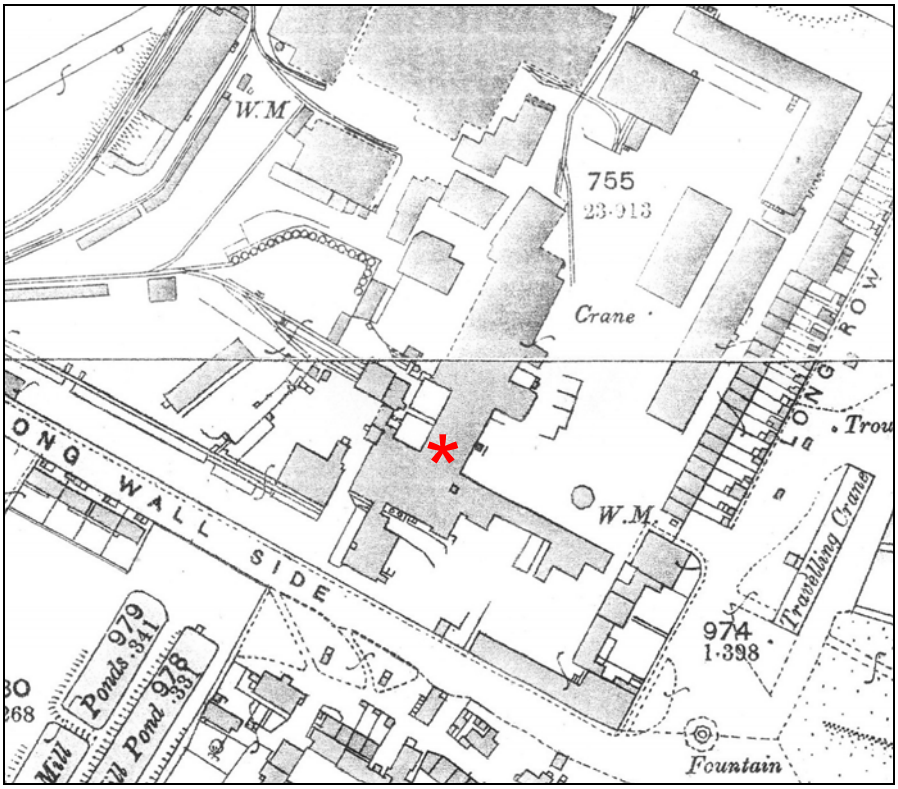


7: Plan of 1888[10]

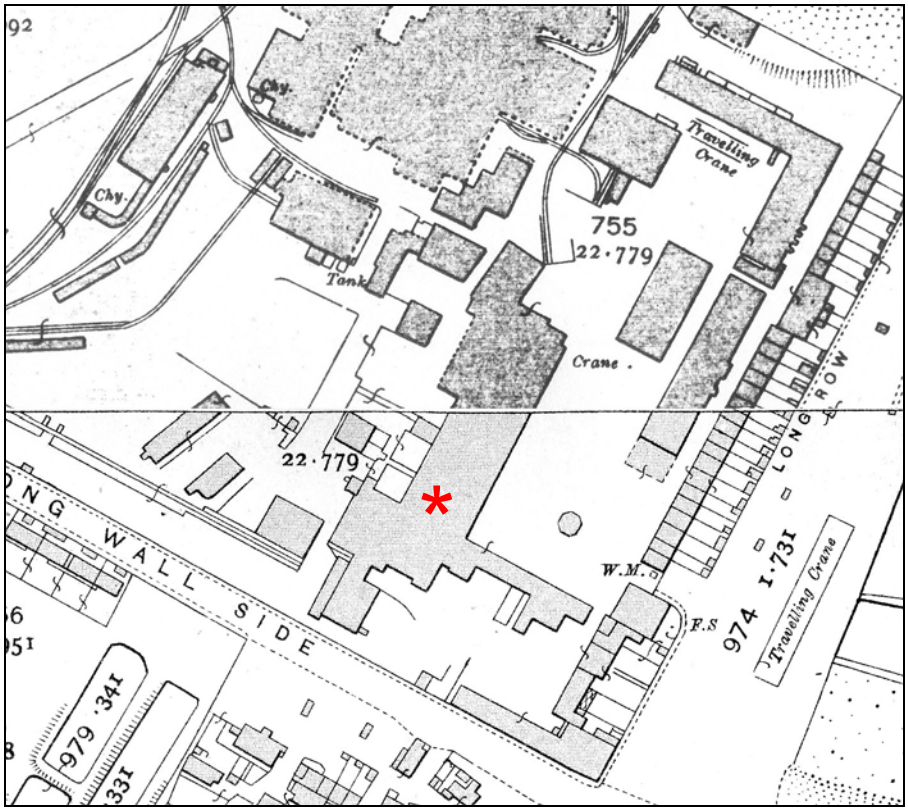
[10] *General Plan of Low Moor Iron Works* 1888 (WYAS Bradford, 91D87) Reproduced by kind permission



8: Tracing of 1888 plan above

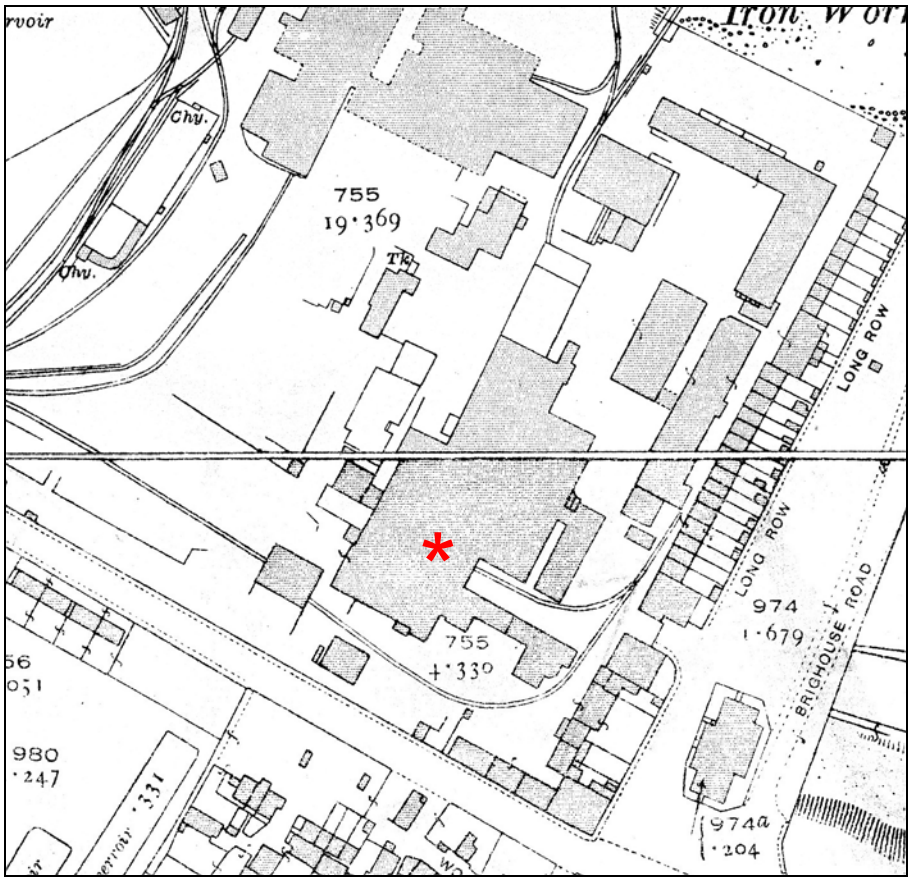


9: OS map, 1893[11]



10: OS map, 1908[12]

