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Elsecar Beam Engine Boiler House

Archaeological investigation

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Archaeological Investigation at the Elsecar Beam Engine Boiler House, South Yorkshire

ArcHeritage Campo House, 54 Campo Lane, Sheffield, S1 2EG

Phone: +44 (0)114 2728884 Fax: +44 (0)114 3279793
archeritage@yorkat.co.uk www.archeritage.co.uk

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NON-TECHNICAL SUMMARY

Archaeological investigations were undertaken at the site of the boiler house associated with the Scheduled Elsecar Newcomen-type atmospheric beam engine in association with conservation work at the site. The investigations aimed to provide information on the nature, condition and extent of survival of remains of the boiler house, and to inform works to replace the failing concrete capping covering the remains. The works were carried out to a brief provided by the Great Place Wentworth and Elsecar and Elsecar Heritage Action Zone, and in line with the Scheduled Monument Consent. The site was recorded photogrammetrically prior to the removal of concrete, which was undertaken by hand under the supervision of an archaeologist. The area was then cleaned by hand to expose the surface structural remains. Two test pits were also excavated to investigate the condition of walls and the nature of the infill deposits.

The Elsecar beam engine was constructed in 1795 to pump water from the Elsecar New Colliery coal mines. It worked until the 1920s, and is the only 18th-century atmospheric beam engine to survive intact in its original location. The nature of the original boiler provision is poorly documented, and it is thought that there were at least two, possibly three different layouts during its operation. The latest boiler house was constructed in the 1850s and contained two externally-fired tubeless boilers, but there are no known detailed descriptions of the boilers. The boiler house was demolished to the current ground level in the late 1930s, but visible brick and stone surfacing in the open air area to the north of the engine were thought to be part of the boiler house plan and sub-surface remains were also thought to survive.

The removal of concrete and cleaning of the boiler house area has demonstrated a good sub-surface survival of the structures forming the boiler house, and has provided some information on its layout and construction method. It is likely that remains of stoking holes, fire pits, ash pits, flues and drains survive below the infill material within the two boiler cavities and the adjacent stoking area. Evidence for some features within the wall between the boiler cavities and the stoking area were noted in one of the test pits. The walls of the boiler house, where investigated, proved to be in a good and stable condition, though the upper surfaces have suffered some damage and loss of bricks, and are at ongoing risk from wear and weathering. One area of root damage to a wall was noted within TP1, but it is possible that further damage is present at depth.

Further archaeological investigations would have the potential to provide information on the type of boilers used and layout of the mid-19th-century boiler arrangement, which are elements that are currently poorly understood. It is also possible that remains of earlier boiler arrangements are preserved within the later structure.

1 INTRODUCTION

This report presents the results of archaeological investigations at the site of a boiler house associated with the Elsecar Newcomen-type atmospheric beam engine, Elsecar Heritage Centre, South Yorkshire. The investigations were undertaken in association with proposed conservation works at the site, and aimed to provide information on the nature, condition, significance and extent of survival of the remains of the boiler house. The site is a Scheduled Monument (NHLE 1004790), and the archaeological works were undertaken in line with the project design (Clement and Roberts 2019) and Scheduled Monument Consent (S00217450). ArcHeritage were commissioned by Great Place Wentworth and Elsecar, and Elsecar Heritage Action Zone to undertake the works.

2 SITE LOCATION, GEOLOGY & TOPOGRAPHY

The site (centred on NGR SK 38700 99972) forms part of Elsecar Heritage Centre, a visitor attraction under the care of Barnsley Museums. It is located at the southeast side of Elsecar and is bounded to the west by Distillery Side, and lies approximately 6 miles south of Barnsley (Figure 1). The area of investigation is approximately 40m^2, and comprises the site of a former boiler house adjacent to the northern side of the late 18th-century Newcomen-type beam engine (Figure 2). The engine was constructed to pump water out of mine workings, and the compound containing the engine and investigation area also encompasses two mine shafts and a brick-built electrical pumping station that replaced the beam engine in the 20th century. The boiler house was levelled in the mid-20th-century, but brickwork and stone blocks visible on the ground surface indicate the location of former walls and surfaces. Much of this area was covered with concrete prior to the investigations, and a small brick-built shed was constructed over the northeast corner of the site.

The site is generally level, and the underlying geology comprises Pennine Middle Coal Measures mudstone, sandstone and siltstone.

3 AIMS & METHODOLOGY

3.1 Aims

The concrete capping within the boiler house area was degrading, representing a risk to the underlying and adjacent archaeological remains. This necessitates conservation work to replace the concrete and consolidate the above-ground remains of the boiler house. The aims of the current project were to record the boiler house remains before the removal of concrete, monitor the removal and then clean and record the exposed structures and deposits.

The specific project aims were to:

- Record the boiler house in its current condition, including any visible archaeological features;
- Establish and evaluate the nature and condition of any underlying archaeological deposits following the removal of the failed concrete capping, along with any future potential risks to the archaeology;

- Inform the approach for a potential future community excavation on the site;
- Inform the approach for future management of the site.

3.2 Methodology

The archaeological fieldwork was undertaken by Richard Jackson and Rowan May between the 3rd and the 15th May 2019, in line with the methodology provided in the brief (Clement and Roberts 2019, see Appendix 2). Prior to the archaeological works, vegetation (scrub and weeds) was removed from the site by volunteers. Following this, the visible features were recorded photogrammetrically, with digital photographic images rectified using Agisoft Photoscan. The concrete capping was then removed by volunteers, using crowbars and picks, under the supervision of an archaeologist.

After removal of the concrete, the site was cleaned using trowels and hoes to fully expose the surface structures. Two small sondages (test pits) were excavated adjacent to the western walls of the boiler house, to examine their construction and to investigate the depth and nature of infill deposits. The features were recorded photogrammetrically, and details were noted on pro-forma context sheets. Elevations of the walls exposed in the test pits were drawn, and digital record photographs of the features were taken with appropriate photographic scales.

The cleaning of the features was undertaken by volunteers organised by Elsecar HAZ and Great Place Wentworth and Elsecar, under the supervision of an archaeologist. Recording was undertaken by the archaeologist and the Elsecar HAZ officer. A small assemblage of finds was recovered from the infill deposits. These were bagged by context and briefly assessed by material and likely date.

4 ARCHAEOLOGICAL BACKGROUND

This summary of the archaeological background draws on the project brief (Clement and Roberts 2019) and a desk-based assessment of the Newcomen Engine site undertaken in 2011 (May and Sheppard 2011).

The Newcomen-type beam engine was constructed in association with the development of Elsecar New Colliery. This was the first deep colliery in Elsecar, sunk to the Barnsley Seam at a depth of approximately 120 feet below ground, substantially deeper than previous coal extraction in the area and deeper than the drainage levels (soughs) that drained the earlier workings. The colliery was developed by the landowner, Earl Fitzwilliam, and formed part of a planned interlinked industrial development within the village, including the adjacent ironworks (now Elsecar Heritage Centre), and the construction of a dedicated branch of the Dearne and Dove canal.

The beam engine was constructed to pump water from the new mine workings. Documentary sources indicate that it was first used in 1795 and it continued to be used for the next 128 years, working up to 12 hours a day. At its peak, it could raise 600 gallons of water per minute. In 1801, the original 42 inch bore cylinder was replaced with a 48 inch version, and in 1838 a cast iron beam supplanted the earlier wooden one.

Though the engine has been subject to detailed research and restoration in recent years, the nature of the boiler provision is poorly understood. There are no recorded details of its original

boiler, which is mentioned in a contemporary account as 'steam pan, large' (Clayton 1964, 100). Early Newcomen engines had 'haystack' boilers, with a circular plan. These were usually positioned below the cylinder of the engine in early examples, but by the later 18th century, when the Elsecar engine was built, external placement of the boilers was more common (Bick 1999). Long 'wagon' boilers were also being used by this date at some sites.

The earliest plan of the Elsecar engine dates to 1840 and shows a long, narrow building to the north of the engine house, which could have housed a wagon-type boiler. This configuration had changed by 1850, when a shorter, wider boiler house was created on the plan of the current investigation area (Figure 3). A description of the engine in 1918 stated that:

> 'the original boilers were of the haycock or beehive pattern. The two present boilers are 22 feet by 7 feet. No tubes or flues are fitted, and they are fired externally. The working pressure is from 1 ½ to 2 ½ pounds per square inch' (Newbould 1918, 183).

The source of Newbould's assertion that haystack ('haycock') boilers were originally used is uncertain, and no explicit references to these have been found in recent documentary research. A section drawing also dated 1918, though of uncertain derivation, shows the layout of the boilers (Figure 4), each aligned east-west and set into cavities that extend below the current ground surface. The section and Newbould's description of the boilers as externally fired, with no tubes or flues fitted, suggests that these are not the more efficient Lancashire boilers, which contain internal furnaces set into tubes running the length of the boiler tanks. A printed question in Newbould's article explicitly compares the Elsecar boilers to the Lancashire boilers used at the engine at Westfield Colliery, Rawmarsh, which might in part account for the greater coal consumption at Elsecar (Newbould 1918, 189). The section drawing indicates fire boxes set into the cavities below the Elsecar boilers.

The Newcomen engine at Elsecar was used until electric pumps were installed in 1923, but the engine remained on standby until 1930. It was briefly put back into use in 1928 when the electrical pumphouse flooded, and the engine was subsequently operated on an occasional basis for demonstration purposes and to keep it in working order. The boilers had been removed, but steam was piped into a receiver on the site, reportedly from the Elsecar Workshops (now the Heritage Centre). Anecdotal evidence states that the engine was last steam-operated in 1953 (AC/81C). Documentary evidence suggests that the 1850s boiler house was demolished in 1938, with the boilers being scrapped (NCB 1297/14/3).

A watching brief carried out in 2015 during groundworks associated with the restoration of the engine recorded a number of features within and close to the area of the boiler house, demonstrating a high potential for the survival of further archaeological remains within the boiler house footprint (Wessex Archaeology 2015). A geophysical survey undertaken by Historic England in 2016 within the boiler house area showed a number of linear features interpreted as walls or structures relating to the boilers surviving below the concrete to a depth of 2.15m (Linford, Linford and Payne 2017).

5 RESULTS

The site was recorded photogrammetrically prior to the removal of concrete (see Figure 5). Brick flooring is visible to the immediate north of the engine house (context 108), on which the 20th-century steam receiver is sited, with further narrower stretches of bricks to the north, aligned east-west (106 & 107) and north-south (105 and 109), separated by concrete capping. In the southwest corner adjacent to the chimney is an area of brick and stone flag surfacing (111). A line of dressed stone flags (104) runs north-south adjacent to the western brick wall (104). To the west of this was a further area of concrete capping, and a narrower row of bricks aligned north-south (112). The northern and eastern ends of the site is marked by a brick boundary wall. At the northwest corner of the site, a square brick-built mid-20th-century shed stands on the concrete capping. This was first shown on the 1957 OS map (see Figure 3).

Removal of the concrete (context 100) revealed that this had been poured *in situ*, with slightly variable thickness. It had been laid on a bed of a dark grey-brown ashy silt deposit (context 101, Plate 1), which was demonstrated to be between 8 and 18cm thick. The brick structures visible prior to the removal of concrete proved to be the remains of walls and floors of the boiler house. Below the concrete were infill deposits filling two rectangular cavities within which the former boilers would have been partially buried (see Figures 6 and 7 for plans). The brick structures 105, 106, 107 and 114 all appear to be walls around the edge of the boiler cavities, as well as forming the structure of boiler house floor. The upper parts of the boilers could have been accessed from this floor level for operation and maintenance purposes.