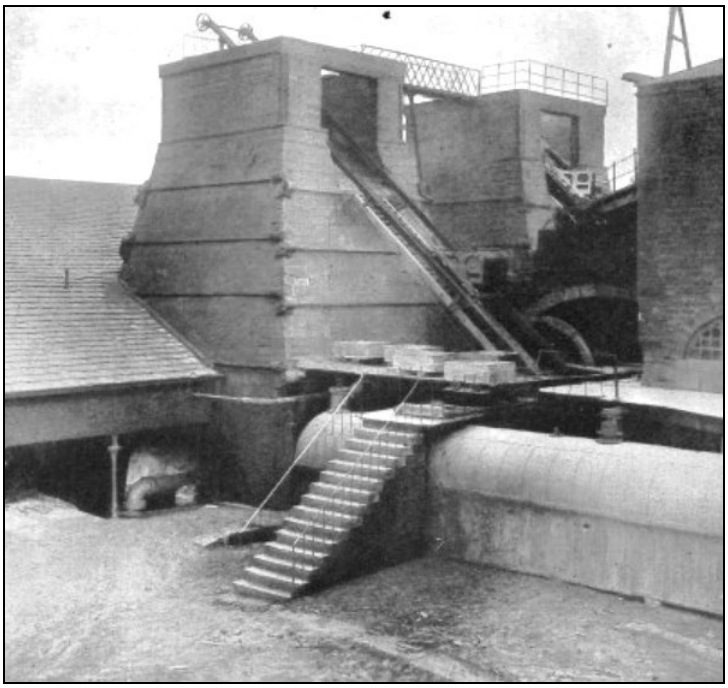
[11] Ordnance Survey 1:2500 map, Yorkshire sheets 216.16 & 231.4, surveyed 1890-2
[12] Ordnance Survey 1:2500 map, Yorkshire sheets 216.16 & 231.4, revised 1905



11: OS map, 1933/6[13]

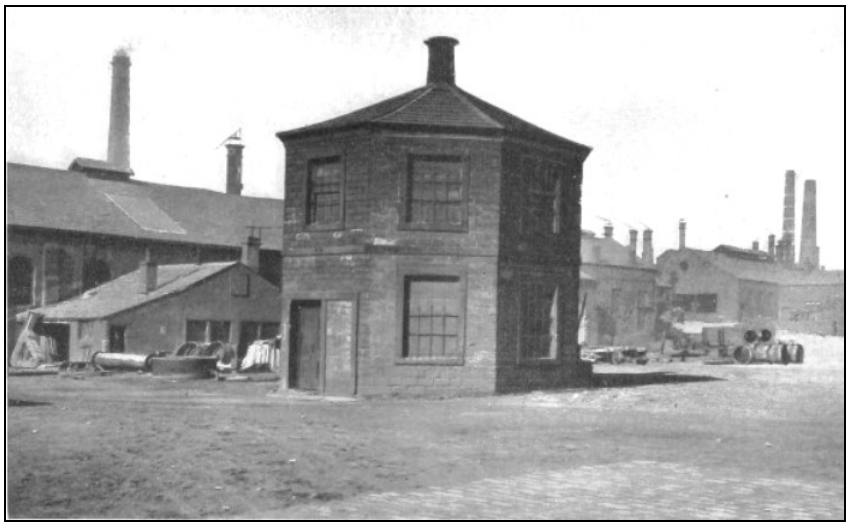
12: Photograph of "old foundry", c.1906[14]

[13] Ordnance Survey 1:2500 map, Yorkshire sheets 216.16 & 231.4, revised 1932
[14] Anon 1906 *A Record of the Origin and Progress of Lowmoor Iron Works from 1791 – 1906*



13: The blast furnaces, c.1906[15]

The furnaces are shown standing on the west side of Building 1



14: The counting house, c.1906[16]

Beyond the octagonal building is the east side of Building 1

6 Recording methodology

6.1 The present recording, carried out during site visits between 16 and 24 September 2015, involved detailed inspection, a drawn survey, and photographic recording of Buildings 1 to 3, in accordance with the specification (Appendix 1).

[15] Anon 1906 *A Record of the Origin and Progress of Lowmoor Iron Works from 1791 – 1906*
[16] Anon 1906 *A Record of the Origin and Progress of Lowmoor Iron Works from 1791 – 1906*

Following this, a meeting was held on 7 October with David Hunter of WYAAS, at which initial approval was given to the results of recording.

6.2 The drawn survey comprises a ground floor plan at 1:100 scale, based on a new total station survey, showing all significant archaeological and architectural detail and using conventions based on those specified by English Heritage[17], as well as the main phases of construction.

6.3 The photographic record was made using a medium format camera with perspective control and other lenses, and black and white film for archival stability (as required by the specification). External and internal photographs were taken of all parts of the building using a 2m ranging pole marked with 0.5m graduations as a scale, or a 0.5m baton with 0.1m graduations. These black and white photographs have been printed at 7" x 5" or 10" x 8", and are all copied in this report, where they are referred to by numbers in **bold**. A small number of photographs was also taken using a digital camera (see Appendix 2), which will be deposited on a CD only, with WYAAS. Locations of all photographs taken are marked on copies of the floor plan.

7 Description of the buildings

7.1 The general layout of the buildings recorded is shown on figure 3. They comprise three parallel ranges, the central one (Building 1) the longest, with Building 2 to the east and Building 3 to the west. The modern (late 20th century) annex at upper ground floor level at the south end was not recorded, although it is built over historic structures partly visible below.

Building 1

7.2 The largest of the three buildings is 93.2m long and 17.9m wide, giving it an internal floor area of over 1500m^2, and seems to have been the principal workshop of the foundry for much of its life, though the 1888 map notes it as a "moulding shop". The majority of the structure may be very early 19th century (pre-dating the 1811 map on which it appears to have its present length), though there may have been substantial rebuilding later in that century. A short length of the west wall does appear to be of older masonry than the majority, and perhaps survives from the 1791 phase of the ironworks (**1**,**2**): it is characterised by blocks of sandstone and contains three arched entrances with large stone voussoirs, the south one with a basket arch (the only example at the site) (**3**,**4**), the northern two with segmental arches, of which the taller one may be a modification, as there has been some rebuilding around it (**5**-**7**). Two other

[17] English Heritage 2006 Understanding Historic Buildings: A guide to good recording practice

smaller openings, both altered, are located in the central part of the wall. There is an abrupt south end to this length of wall (**8**), and it is believed that this represents the position where it joined the blast furnaces, but at the north end is a more ragged joint indicating a different construction phase, beyond which the stonework is of similar character, but clearly not of the same date. As with the whole of Building 1, the walls have been heightened with brickwork in the early 20th century, by about 2 to 3m.

7.3 To the south of this early wall, the extent of the two former blast furnaces is believed to be indicated by a row of modern steel stanchions (**9**), which on map evidence was introduced between 1905 and 1932, when the furnaces were demolished and the building heightened and re-roofed; these stanchions account for a length of about 21m. Beyond these, the south end of the west wall is represented by a colonnade of seven tall cast iron columns with vertical flanges at their bases (**10**,**11**), probably dating from the early 19th century rather than the 1791 phase. They carry a long iron wall plate, on the outer face of which is a row of five iron brackets, likely to have held the tie beams or trusses for the original roof over the south end of Building 3 (**12**).

7.4 There are a number of features to be noted in the north end of Building 1's west wall, though externally the ground level has been raised by about 2m for much of this length, burying some of them. Two adjacent blocked openings with cast iron lintels are discernible, which may have been the entrances to external furnaces, to judge from the 1888 map (see figures 7 & 8) (**13**,**14**): they closely resemble one in the east side of the building, of which considerably more is visible (see below). To the north of these is a row of three columns representing a formerly wide opening (the 1888 map implies an adjoining lean-to stood here), with the stonework above them obviously having been rebuilt when this colonnade was inserted (**15**-**19**); it may have exploited the jamb of an existing doorway at the right-hand end. Another earlier entrance is indicated by part of an arch at the north end of this secondary, quadripartite opening (**20**,**21**).

7.5 In the south wall of Building 1 are four tall, altered, arched openings, the formerly exterior view of which is now impeded by the adjoining structures, which include the steel and concrete floor of the modern annex, now linking an earlier structure to the south which has battered brick footings, perhaps part of the coke ovens or warehouse shown on the 1888 map (**22**-**25**). The tall arched openings appear to have been windows, though three of them have been truncated by the creation of a wide opening below, containing two short columns (**26**-**29**), an intervention which on map evidence is likely to be 20th century. A small flue within the thickness of the wall occupies the south-east corner of the building here.