The cavities for the boilers were filled by deposits 101 and 102. The overall size of these cavities at the current ground level are 7.2m by 2m. This would fit with the size of the boilers described by Newbould (1918) at 22 feet (6.7m) long by 7 feet (2.13m) wide, assuming the cavities curve outwards below this surface to accommodate the widest point of the cylindrical boiler. TP1, 0.8m square, was excavated within the northern boiler cavity to the east of wall 105. This revealed that the dark, ashy deposit (101) was between 8 and 18cm thick, containing small coal, brick and slate fragments. It may have been laid as a deliberate bedding for the concrete (101), though it could also have been the last in a series of tipping deposits used to backfill the cavities. Context 101 overlay infill deposits that were given a single context number (102), though this comprised stratified lenses of several different materials, including yellow-brown clay, reddish gritty deposits, darker ashy/clinker layers, and a softer dark brown sandy silt deposit towards the base of the test pit at 0.6-0.8m below the ground surface (Plate 2). Though different materials were evident, it appears likely that these all form a contemporary infilling episode and are representative of material having been brought to the site from different sources. There was generally a lack of large rubble within the deposits within the test pit, with the exception of occasional bricks. If material from demolition of the superstructure of the boiler house is incorporated into the infill, this may be found in the earliest tipping layers at the base of the cavities. Excavation of the test pit ceased at 0.80m, and probing suggested that at least another 0.70m of fill was present below the base of the test pit, with solid material hit at that depth. This suggests that the boiler cavity extends to a depth of at least 1.5m below the current ground surface.

Structure 107, at the northern side of the site, had chamfered bricks preserved along much of its southern edge (Plate 3). These were cut diagonally inwards across the edge, suggesting they had

been laid around an *in situ* curving boiler cylinder. A small patch of similarly chamfered bricks survived at the southeast side of the site, forming part of the northern edge of structure 114. This edge has been lost across most of the floor 108, which has only one chamfered brick surviving (Plate 4). The preservation of the chamfered bricks within parts of the site suggests the boilers were cut up *in situ* and removed in pieces with some care, to avoid damaging the structure, perhaps indicating that the people removing the boilers were well aware of the significance of the steam engine and its infrastructure.

Structure 106 runs east-west across the centre of the boiler house separating the two boiler cavities. Voids along its edge reveal that this is a wall rather than just a floor layer, though it would also have formed a maintenance access walkway between the boilers. Removal of the concrete exposed more of this wall than was previously visible. This has lost its upper course of bricks along most of its length, but a hard dark grey mortar layer is present along its eastern half, covering bricks below (Plate 5). A small patch of pink asbestos fabric was found embedded in this mortar to the southwest of the mid-20th-century shed. A gap in the bricks at the western end and two areas of slightly different mortar along the lower section of wall may indicate the location of former pad-stones, possibly for roof supports. These features are a fairly regularly spaced and at the eastern and western sides they line up with brick supports in the northern boundary wall of the site.

There was further damage at the eastern end of wall 106, and its junction with structure 109 was not visible, though probing suggests that 106 continues below 102 across this gap at a slightly lower level. The upper course of this wall, as with 107 and 114, comprises bricks laid in stretcher courses on their narrow edges. All the surface bricks appear to be a uniform size (22 x 11 x 8cm) and machine-pressed. At least some are frogged, and a couple of stamped examples were recorded ('James Smith & Co, Skyers Spring, Barnsley', see discussion). The surfaces of walls 106 and 107 were probably originally three and a half stretcher bricks wide (0.82m), whilst 114 appears to have been slightly narrower at three bricks, possibly constrained by the chimney to the south.

Surface 108 forms the base for the steam receiver and merges with 114 on its eastern side. It is constructed of similar-sized red bricks, but these are laid on their wider face. The surface has sunk below the steam receiver setting (Plate 6), possibly due to the weight of the receiver, though this may indicate a void or soft area below the surface, perhaps associated with earlier boiler provision.

At the eastern edge of the boiler house, surfaces 109 and 111 were separated by the concrete capping, but below this is an area of hard dark grey mortar overlying bricks (110), at least one of which is a firebrick. It is likely that this area originally had a continuous surface running along the east side of the chimney and boilers. Much of the upper surface of 109 and 111 are red bricks in the same style as 106-107 and 114, but there is an area of more recent brick infill at the northeast corner, just south of the modern shed (Plate 7). Two stone slabs are set into the western edge of 109, one with mouldings on its western face, which appear to form a setting in the centre of the cavity, possibly associated with a boiler fitting. A metal pipe is set into the base of the eastern boundary wall of the site adjacent to the lower area 110, and it is possible that the upper course of bricks in this area was damaged or removed during the insertion of the pipe. The pipe bends upwards to the west of the wall, and its purpose is unclear.

The western edge of the boiler house is formed by two parallel walls, 104 and 105. The former has an upper layer of stone, whilst the latter is surfaced in brick. It is possible that below the surface these form a single wide wall with different surface treatments. The sondages to either side

suggest some differences in the construction details, though these were offset and may indicate differences in detailing along the length of the wall. Considered together, the two are a similar width to wall 106. The eastern of the two, wall 105, was examined in TP1 (see Figure 8, Plate 8). The upper course is of red bricks laid on their narrow edges in a similar fashion to structures 106 and 107, though only two stretcher-bricks wide (0.36m). There was some root intrusion and soil below the brick surface of 105; however, it was unclear if the roots were exploiting a soil deposit or that the roots separated and offset the bricks and enabled the soil to accumulate. A rectangular soil-filled void or recess was present in the northern side of the elevation below the upper course, up to 30cm deep. It is uncertain if the recess was original to the structure, possibly for pipe access, or the result of loss of bricks during demolition of the boiler. Eight courses of bricks were exposed in the elevation of 105 within TP1. The upper four courses are red bricks, whilst the lower four courses appear to be fire bricks. A straight joint is visible on the southern side of the elevation, in the lower three courses of red bricks. This may indicate some alteration to the wall. Below the rectangular void is another void, capped by a firebrick with a slightly curved indentation along its bottom face. This slight shaping suggests that the void is a former opening in the wall, perhaps for a pipe or small hatch. The void is 17cm tall by 17cm wide.