7.6 Much of the east side of Building 1 now faces into Building 2, but at the south end is a length of rendered wall, within which a number of historic openings survive: a tall, segmental arched doorway, and two similar but lower openings (**30**). The rectangular doorway at the south end is clearly modern in its present form and the 1888 map does not suggest that there was an historic opening here previously (**31**,**32**), but rather that there were adjoining structures externally. Because of render and later infilling, the two lower doorways are only clearly visible inside the building (**33**,**34**). There is also a vertical straight joint within this part of the wall, suggesting there has been some rebuilding at the south end. Next to it in the wall close to floor level is a recess lined with cast iron, which presumably had a function relating to the use of the building as a foundry (**35**).

7.7 The majority of Building 1's east side, believed to belong to the early 19th century phase of the ironworks, is characterised by a buttressed stone wall with an array of mid-height arched windows and various wide, tall doorways (most of them blocked), as well as more minor openings (**36**-**46**); the wall has been heightened with brickwork by some 2m, and a course of large stone blocks represents the former eaves level. There are subtle differences in the form of the doorways however: that at the north end has tie-stone jambs with upright blocks and a rebate to hold external doors, in which some of the hinges remain in situ (**47**-**49**), while the others have straight jambs with round edges, built from quoins with a distinctive pecked tooling and drafted margins, and are probably a later form, although there is no indication of any phase break within the wall itself.

7.8 The former opening to an external furnace is discernible in the middle of this wall, similar to the pair observed opposite, in the west side of Building 1 (see above): it is 2.6m wide and 1.6m high, with an iron lintel and jambs of refractory (**41**,**50**,**51**). It is not annotated on the 1888 plan so the furnace itself may already have been demolished by that date. Another feature within the inner face of the wall is a curved recess near the north end, though quite what this might have functioned as is enigmatic (**49**).

7.9 There is no access to the outer face of the north gable, but the inner face displays various former openings including three former doorways at ground level as well as some higher level openings, none of them of obvious noteworthiness (**52**); further air furnaces were located here in 1888 but there are no clear signs of these now.

7.10 Disregarding a 20th century division formed by steel uprights, the interior of Building 1 forms a single large space with a concrete floor on a single level, and open to the early to mid 20th century steel trussed roof (**53**-**55**), so that it is only

around the perimeter that evidence for the activities which took place within the building now manifests itself. This space, as described above, seems to have been the principal foundry at Low Moor for producing cast iron, both as pig and finished goods, between 1791 and the early 20th century.

Building 2

7.11 This brick-built shed of similar proportions to Building 1, but smaller in size (64.7m by 10.2m in plan), was built along its east side between 1905 and 1932, and seems to have provided additional production space for the foundry. There is no access to view the east or north outer elevations (**30**), but it is entirely brick-built and incorporates piers along the east side to support a travelling crane which once ran the full length of the building (**56**,**57**). The south gable is in more recent brickwork and incorporates one of the roof trusses, so the building must have been slightly longer at one time. It has four former wide doorways in the east side, under steel lintels (**58**), and that side may have been the principal means of access, with the doorway in the south end perhaps only being created when iron working ceased and the site was broken up into separate properties. Two small wall bearing boxes are present in the west side, which must have been related to powered processes, perhaps moving the travelling crane (**59**).

Building 3

7.12 Although now simply another long shed, measuring 58.1m long and some 13.7m wide, Building 3 is clearly of two distinct parts, of which the stone-built south end is the earlier, while the north end (of brick internally) was built between 1905 and 1932, to replace the demolished blast furnaces which formerly stood here. External ground level has been raised at the south end and the upper part of the gable there rebuilt, so that there are no diagnostic external features here (**23**), but internally there are three former rectangular windows, one of which has been made into a doorway now leading to a recess, with former access to the east (**60**,**61**).

7.13 The west side of the building displays a number of straight joints both externally and internally, some of them probably relating to the former “large chimney” which was recorded alongside the “moulding shop” in 1888. However there is a clear change just to the north of this, which marks the end of the building as it appears on maps prior to 1933, and which is distinguished internally by the change to brick (**62**-**64**). Other than the roof truss brackets noted above (**12**), there is no evidence for the internal form of this former workshop, nor anything to show how the space was used (**65**).

7.14 The 20th century part of Building 3 has ample fenestration on two storeys (**66**-**68**), and has an inner face lined for the most part with yellow refractory bricks, which it is presumed were salvaged from the demolished blast furnaces (**69**,**70**). They are machine cut and appear to be 19th century, and most unlikely to be late 18th century, so if these were the original furnaces it can be inferred that they were rebuilt or re-lined during the 19th century. The present roof over the whole of Building 3 dates from this late phase, but there is no indication of how this enlarged structure was used.

8 Discussion

8.1 Recording at the former ironworks, together with a new examination of documentary sources, appears to have increased significantly the understanding of the extent of surviving historic fabric, and the layout of the site in the 19th century, particularly as regards the former location of the pair of blast furnaces which survived into the early 20th century. Study of the three existing buildings shows that there has been continual modification at the site, as would be expected of a thriving industrial concern, which means that there is only piecemeal survival, but nonetheless sufficient to obtain a good interpretation, particularly of the main foundry building. This stood adjacent to two blast furnaces, and seems to have accommodated the full range of metal processes, whereby the pig iron produced as the first stage could be converted to cast iron, either as part of the manufacture of finished articles such as structural ironwork or machinery, or subsequently worked into wrought iron. Although there are isolated hints of how and where these secondary processes were undertaken, such as the openings to external furnaces along the foundry's perimeter, the use of the large space which the building provided was most likely intended to be flexible, and its principal role would have been as a large covered workshop in which the full range of metal working could be carried out. It is anticipated that further significant information will be added to an understanding of the site, during or following demolition.

Appendix 1: WYAAS Specification

SPECIFICATION FOR PHOTOGRAPHIC BUILDING RECORDING AT THE LOW MOOR IRON WORKS, NEW WORKS ROAD, LOW MOOR, BRADFORD (415600 428597)

Specification prepared at the request of the Mr Matthew Hall of Kilmartin Plowman & Partners Ltd. on behalf of City of Bradford Metropolitan District Council (Planning Permission 14/02246/FUL)

1 Summary

1.1 A building record (drawn and photographic survey) is required to identify and document items of archaeological and architectural interest prior to the demolition of this 19th century iron works building.

1.2 A specification detailing below ground archaeological remains will be produced separately by the WYAAS.

1.3 This specification for the necessary work has been prepared by the West Yorkshire Archaeology Advisory Service, the curators of the West Yorkshire Historic Environment Record.

NOTE: The requirements detailed in paragraphs 6.1.1 to 6.1.5 inclusive, 8.3 and 8.4 are to be met by the archaeological contractor **prior** to the commencement of fieldwork by completing and returning the attached form to the WY Archaeology Advisory Service.

2 Site Location and Description

2.1 Location

(Grid ref. **SE15600 28597**) The site is located to the north of New Works Road in the southern portion of theLow Moor industrial estate which was formerly the Low Moor Iron Works (West Yorkshire Historic Environment Record PRN 3794).

Save an area of grassy bank the site comprises yard surfaces (concrete and gravel) and former industrial buildings. The site is considerably higher along New Works Road (c.168m AOD) than the central yard and internal floor levels (c.164m). The western site boundary comprises a high retaining wall and industrial buildings form the northern and part of the eastern boundaries.

The site has a footprint of c 7000m2 of which 3135m2 comprises built development.

The site is located in the historic township of North Bierley.

2.2 Description

The WYAAS have not had the opportunity to consult records of the Low Moor Iron Company held by the West Yorkshire Archive Service's Bradford office which include maps and plans of the works in the 19th century. However, using published information the subject building can be established to lie to the south-east of the original 1790s blast furnaces and west of the company offices in an area occupied by casting houses and a forge. The 19th century Ordnance Survey maps show that a building here, with a similar footprint, was altered (or reconstructed) after 1850. A photograph of the "Old Foundry" reproduced in "A Record of the Origin and Progress of the Low Moor Iron Works From 1791 to 1906" probably shows the southern part of the subject building (http://www.an-englishmanshome.co.uk/low_moor_ironworks_1790.html).

The subject building comprises three long high spaces each with their own pitched roof. The central space which is 101m long and 15m wide constitutes the earliest building. It is stone built although its eves have been raised in brick. A modern roof with light weight steel trusses covers the entire floor area. In the southern and earliest part of the building the western stone wall has been removed and the roof is supported on two phases of arcading comprising massive cast ? iron columns.

Both internal and external faces of a potentially early eastern wall are masked: by render on the outside and a two storey modular office internally. However, a wide entrance, possibly a cart way, with a basket arched head survives in the west wall and is likely to be original and date to the late 18th or early 19th century. Tall round headed entrances are provided to the eastern and western walls of the later 19th century extension (mostly blocked up) and tall high level round-headed windows line the eastern wall and southern gable at regular intervals. All the windows are blocked, some from the “inside” others from the “outside”. Two blocked pedestrian sized entrances, again with round heads, were noted in the western wall.

Although austere in design the use of tie stones and margin dressing to decorate the jambs of the arched entrances establishes a link to local vernacular traditions.

The latter extensions appear to date to the 20th century although that to the west may in part be a little earlier. The eastern shed, which is entirely in brick and conceals the fenestration of the 19th century building post dates the demolition of the original iron work’s office range in the mid 20th century.

3 Planning Background

The site owners, through their agents Kilmartin Plowman & Partners Limited (Lodge House, 12 Town Street, Horsforth, Leeds, LS18 4RJ contact Mr Matthew Hall Tel: 0113 2390) have obtained planning consent (Planning Application No. 14/02246/FUL Condition 19) for the demolition of existing buildings and the construction of three industrial units. The WY Archaeology Advisory Service (as Bradford district’s archaeological advisor) has prepared this specification in order to allow the developers to meet the terms of an archaeological condition which has been placed on the consent (Condition 19).

4 Archaeological Interest

4.1 Historical Background

The application site lies in on southern side of the former Low Moor Iron Works and is a Class III Archaeological Area and a non-designated heritage asset (West Yorkshire Historic Environment Record PRN 3794). The grade II listed “office” which was originally built as a store and waggon shed lies c. 150m to the north. This is the only original building known to survive at the works (National Heritage List for England No. 1132938). The subject buildings comprise, in part, the original works foundry established in 1791.

The Low Moor Iron Works commenced production in August 1791 and closed in 1928. Amongst documentary material relating to the site is a map of 1811 by George Leather Jr. which shows the iron works’ extensive mineral holdings, the network of waggon-ways used to carry coal and iron ore to the Low Moor site; various ore and coking kilns; brick kilns; the dam; cottages along Long Row; casting house; forge and offices. The application site falls on parts of the site known to contain later 19th century coking ovens, part of the office and stores range and buildings identified as a casting house and forge.

During the late 18th and 19th century the Low Moor Iron Works was arguably the foremost producer of cast and wrought iron in the county and a byword for excellence. The iron rivets produced by the company were recognised as the bench mark while many engineered products from cannon and steam engines to more workaday components were produced in

the early – mid-19th century. Low Moor's reputation was based on superior raw materials and the application of strict quality control to their castings and other products.

The form of the main building within the development area suggest a foundry role and, as noted above, can be dated in part to the late 18th and early 19th century in part although the majority of the structure is of later 19th century date.

Earlier structures may survive as below ground remains and a programme of archaeological observation and recording during ground works will be carried out under a separate specification.

The present buildings which include parts of the original foundry should be recorded prior to demolition as they add to our understanding of the development and operation of the Low Moor Iron Works.

4.2 Impact of proposed development
All the standing buldings will be demolished and the site's levels altered to provide three industrial units. Important surviving remains of the original Low Moor Iron Works foundry and later buildings will be demolished.

5 Aims of the Project
5.1 The first aim of the proposed work is to identify and objectively record by means of photographs and annotated measured drawings any significant evidence for the original and subsequent historical form and functions of the buildings, and to place this record in the public domain by depositing it with the WY Historic Environment Record (Registry of Deeds, Newstead Road, Wakefield WF1 2DE).

5.2 The second aim of the proposed work is to analyse and interpret the buildings as an integrated system intended to perform a specialised function. The archaeologist on site should give particular attention to reconstructing as far as possible the functional arrangements and division of the buildings. The roles of historical plan form, technical layout and process flow should all be considered in this process of interpretation.

6 Recording Methodology
6.1 General Instructions
6.1.1 Health and Safety
The archaeologist on site will naturally operate with due regard for Health and Safety regulations. Prior to the commencement of any work on site (and preferably prior to submission of the tender) the archaeological contractor may wish to carry out a Risk Assessment in accordance with the Health and Safety at Work Regulations. The archaeological contractor should identify any contaminants which constitute potential Health and Safety hazards (e.g. chemical drums) and make arrangements with the client for decontamination/making safe as necessary and appropriate. The WY Archaeology Advisory Service and its officers cannot be held responsible for any accidents or injuries which may occur to outside contractors engaged to undertake this survey while attempting to conform to this specification.

6.1.2 Confirmation of adherence to specification
Prior to the commencement of any work, the archaeological contractor must confirm in writing adherence to this specification (using the attached form), or state in writing (with reasons) any specific proposals to vary the specification. Should the contractor wish to vary the specification, then written confirmation of the agreement of the WY Archaeology Advisory Service to any variations is required prior to work commencing. Unauthorised variations are made at the sole risk of the contractor (see para. 8.3, below). Modifications

presented in the form of a re-written project brief will not be considered by the West Yorkshire Archaeology Advisory Service.

6.1.3 Confirmation of timetable and contractor's qualifications
Prior to the commencement of *any work*, the archaeological contractor must provide WYAAS in writing with:

- a projected timetable for the site work
- details of project staff structure and numbers
- names and *CVs* of key project members (the project manager, site supervisor, any proposed specialists, sub-contractors *etc.*)
- details of any specialist sub-contractors

All project staff provided by the archaeological contractor must be suitably qualified and experienced for their roles. In particular, staff involved in building recording should have proven expertise in the recording and analysis of industrial buildings. The timetable should be adequate to allow the work to be undertaken to the appropriate professional standard, subject to the ultimate judgement of WYAAS.

6.1.4 Site preparation
Prior to the commencement of archaeological recording work on site, the archaeological contractor should identify all removable modern material (including 20th-century partitions, dry-boarding, suspended ceilings etc.) which may significantly obscure features requiring an archaeological record, and should make arrangements with the developer for its removal. In particular the modular offices in the southern part of the original building should be removed to allow an examination of the inner face of the building to be made (render obscures the outer face). As part of this process, the contractor should also formally identify to the developer any material which needs to be retained for archaeological recording, where there is the potential for confusion with modern material during stripping-out. It is not the intention of this specification that large-scale removal of material of this type should take place with the archaeological contractor's manpower or at that contractor's expense. If necessary, however, this soft-strip should be carried out under archaeological supervision.

6.1.5 Documentary research
Prior to the commencement of work on site, the archaeological contractor should undertake a rapid map-regression exercise based on the readily-available map and photographic evidence held by the relevant Local History Library (Local Studies Library Old Central Library Princes Way Bradford. BD1 1NN Tel.: 01274 433688) and the West Yorkshire Archive Service Bradford office (at the above address Telephone: +44 0113 393 9785 [sic] Email: bradford@wyjs.org.uk), and a rapid examination of the available historic records of the company (e.g. plans of the works such as BC87091 - LOW MOOR IRON WORKS, PLAN (91D87)), 19th- and 20th-century Trades and Postal directories, the appropriate census returns and all other available primary and relevant secondary sources. This work is intended to inform the archaeological recording by providing background information with regard to function and phasing. Please note that this exercise is not intended to be a formal desk-based assessment, and should not represent a disproportionate percentage of the time allowed for the project overall.

A file on this site is held in the West Yorkshire Historic Environment Record (Registry of Deeds, Newstead Road, Wakefield WF1 2QP ☏ 01924 306797 wyher@wyjs.org.uk) which contains articles on the history and development of the Low Moor Iron Works by Charles Dodsworth and Gary Firth). Please note that the HER makes a charge for commercial consultations.