The western side of this structure, wall 104, is capped by a course of dressed sandstone slabs 0.42m wide. Four of the slabs have fittings for former railings along the western edge, with slight differences in their form suggesting there may have been two successive sets of railings. A test pit adjacent to this wall (TP2) revealed a brick wall below the slabs, extending down beyond the base of the test pit, in which excavation ceased at 70cm below the current ground surface. The part of this wall exposed in the test pit had a thick layer of hard, dark mortar below the stones, overlying neatly coursed red bricks. The upper brick course was set header-on, with all the lower courses revealed being arranged mainly as stretchers (see Figure 8, Plate 9). The bricks are of a uniform size identical to those in the areas of surfacing.

West of wall 104 was a double skin brick wall 112 (Plate 10) and between them was another area of infill. The southern end of wall 112 has lost the upper course of bricks, but the wall continues south at a lower level. The bricks are similar to those found in the other structures on the site. A small slot excavated adjacent to this wall confirmed that it extends down and appears to be in a good condition. This wall forms the western edge of a cavity adjacent to the main part of the boiler house, probably an access cellar for stoking the furnaces below the boilers and removing ash. The cavity was infilled with deposit 103, examined in TP2. This is similar in nature to 102, including yellowish clayey deposits and darker blackish gritty sand and clinker deposits; however, a paler deposit of sub-rounded pebbles in a sandy matrix was only found in TP2, as well as a deposit containing pieces of asbestos-cement tiles. These tiles appeared to be in a single tipping layer, found between 0.24 and 0.36m below the ground surface. Samples of the tiles were recovered for testing, and soil samples were subsequently taken from this area to test for loose asbestos fibres in the soil. The latter tests were negative (T. Roberts pers. comm.). At the western side of 103, some larger rubble fragments (bricks and stone) were recovered in the upper layers adjacent to wall 112.

It is likely that the stoking cellar was accessed via a former stairwell just north of the northwest corner of the engine house, which would suggest that the cavity extends further south from the evaluated area, up to the edge of the engine house. However, a structure of brick with stone capping (113) crosses the infilled area 103 at the southern edge of the cleaned area. It is not clear whether 113 extends down as a blocking wall, though at least two courses are visible. One of its

stone blocks has an incised octagonal setting on its upper face, possibly a base for a former support, suggesting these may have been reused from elsewhere in the boiler house (Plate 11).

6 DISCUSSION

The removal of concrete and cleaning of the site has revealed that substantial structures associated with the 1850s boiler house survive. The structure seems to have been demolished to the top of the surfaces which would have formed the main floor level. The boilers themselves would have been set into below-ground cavities each aligned east-west, with fire boxes, ashpits and flues located below the boilers. A cellar area to the west of the main structure probably provided access for stoking the furnaces and raking out ash, and evidence within the western wall of the boiler house may relate to openings and fittings extending through the wall.

The boiler cavities and cellar area were backfilled after removal of the boilers in the 1940s. The boilers appear to have been removed in pieces, avoiding substantial damage to the surrounding brickwork that encased them. This may indicate that they were removed for scrap metal, possibly for the war effort, rather than for reuse, and that the people dismantling the boilers were aware of the significance of the engine house and its associated infrastructure. The cavities have been infilled with stratified deposits of tipped material, with some differences noted in the fills between the northern boiler cavity and the stoking cellar area. Probing within the fill material indicates that the boiler cavity extends down at least 1.5m below the current ground surface, with a similar depth indicated in the cellar area.

The investigations have also demonstrated that the walls of the boiler house and its external stoking area survive in a good condition below the ground surface. There has been some damage to the upper brick surfaces themselves through loss of bricks around the edges of the cavities, possibly partly due to removal of the boilers and to subsequent wear and weathering of the unprotected surfaces. One area of root damage was noted in TP1, affecting the upper courses of wall 105.

Though the cleaning has revealed the plan of the boiler house at ground floor level, the nature of the boiler arrangement, flues, fire boxes, etc., as well as the stoking arrangement, is still poorly understood. No documentary sources clearly describe the boilers, with the main source for the mid-19th-century boilers noting their size and that they were of an externally-fired, tubeless type, less efficient than Lancashire boilers used at similar sites in that period (Newbould 1918). The 'tubeless' description suggests their operation was more similar to the wagon boiler type (though in a cylindrical form), rather than subsequent designs, such as Cornish or Lancashire boilers, which all featured internal furnace tubes.

A number of bricks stamped 'James Smith & Co, Skyers Spring, Barnsley' were noted in the upper level of brickwork at the site (Plate 12). Smith's Skiers Spring brickworks was in business from 1878 to *c.*1900, before being taken over by Earl Fitzwilliam (Chris Jones pers. comm. [Friends of Hemingfield Colliery]). These bricks may indicate a date for the construction of the latest phase of the boiler house, though as these are from the uppermost levels, it is equally possible that they relate to later repairs to the surfaces. This latter suggestion is supported by map evidence that indicates the boiler house had been constructed on its current plan by 1859 (Figure 3).

Few excavations of atmospheric beam engines and their associated infrastructure have been published. One example is a report on 1970s rescue excavations at the Reelfitz Pit colliery pumping engine, Cumbria, which was constructed in 1780 but disused by 1781. The excavation revealed two external boiler houses, positioned to either side of the engine house. Though it is not explicitly stated in the article, these appear to have been haystack boilers, and were sited over rectangular brick-lined fire pits. Fine slack coal left stacked on the floor at abandonment indicated that unsaleable coal from the pit was used to fire the boilers, and also demonstrated an abrupt abandonment of the engine, possibly after an accident caused damage to the steam engine (George and Nevell 2014).

The Fairbottom Bobs Newcomen engine is now in Henry Ford's Dearborn Museum in the US, but its site at Ashton-under-Lyne was subject to excavation in 1999-2000. This colliery pumping engine was built between 1765 and 1776 and worked until the 1820s. In 1929 it was dismantled and shipped to Ford's museum, but sub-surface remains survived. The Fairbottom engine was not encased within an engine house but had the beam supported on stone pillars, with an external boiler to the south of the engine. The 1999-2000 excavations revealed remains of the cylinder bay, beam wall, ash pit, drains, and the walls and floor of the boiler structure, all constructed from ashlar blocks with later alterations in red brick.