6.1.6 Use of existing plans

It is not currently known if there are plans of the buildings as existing. If plans do exist and they are appropriate, these may be used as the basis for the drawn record and for any annotation relative both to the historic and photographic record. Additional information relevant to the historic record should be indicated on the plans, which shall be re-drawn as necessary. It is the responsibility of the archaeological contractor to check the accuracy of these drawings and to make any necessary adjustments or corrections. Contractors are therefore advised to determine prior to the submission of tender whether major re-survey/re-drawing will be necessary. For this purpose, the WY Archaeology Advisory Service would suggest that the tendering contractor check a small number of randomly selected measurements across the site, e.g. a few long face measurements, the position and size of a selection of doors and windows, and a random series of internal diagonals (it is accepted that the contracting archaeologist will not be able to identify isolated and unpredictable errors by using this method). It is the archaeological contractors' responsibility to obtain the appropriate copyright permissions for any original material employed as a basis for further work.

6.2 Sequence of recording

6.2.1 Initial record

The buildings should be recorded as extant, with due provision made for the removal of any debris or modern material which may obscure fabric or features requiring an archaeological record (para 6.1.4 above).

6.3 Written Record

The archaeologist on site should carefully examine all parts of each building prior to the commencement of the drawn and photographic recording, in order to identify all features relevant to its original use and to obtain an overview of the development of the building and of the site as a whole. As part of this exercise, the archaeologist on site should produce written observations (e.g. on phasing; on building function) sufficient to permit the preparation of a report on the structure. This process should include the completion of a Room Data Sheet or similar structured recording pro-forma[18] for each room or discrete internal space within the volume of the structure. The crucial requirement is that each room should be examined individually, that the results of that examination should be noted in a systematic fashion, and that these objective observations should be used to inform an analytical interpretation of the overall development and operation of the site.

6.4 Drawn Record

6.4.1 Drawings required

Given the much altered state of the foundry building a phased floor plan should be prepared.

Drawings should be made at an appropriate scale (not smaller than 1:100 for plans; not smaller than 1:50 for sections). The structures should be recorded as existing, but a clear distinction should be made on the final drawings between surviving as-built features and all material introduced in the structure during the late 20th-century.

6.4.2 Provision for Additional Drawings

6.4.2a The recording requirements outlined above are based on a brief inspection of the site by the WY Archaeology Advisory Service. However, detailed examination and analysis of the site by the archaeological contractor may reveal features which merit detailed recording

[18] The WY Archaeology Advisory Service would recommend the employment of the attached pro-forma, but will consider any suitable alternative which the archaeological contractor may wish to submit (Note that agreement for the employment of an alternative schema must be obtained in writing from the WY Archaeology Advisory Service prior to the commencement of work on site).

beyond what has been specifically required. In addition to what is requisite to complete the work specified above, the archaeological contractor should tender for a contingency period of one days recording on site (with one days drawing-up time off site – two days in total) in order that features so identified may be adequately recorded. This contingency should be clearly and separately identified in any tender document.

6.4.2b If features requiring additional drawing are identified during the course of work on site, the WY Archaeology Advisory Service should be contacted as soon as possible, and should be provided in writing with a schedule of proposed additional work. A site visit will then be arranged by the WYAAS to examine the features in question and to assess the need to apply the contingency (this visit will usually be combined with a routine monitoring visit). Implementation of the contingency will be at the decision of the West Yorkshire Archaeology Advisory Service, which will be issued in writing, if necessary in retrospect after site discussions.

6.4.3 Scope of record

All features of archaeological and architectural interest identified during the process of appraisal should be incorporated into, and clearly identified in, the final drawn record. Typically, items of interest would include:

- Materials employed in the construction of the foundry building
- Original and later fenestration
- Original access
- Any evidence of original fixed plant or machine bases
- Any evidence for the transmission of power.

but this list should not be treated as exhaustive. The archaeologist on site should also identify and note:

- any significant changes in construction material – this is intended to include significant changes in stone/brick type and size
- any blocked, altered or introduced openings
- evidence for phasing, and for historical additions or alterations to the building.

6.4.4 Dimensional accuracy

Dimensional accuracy should accord with the normal requirements of the English Heritage Architecture and Survey Branch (at 1:20, measurements should be accurate to at least 10mm; at 1:50, to at least 20mm; at 1:100, to at least 50mm.

6.4.5 Drawing method

The survey may be executed either by hand or by means of reflectorless EDM as appropriate. In accordance with national guidelines[19], drawings executed on site should be made either on polyester-based film (minimum thickness 150 microns) with polymer-bonded leads of an appropriate thickness and density, or on acid-free or rag paper. If finished drawings are generated by means of CAD or a similar proven graphics package, recorders should ensure that the software employed is sufficiently advanced to provide different line-weight (point-size); this feature should then be used to articulate the depth of the drawings. CAD repeats or cloning of features should **not** be used. What is required as an end product of the survey is a well-modelled and clear drawing; ambiguous flat-line drawings should be avoided. Drawing conventions should conform to English Heritage guidelines as laid out in English Heritage 2006, *Understanding Historic Buildings – a guide to good recording*

[19] English Heritage 2006, *Understanding Historic Buildings – a guide to good recording practice*, 7.1.1ff

practice, and the WYAAS would recommend that the CAD layering protocol detailed in the same volume (8.3, Table 2) should be adhered to.

6.5 Photographic Record

6.5.1 External photographs

An external photographic record should be made of all elevations of all buildings, from vantage points as nearly parallel to the elevation being photographed as is possible within the constraints of the site. The contractor should ensure that all visible elements of each elevation are recorded photographically; this may require photographs from a number of vantage points. A general external photographic record should also be made which includes a number of oblique general views of the buildings from all sides, showing them and the complex as a whole in their setting. In addition, a 35mm general colour-slide survey of the buildings should also be provided (using a variety of wide-angle, medium and long-distance lenses). See 6.5.6 covering digital photography as an alternative to slide photography below. While it is not necessary to duplicate every black-and-white shot, the colour record should be sufficiently comprehensive to provide a good picture of the form and general appearance of the complex and of the individual structures. The colour slide record should include some internal shots.

6.5.2 Internal photographs

A general internal photographic record should be made of the buildings. General views should be taken of *each room* or discrete internal space from a sufficient number of vantage points to adequately record the form, general appearance and manner of construction of each area photographed. In areas which are wholly modern in appearance, character and materials, a single shot to record current appearance will suffice.

6.5.3 Detail photographs

In addition, detailed record shots should be made of all individual elements noted in section 6.4.3 above. Elements for which multiple examples exist (e.g. each type of roof truss, column or window frame) may be recorded by means of a single representative illustration. **N.B.** Detail photographs must be taken at medium-to-close range and be framed in such a way as to ensure that the element being photographed clearly constitutes the principal feature of the photograph.

6.5.4 Equipment

General photographs should be taken with a Large Format camera (5” x 4” or 10” x 8”) using a monorail tripod, or with a Medium Format camera which has perspective control, using a tripod. The contractor must have proven expertise in this type of work. Any detail photographs of structural elements should if possible be taken with a camera with perspective control. Other detail photographs may be taken with either a Medium Format or a 35mm camera. All detail photographs must contain a graduated photographic scale of appropriate dimensions (measuring tapes and surveying staffs are not considered to be acceptable scales in this context). A 2-metre ranging-rod, discretely positioned, should be included in a selection of general shots, sufficient to independently establish the scale of all elements of the building and its structure.

6.5.5 Film stock

All record photographs to be black and white, using conventional silver-based film only, such as Ilford FP4 or HP5, or Delta 400 Pro (a recent replacement for HP5 in certain film sizes such as 220). Dye-based (chromogenic) films such as Ilford XP2 and Kodak T40CN are unacceptable due to poor archiving qualities.