One wall of the Fairbottom boiler house was partially curved, suggesting it originally housed a haystack boiler, but this was replaced with a larger wagon boiler sometime around 1800. Evidence for alterations to the structure associated with the insertion of the new boiler included the brick floor and modifications to the flue and ash pit. The latter was at the eastern end of the boiler house, with recesses in the upper wall for the insertion of a suspended plank floor over it, allowing access to the boiler (Nevell *et al*. 2004).

The boiler houses at both Reelfitz and Fairbottom had a system of drains that ran into the ash pit, and it is suggested that these were designed to both cool and flush out the ashes. The Reelfitz drains were fed by condensated water from the cylinder and subsequently exited into the drainage sough, whilst those at Fairbottom seem to have channelled a natural spring and fed into a drain leading into the nearby river (George & Nevell 2014, Nevell *et al*. 2004).

7 CONCLUSIONS

The removal of concrete and cleaning of the boiler house area has demonstrated a good sub-surface survival of the structures forming the boiler house, and has provided some information on the layout and construction method. It is likely that remains of stoking holes, fire pits, ash pits, flues and drains survive below the infill material within the boiler cavities and the stoking area. Evidence for some features within the wall between the boiler cavities and the stoking area were noted in one of the test pits. The walls of the boiler house, where investigated, proved to be in a good and stable condition, though the upper surfaces have suffered some damage and loss of bricks, and are at ongoing risk from wear and weathering. One area of root damage to a wall was noted within TP1, but it is possible that further damage is present at depth, particularly towards the northeast corner, close to a tree in the garden to the north.

Further archaeological investigations would have the potential to provide information on the type and layout of the mid-19th-century boiler arrangement, which are elements that are currently poorly understood. Documentary sources suggest that the boilers were an unusual

externally-fired type for their period, but no clear descriptions have been found. There is also the potential that remains associated with the original boiler provision may be preserved within the later boiler house structure; again, there are no clear descriptions of the original boiler(s) in documentary sources. These aspects would enable a clearer understanding of the functioning of the engine house and allow improved interpretation to be provided.

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9 REFERENCES

Bick, D. 1999. Evolution of the pre-Cornish beam engine house. *Industrial Archaeology Review* 21/2, pp. 117-36.

Clayton, A.K. 1964. The Newcomen-type engine at Elsecar, West Riding. *Transactions of the Newcomen Society* 35, pp.97-108.

Clement, M. and Roberts, T. 2019. Newcomen Beam Engine Boiler House, Elsecar: Project Design for a Community Archaeology Project. Unpublished Great Place Wentworth and Elsecar and Elsecar Heritage Action Zone document.

George, D. and Nevell, M. 2014. Revisiting the iconic: the excavation of the Reelfitz Pit Engine and the Newcomen steam engine in Cumberland, UK. *Industrial Archaeology Review* 36/2, pp. 128-140.

Linford, N., Linford, P. and Payne, A. 2017. Elsecar, Barnsley: Report on Geophysical Surveys, May 2017. Historic England Research Report 62-2017.

May, R. and Sheppard, R. 2011. Elsecar Newcomen-Type Engine and Environs, Barnsley, South Yorkshire: Enhanced Desk-Based Assessment. Unpublished ArcHeritage report 2011/56.

Mitchell, J.S. 2010. Elsecar Engine Report 2010 Update. Unpublished Industrial Heritage Consulting report.

Nevell, M., Roberts, J. and Champness, B. 2004. Excavating the iconic: the rediscovery of the Fairbottom Bobs colliery pumping engine. *Industrial Archaeology Review* 26/2, pp.83-93.

Newbould, G.T. 1918. Notes on Newcomen Atmospheric Engines. Paper presented at the General Meeting in Sheffield, July 1918. *Proceedings of the Midland Institute of Mining, Civil and Mechanical Engineers* 24/6, pp. 167-192.

Wessex Archaeology. 2015. Newcomen Engine, Elsecar, South Yorkshire: Archaeological Watching Brief Report. Unpublished Wessex Archaeology report.

Historic maps and documents

WWM Add. Dep. Map R208: Plan of Elsecar canal basin and railway line, 1849.*

NBC/460a: Map of land at Elsecar required from Earl Fitzwilliam by the Manchester, Liverpool and Sheffield railway, 1859. *

NCB 1297/14/3: South Yorkshire Mines Drainage Scheme 1929 & 1936: report for the year ending 31st December 1938 to the owners of mines in the South Yorkshire Mines Group.

WWM/MP/115R: Map with field numbers to correspond with cropping books, Brampton Bierlow, 1866-68. Sheffield Archives.

1850 OS 6 inch: 1 mile map sheet Yorkshire 283.

1892 OS 25 inch: 1 mile map sheet Yorkshire 283/5.

1957 OS 1:1250 map sheets SK 3899 NE and SE3800 SE.

AC/81C: Documents and correspondence relating to Elsecar Newcomen Engine, Barnsley Archives.

[*: Sheffield Archives reference correct as of 2011, possibly now transferred to Barnsley Archives.]