6.5.6 Digital photography

As an alternative to our requirement for colour slide photography, good quality digital photography may be supplied as an alternative, using cameras with a minimum resolution of

8 megapixels. Note that conventional black and white print photography is still required and constitutes the permanent record. Digital images will only be acceptable as an alternative to colour slide photography if each image is supplied in three file formats (as a RAW data file, a DNG file and as a JPEG file). The contractor must include metadata embedded in the DNG file. The metadata must include the following: the commonly used name for the site being photographed, the relevant centred OS grid coordinates for the site to at least six figures, the relevant township name, the date of photograph, the subject of the photograph, the direction of shot and the name of the organisation taking the photograph. Images are to be supplied to WYAAS on gold CDs by the archaeological contractor accompanying the hard copy of the report.

6.5.7 Printing

6.5.6a Record photographs should be printed at a minimum of 5" x 7" (for domestic. In addition, a selection of photographs intended to illustrate structural detail should be printed at 10" x 8" (it is expected that there is likely to be a need for 4 such prints of the 19th century foundry building). Bracketed shots of identical viewpoints need not be reproduced, but all viewpoints must be represented within the report.

6.5.6b Prints may be executed digitally from scanned versions of the film negatives, and may be manipulated to improve print quality (but **not** in a manner which alters detail or perspective). All digital prints must be made on paper and with inks which are certified against fading or other deterioration for a period of 75 years or more when used in combination. If digital printing is employed, the contractor must supply details of the paper/inks used in writing to the WY Archaeology Advisory Service, with supporting documentation indicating their archival stability/durability. Written confirmation that the materials are acceptable must have been received from the WYAAS prior to the commencement of work on site.

6.5.7 Documentation

A photographic register detailing (as a minimum) location, direction and subject of shot must accompany the photographic record; a separate photographic register should be supplied for any colour slides or for colour digital photographs. The position and direction of each photograph and slide should be noted on a copy of the building plan, which should also be marked with a north pointer; separate plans should be annotated for each floor of each building

7. Post-Recording Work and Report Preparation

7.1 After completion of fieldwork

Prior to the commencement of any other work on site, the archaeological contractor should arrange a meeting at the offices of the WY Archaeology Advisory Service to present a draft of the 1st- stage drawn record (fully labelled and at the scale specified above), a photo-location plan, and photographic contact prints adequately referenced to this plan (material supplied will be returned to the contractor). Copies of the slides or digital photographs should also be brought in for checking. **N.B**. if full-sized prints or digital versions of contact sheets are supplied for this purpose, they must be accompanied by a sample of the processed negatives. If appropriate, the WY Archaeology Advisory Service will then confirm to Bradford District Planning Services that fieldwork has been satisfactorily completed and that other work on site may commence (although discharge of the archaeological condition will not be recommended until a completed copy of the full report and photographic record has been received and approved by the West Yorkshire Archaeology Advisory Service). Please note that as of the 1st April 2011, the WYAAS will charge the archaeological contractor a fee for each fieldwork verification meeting.

7.2 Report Preparation

7.2.1 Report format and content

A written report should be produced. This should include:

- an executive summary including dates of fieldwork, name of commissioning body, and a brief summary of the results including details of any significant finds
- an introduction outlining the reasons for the survey
- a brief architectural description of the buildings presented in a logical manner (as a walk around and through the buildings, starting with setting, then progressing to all sides of the structure in sequence, and finally to the interior from the ground floor up)
- a discussion placing the foundry and later buildings in their local, historical and technological contexts, describing and analysing the development of individual structures and of the complex as a whole. This analysis should consider the foundry as part of an integrated system intended to perform a specialised function, with particular attention being given to historical plan form, technical layout and process flow.

The architectural description should be fully cross-referenced to the drawn and photographic record, sufficient to illustrate the major features of the site and the major points raised. It is not envisaged that the report is likely to be published, but it should be produced with sufficient care and attention to detail to be of academic use to future researchers. A copy of this specification and a quantified index to the field archive should also be bound into the back of the report. The cover sheet should include a centred eight-figure OS grid reference and the name of the township in which the site is located (North Bierley).

7.2.2 Report Illustrations

Illustrations should include:

- a location map at a scale sufficient to allow clear identification of the foundry in relation to other buildings in the immediate area
- an overall keyed plan of the site showing the surviving buildings in relation to each other and to the buildings on site which have been demolished
- any relevant historic map editions, with the position and extent of the site clearly indicated
- a complete set of site drawings completed to publication standard, at the scale stipulated in Para. 6.4.1 above (unless otherwise agreed in writing by the West Yorkshire Archaeology Advisory Service)
- a complete set of site drawings at a legible scale, on which position and direction of each photograph has been noted
- any additional illustrations pertinent to the site
- a complete set of good-quality laser copies of all photographs (reproduced at a minimum of 6” by 4”).

The latter should be bound into the report in the same logical sequence employed in the architectural description (Para. 7.2.1 above) and should be appropriately labelled (numbered, and captioned in full). When captioning, contractors should identify the individual photographs by means of a running sequence of numbers (e.g. Plate no. 1; Plate no. 2), and it is this numbering system which should be used in cross-referencing throughout the report and on the photographic plans. However, the relevant original film and frame number should be included in brackets at the end of each caption.

7.3 Report deposition

7.3.1 General considerations

7.3.1a The report should be supplied to the client and identical copies supplied to the West Yorkshire HER, the WY Archive Service and to the Oasis project. A recommendation from WYAAS for discharge of the archaeological condition is dependant upon receipt by WYAAS

of a satisfactory report which has been prepared in accordance with this specification. Any comments made by WYAAS in response to the submission of an unsatisfactory report will be taken into account and will result in the reissue of a suitably edited report to all parties, within a timescale which has been agreed with WYAAS.

7.3.1bThe report copy supplied to the West Yorkshire HER should include a complete set of photographic prints (see Para. 7.3.2 below). A copy of the report in .pdf format should also be supplied on gold CD. The finished report should be supplied within eight weeks of completion of all fieldwork, unless otherwise agreed with the West Yorkshire Archaeology Advisory Service. The information content of the report will become publicly accessible once deposited with the Advisory Service, unless confidentiality is explicitly requested, in which case it will become publicly accessible six months after deposit.

7.3.1c **Copyright** - Please note that by depositing this report, the contractor gives permission for the material presented within the document to be used by the WYAAS, in perpetuity, although The Contractor retains the right to be identified as the author of all project documentation and reports as specified in the *Copyright, Designs and Patents Act* 1988 (chapter IV, section 79). The permission will allow the WYAAS to reproduce material, including for commercial use by third parties, with the copyright owner suitably acknowledged.

7.3.1.d The West Yorkshire HER supports the Online Access to Index of Archaeological Investigations (OASIS) project. The overall aim of the OASIS project is to provide an online index to the mass of archaeological grey literature that has been produced as a result of the advent of large-scale developer funded fieldwork. The archaeological contractor must therefore complete the online OASIS form at http://ads.ahds.ac.uk/project/oasis/. Contractors are advised to contact the West Yorkshire HER officer prior to completing the form. Once a report has become a public document by submission to or incorporation into the HER, the West Yorkshire HER may place the information on a web-site. Please ensure that you and your client agree to this procedure in writing as part of the process of submitting the report to the case officer at the West Yorkshire HER.

7.3.1e With the permission of the developer, the archaeological contractor are encouraged to consider the deposition of a copy of the report for this site with the appropriate Local History Library.

7.3.1f A brief note for 'Post-medieval Fieldwork in England and Northern Ireland' should be submitted to the Journal of the Society for Post Medieval Archaeology.

7.3.2 Deposition with WY Archaeology Advisory Service (West Yorkshire Historic Environment Record)

The report copy supplied to the WY Archaeology Advisory Service should also be accompanied by both the photographic negatives and a complete set of labelled photographic prints (mounted in archivally stable KENRO display pockets or similar, and arranged in such a way that labelling is readily visible) bound in a form which will fit readily into a standard filing cabinet suspension file (not using hard-backed ring-binders). Labelling should be on the *back* of the print in pencil giving film and frame number only and on applied printed labels on the front of the appropriate photographic sleeve which should include:

- film and frame number
- date recorded and photographer's name
- name and address of building
- national grid reference
- specific subject of photograph.

Negatives should be supplied in archivally stable mounts (KENRO display pockets or similar), and each page of negatives should be clearly labelled with the following:

- Township name
- Site name and address
- Date of photographs (month/year)
- Name of archaeological contractor
- Film number

Colour slides should be mounted, and the mounts suitably marked with – 'North Bierley' (the Township name) with 'Low Moor Iron Works' under, at the top of the slide; grid reference at the bottom; date of photograph at the right hand side of the mount; subject of photograph at the left hand side of the mount. Subject labelling may take the form of a numbered reference to the relevant photographic register. The slides should be supplied to the WY Archaeology Advisory Service in an appropriate, archivally stable slide hanger (for storage in a filing cabinet).

7.4 Summary for publication
The attached summary sheet should be completed and submitted to the WY Archaeology Advisory Service for inclusion in the summary of archaeological work in West Yorkshire published on the WYAAS website. During fieldwork monitoring visits WYAAS officers will take digital photographs which may be published on the Advisory Service's website as part of an ongoing strategy to enable public access to information about current fieldwork in the county.

7.5 Preparation and deposition of the archive
After the completion of all recording and post-recording work, a fully indexed field archive should be compiled consisting of all primary written documents and drawings, and a set of suitably labelled photographic contact sheets (only). Standards for archive compilation and transfer should conform to those outlined in *Archaeological Archives – a guide to best practice in creation, compilation, transfer and curation* (Archaeological Archives Forum, 2007). The field archive should be deposited with the Bradford District Office of the West Yorkshire Archive Service (Bradford Archives WYAS, Bradford, Prince's Way, Bradford BD1 1NN Telephone: 0113 393 9785 Email: bradford@wyjs.org.uk), and should be accompanied by a copy of the full report as detailed above. Deposition of the archive should be confirmed in writing to the WY Archaeology Advisory Service.

8 General considerations
8.1 Technical queries
Any technical queries arising from this specification should be addressed to the WY Archaeology Advisory Service without delay.

8.2 Authorised alterations to specification by contractor
It should be noted that this specification is based upon records available in the West Yorkshire Historic Environment Record and on a brief examination of the site by the West Yorkshire Archaeology Advisory Service. Archaeological contractors submitting tenders should carry out an inspection of the site prior to submission. If, on first visiting the site or at any time during the course of the recording exercise, it appears in the archaeologist's professional judgement that

> i) a part or the whole of the site is not amenable to recording as detailed above, and/or

ii) an alternative approach may be more appropriate or likely to produce more informative results, and/or
iii) any features which should be recorded, as having a bearing on the interpretation of the structure, have been omitted from the specification,

then it is expected that the archaeologist will contact the WY Archaeology Advisory Service as a matter of urgency. If contractors have not yet been appointed, any variations which the WY Archaeology Advisory Service considers to be justifiable on archaeological grounds will be incorporated into a revised specification, which will then be re-issued to the developer for redistribution to the tendering contractors. If an appointment has already been made and site work is ongoing, the WY Archaeology Advisory Service will resolve the matter in liaison with the developer and the Local Planning Authority.

8.3 Unauthorised alterations to specification by contractor

It is the archaeological contractor's responsibility to ensure that they have obtained the West Yorkshire Archaeology Advisory Service's consent in writing to any variation of the specification prior to the commencement of on-site work or (where applicable) prior to the finalisation of the tender. Unauthorised variations may result in the WY Archaeology Advisory Service being unable to recommend discharge of the archaeological recording condition to the Local Planning Authority and are made solely at the risk of the contractor.

8.4 Monitoring

This exercise will be monitored as necessary and practicable by the WY Archaeology Advisory Service in its role as 'curator' of the county's archaeology. The Advisory Service should receive at least one week's notice in writing of the intention to start fieldwork. A copy of the contractor's Risk Assessment should accompany this notification.

8.5 Valid period of specification

This specification is valid for a period of one year from date of issue. After that time it may need to be revised to take into account new discoveries, changes in policy or the introduction of new working practices or techniques.

Any queries relating to this specification should be addressed to the WY Archaeology Advisory Service without delay.

West Yorkshire Archaeology Advisory Service
David Hunter **August 2015**

West Yorkshire Archaeology Advisory Service
Registry of Deeds
Newstead Road
Wakefield
WF1 2DE

Telephone: (01924) 306798.
Fax: (01924) 306810
E-mail: dhunter@wyjs.org.uk

Appendix 2: List of digital photographs

CD of photographs (in JPG, NEF & DNG formats) deposited with the West Yorkshire Historic Environment Record

Number	Subject
d01	Building 1: external view of phase 1 wall in west side
d02	Building 1: external view of phase 1 wall in west side
d03	Building 1: internal view of phase 1 wall in west side
d04	Building 1: internal view of phase 1 wall in west side with later wall to right
d05	Building 1: internal view of west side, showing former position of blast furnaces (steel stanchions) and columns
d06	Building 1: external view of west wall, north end, with straight joint and inserted colonnade
d07	Building 1: internal view of west wall, showing inserted colonnade
d08	Buildings 1 and 3, from the south-west, with modern annex at right
d09	Building 1: interior view of south-west corner
d10	Building 1 (left) and Building 2 (right), from the south-east
d11	Building 1: external view of east wall, south end
d12	Building 1: external view of east wall, now within Building 2
d13	Building 1: internal view of east wall, from the south-west
d15	Building 1: internal view of north end
d14	Building 1: internal view of east wall, from the south-west
d16	Building 3: internal view of south end
d17	Building 3: external view of west wall, south end
d18	Building 3: external view of west wall, north end
d19	Building 3: external view of west wall, north end
d20	Building 3: external view of north wall

Appendix 3: Contents of the project archive

To be deposited with the Bradford office of the West Yorkshire Archive Service

1 file, containing:

- a copy of the report
- photographic contact sheets (5 no)
- site notes including “room data sheets”

Complete list of black and white photographs taken, in film order

Photo	Film	Frame	Subject
30	1	1	Building 1 (left) and Building 2 (right), from the south-east
31	1	2	Building 1: external view of east wall, south end
32	1	3	Building 1: external view of east wall, south end
23	1	5	Buildings 1 and 3, from the south-west, with modern annex at right
62	1	6	Building 3: external view of west wall, south end
67	1	7	Building 3: external view of west wall, north end
66	1	8	Building 3: external view of west wall, north end
68	1	10	Building 3: external view of north wall
15	1	11	Building 1: external view of west wall, north end, with straight joint and inserted colonnade
7	1	12	Building 1: external view of arched doorway in phase 1 wall in west side, with later phase to left
13	1	13	Building 1: external view of west wall with tops of furnace openings at ground level
16	1	14	Building 1: external view of west wall, showing inserted colonnade
17	1	15	Building 1: external view of west wall, showing inserted colonnade
20	1	17	Building 1: external view of west wall, north end, showing arch slighted by inserted colonnade
38	1	18	Building 1: external view of east wall, now within Building 2, with mid-height arched windows
36	2	1	Building 1: external view of east wall, now within Building 2
40	2	2	Building 1: external view of east wall, now within Building 2
41	2	4	Building 1: external view of east wall, now within Building 2
50	2	5	Building 1: external detail of refractory jamb to blocked opening to former furnace, east wall
39	2	9	Building 1: external view of east wall, now within Building 2, with blocked, tall arched doorway
42	2	10	Building 1: external view of east wall, north end, now within Building 2
47	2	11	Building 1: external view of doorway at north end of east wall
37	2	12	Building 1: external view of east wall, now within Building 2
59	2	14	Building 2: wall bearing box in west wall
48	2	16	Building 1: detail of external jamb of doorway at north end of east wall
56	2	17	Building 2: interior, from the south-west
58	2	18	Building 2: internal view of east wall, from the south-west
57	3	1	Building 2: view up towards roof, from the south
26	3	2	Building 1: interior view of south wall
28	3	4	Building 1: interior view of south-east corner, with blocked window and corner flue
29	3	5	Building 1: interior view of south wall, showing inserted opening with column
10	3	6	Building 1: internal view of large colonnade, west side