PLATES

Plate 1: View east across the boiler house after concrete removal

Plate 2: Section through deposit 102 in TP1, viewed facing north

Plate 3: Chamfered bricks at the edge of the boiler cavity, structure 107, viewed facing northeast

Plate 4: View east across southern boiler cavity showing walls 105, 106, 108 & 114

Plate 5: Wall 106 viewed facing east

Plate 6: Surface 108 showing sunken area below steam receiver, viewed facing south

Plate 7: Surface 109 and 110, showing brick infill to left and stone settings, facing east

Plate 8: Elevation of wall 105, viewed facing west

Plate 9: Elevation of wall 104, viewed facing east

Plate 10: View north over infilled area (103) between walls 112 and 104

Plate 11: Structure 113, viewed facing west

Plate 12: Example of a 'James Smith Skyers Spring' brick

FIGURES

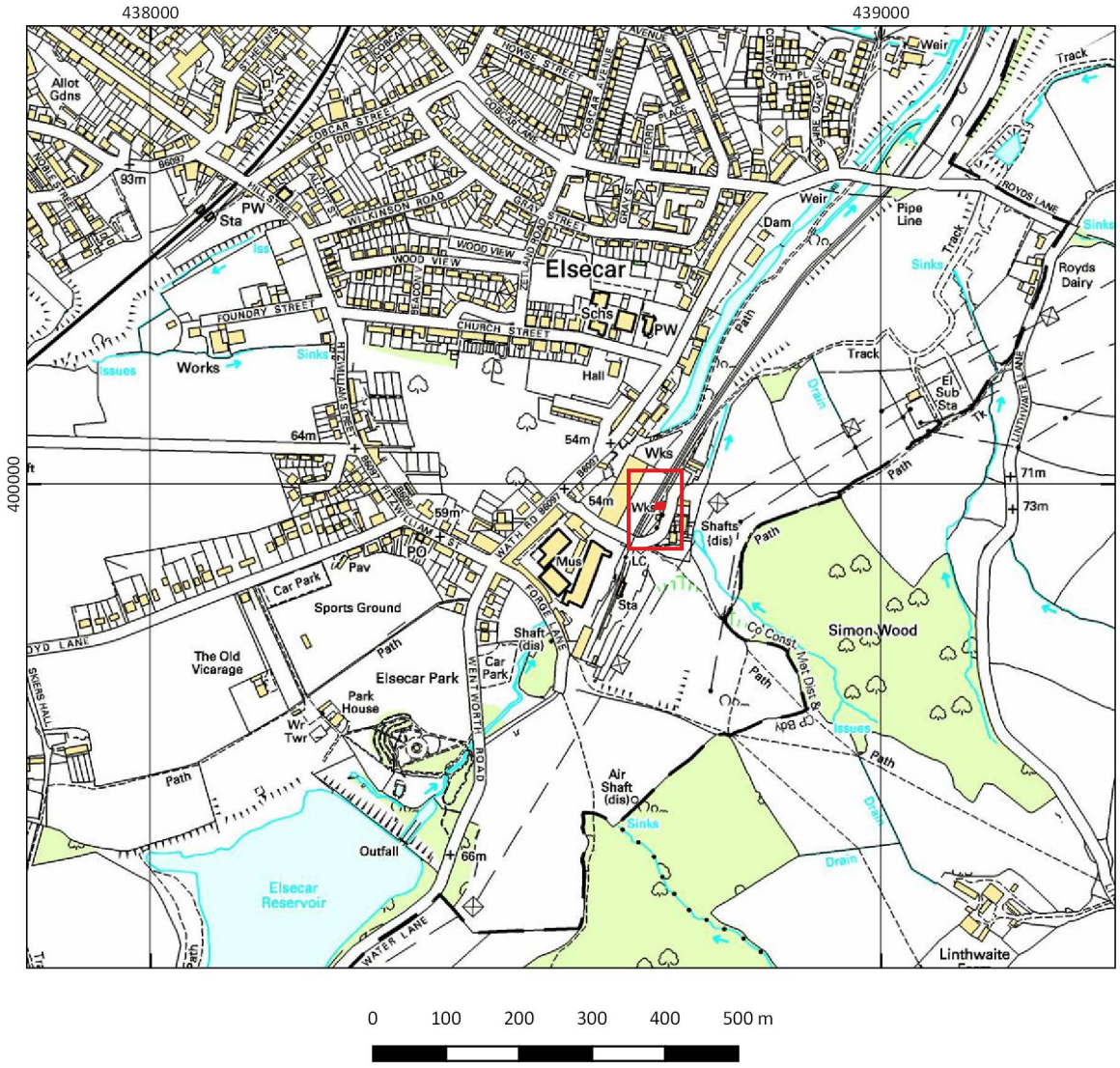


Figure 1: Site location

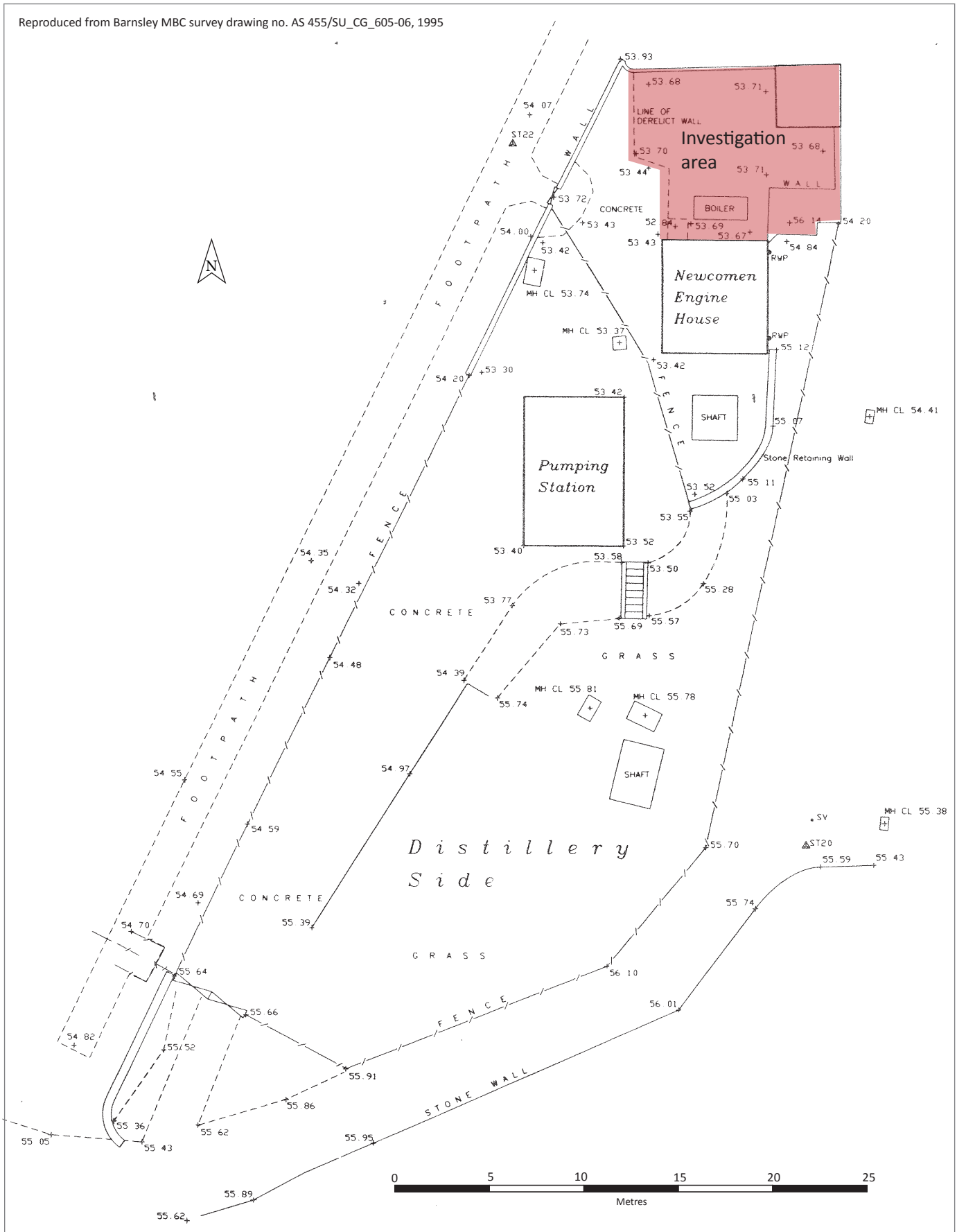
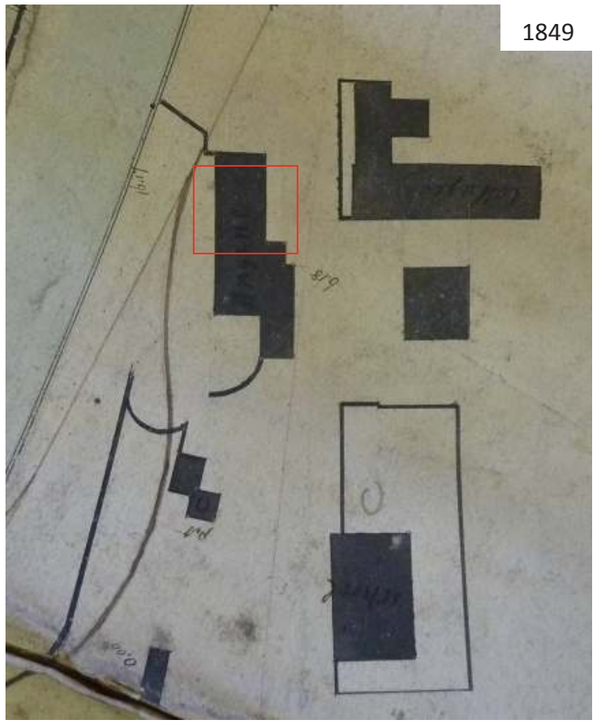