27	3	7	Building 1: interior view of south-west corner
9	3	8	Building 1: internal view of west side, showing former position of blast furnaces (steel stanchions) and columns
43	3	10	Building 1: internal view of east wall, from the south-west
33	3	11	Building 1: internal view of east wall, south end
34	3	12	Building 1: interior view of one of two arched former openings in east wall, south end
35	3	13	Building 1: detail of iron “socket” in east wall, next to straight joint
24	3	14	Building 1: enclosed area at ground floor, by south wall, from the west
25	3	16	Building 1: enclosed area at ground floor, by south wall, from the east (former coke ovens to left?)
22	3	17	Building 1: external view of south wall, showing arched former window and floor of modern building above
11	3	18	Building 1: detail of lower part of column, west side
49	4	1	Building 1: internal view of doorway at north end of east wall
46	4	2	Building 1: internal view of east wall
51	4	3	Building 1: internal view of blocked opening to former furnace, east wall
45	4	5	Building 1: internal view of east wall
44	4	6	Building 1: internal view of east wall
54	4	7	Building 1: internal view of east wall, from the south-west
8	4	8	Building 1: internal view of phase 1 wall in west side, with former position of blast furnaces to left
2	4	9	Building 1: internal view of phase 1 wall in west side
14	4	11	Building 1: internal view of west wall, with former openings to furnaces
18	4	12	Building 1: internal view of west wall, showing inserted colonnade
21	4	13	Building 1: internal view of west wall, north end, showing arch slighted by inserted colonnade
52	4	14	Building 1: internal view of north end
53	4	15	Building 1: internal view of east wall, from the north-west
55	4	17	Building 1: internal view of west wall, from the north-east
19	4	18	Building 1: internal view of west wall, showing inserted colonnade
6	5	1	Building 1: internal view of phase 1 wall in west side
4	5	2	Doorway with basket arch in phase 1 wall, internal view
3	5	4	Doorway with basket arch in phase 1 wall, external view
1	5	5	Building 1: external view of phase 1 wall in west side
5	5	6	Building 1: external view of phase 1 wall in west side
70	5	7	Building 3: interior at north end
69	5	8	Building 3: internal view of west wall, north end
64	5	10	Building 3: interior at south end
63	5	11	Building 3: internal view of west wall, south end
60	5	12	Building 3: internal view of south end
61	5	13	Building 3: internal view of south-west corner
12	5	14	Building 1/3: detail of bracket for roof truss over Building 3
65	5	16	Building 3: interior, from the south-east

approximate position of blast furnaces in 1888

modern buttress

site of chimney, 1888

sj

stone

brick

blocked window

blocked window

roof trusses

building 3

high level brackets – for roof trusses?

modern stanchions

modern stanchions

low arched doorway

low arched doorway

low arched opening

ragged joint

blocked openings to furnaces

straight joint over

inserted colonnade

low arched opening (blocked)

blocked doorway

blocked doorway

Phase boundary

former coke ovens?

upper level window

inserted colonnade

upper level window

modern annex at upper level

phase boundary

upper level window

roof trusses

building 1

blocked window

flue

iron socket

sj

tall modern doorway

low arched doorway

low arched doorway

tall arched doorway

recess

tall arched doorway

upper level window

upper level window

blocked opening below windows

upper level window

upper level window

upper level window

upper level window

upper level window

sj

upper level window

blocked opening to furnace

upper level window

tall arched doorway

blocked doorway

recess

recess

upper level window

tall arched doorway

sj

no access to rear

building 2

building shortened

roof trusses

upper level window

upper level window

upper level window

upper level window

upper level window

upper level window

upper level window

upper level window

upper level window

blocked doorway

blocked doorway

blocked doorway

blocked doorway

blocked doorway

no access to rear

50m

KEY

sj straight joint

elb wall box for line shaft bearing

blocking/infill

column

PHASE HATCHING

1791 (tentative)

Early 19th century

1905 – 1932

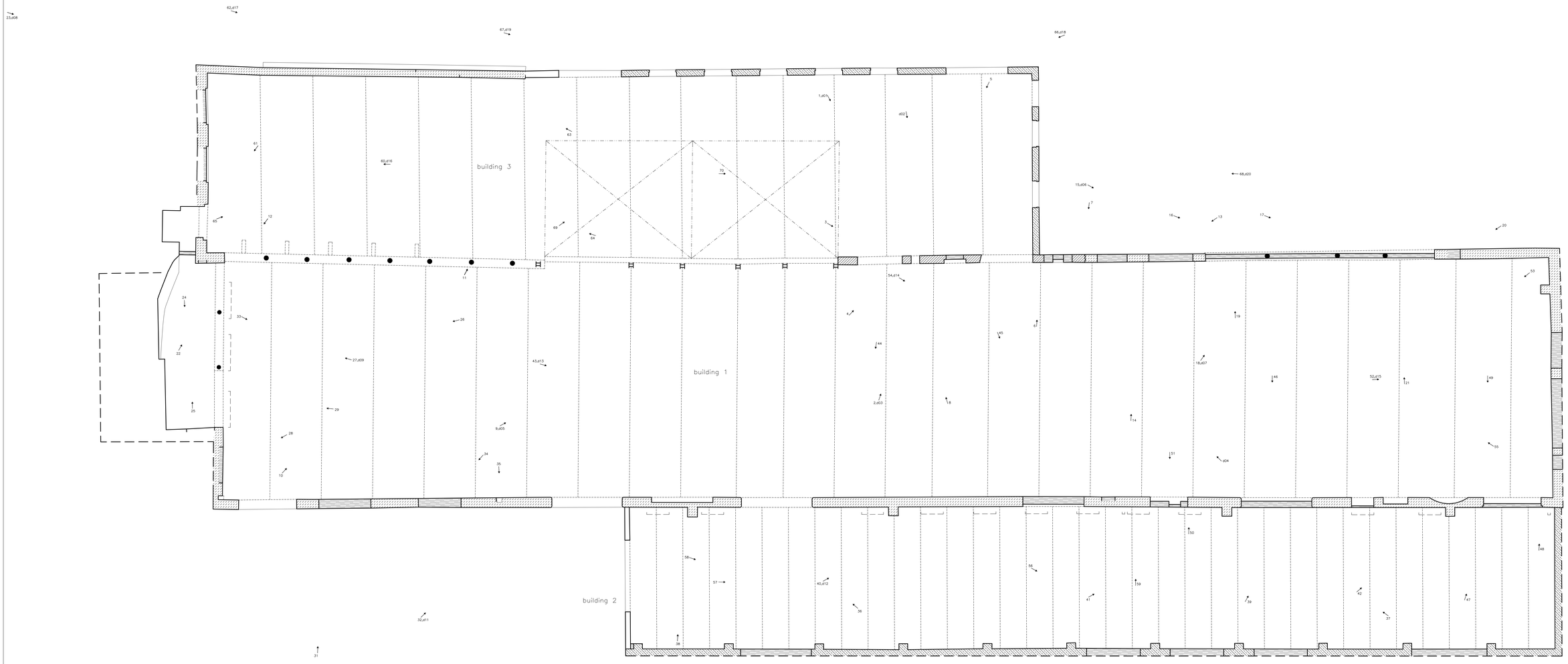
LOW MOOR IRONWORKS
ON LAND AT LONG ROW
NEW WORKS ROAD, BRADFORD
WEST YORKSHIRE (SE 15600 28597):
HISTORIC BUILDINGS RECORD

FIGURE 15: GROUND FLOOR PLAN

SCALE: 1:100 (at A0)

DATE OF SURVEY: SEPTEMBER 2015

STEPHEN HAIGH
Buildings Archaeologist



1: photograph direction and number (black and white)
d01: photograph direction and number (digital)

LOW MOOR IRONWORKS
ON LAND AT LONG ROW
NEW WORKS ROAD, BRADFORD
WEST YORKSHIRE (SE 15600 28597):
HISTORIC BUILDINGS RECORD

FIGURE 16: GROUND FLOOR PLAN
WITH KEY TO PHOTOGRAPHS

SCALE: 1:100 (at A0)

DATE OF SURVEY: SEPTEMBER 2015

STEPHEN HAIGH
Buildings Archaeologist