Figure 2: Location of evaluation

1849



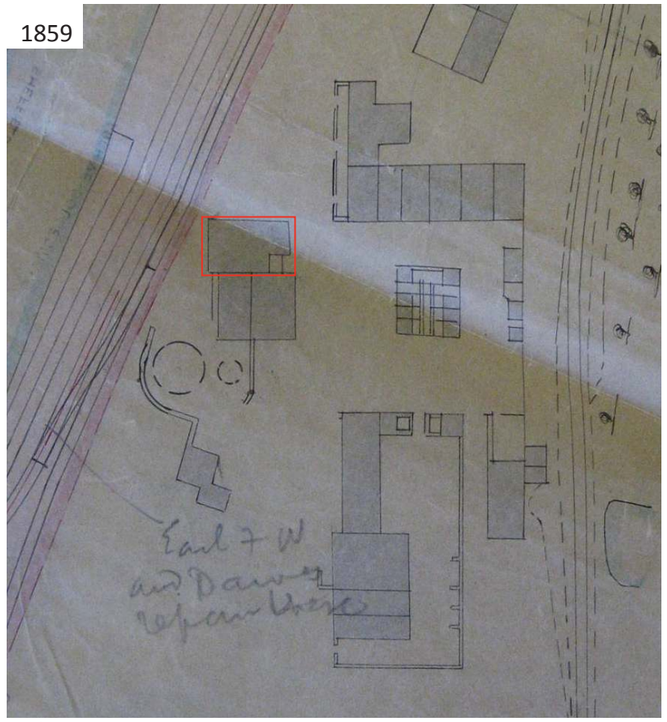
WWM Add. Dep. Map R208

1855

1855 OS 6 inch: 1 mile map

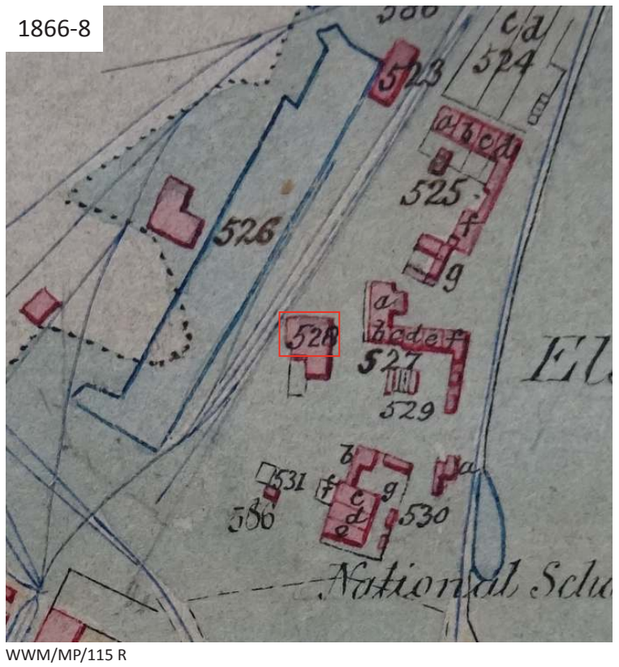
Approximate site location

1859



NBC/460a

1866-8

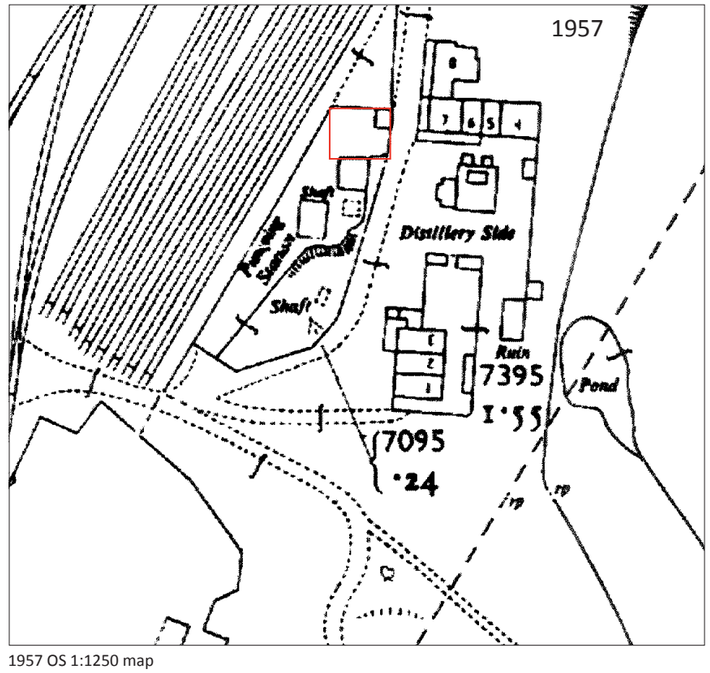


WWM/MP/115 R

1892

1892 OS 25 inch: 1 mile map

1957



1957 OS 1:1250 map

Figure 3: Historic maps

Reproduced from Industrial Heritage Consulting Ltd. 2010, fig.5.

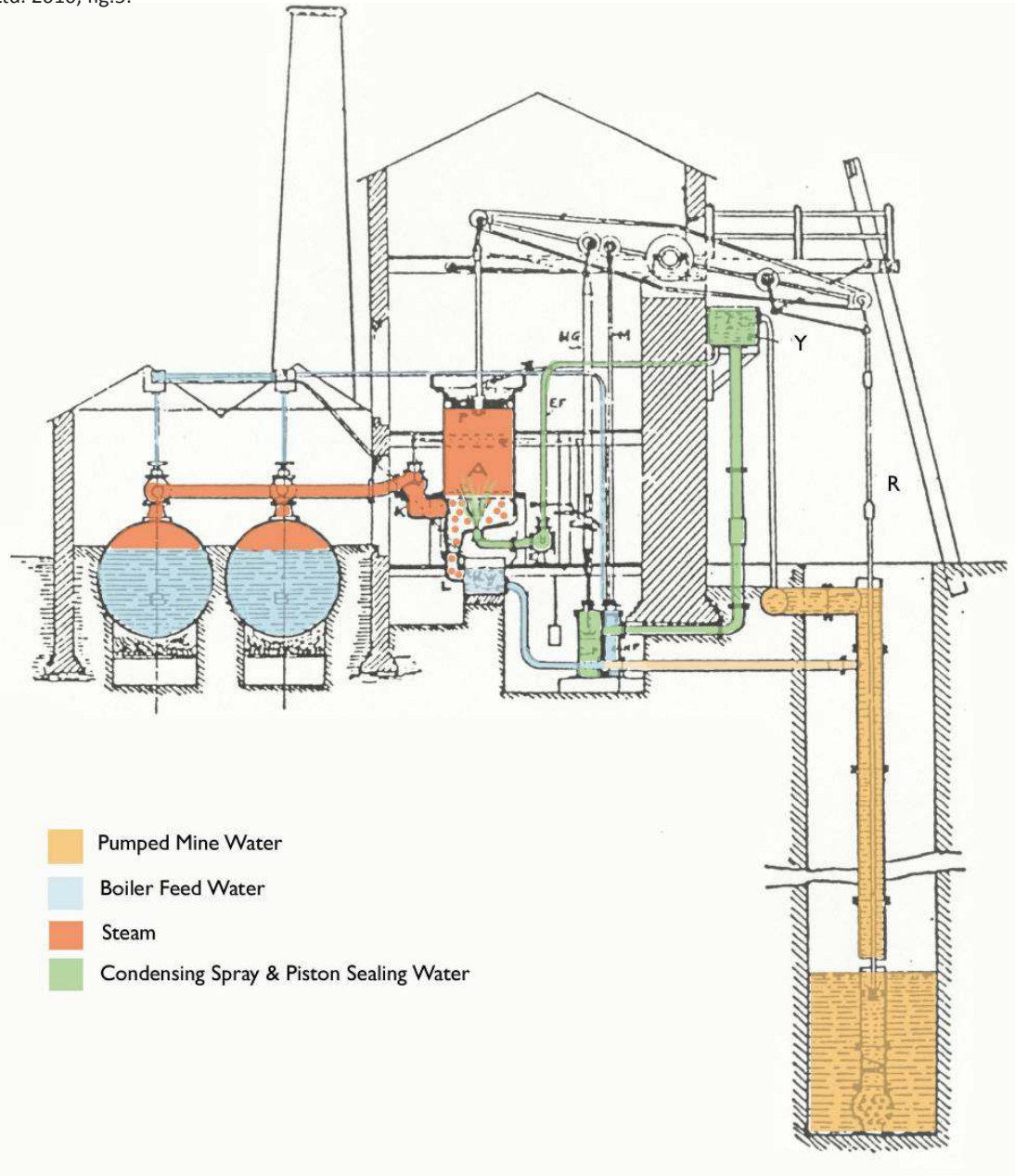


Figure 4: Section of the boiler house and engine house, c.1918

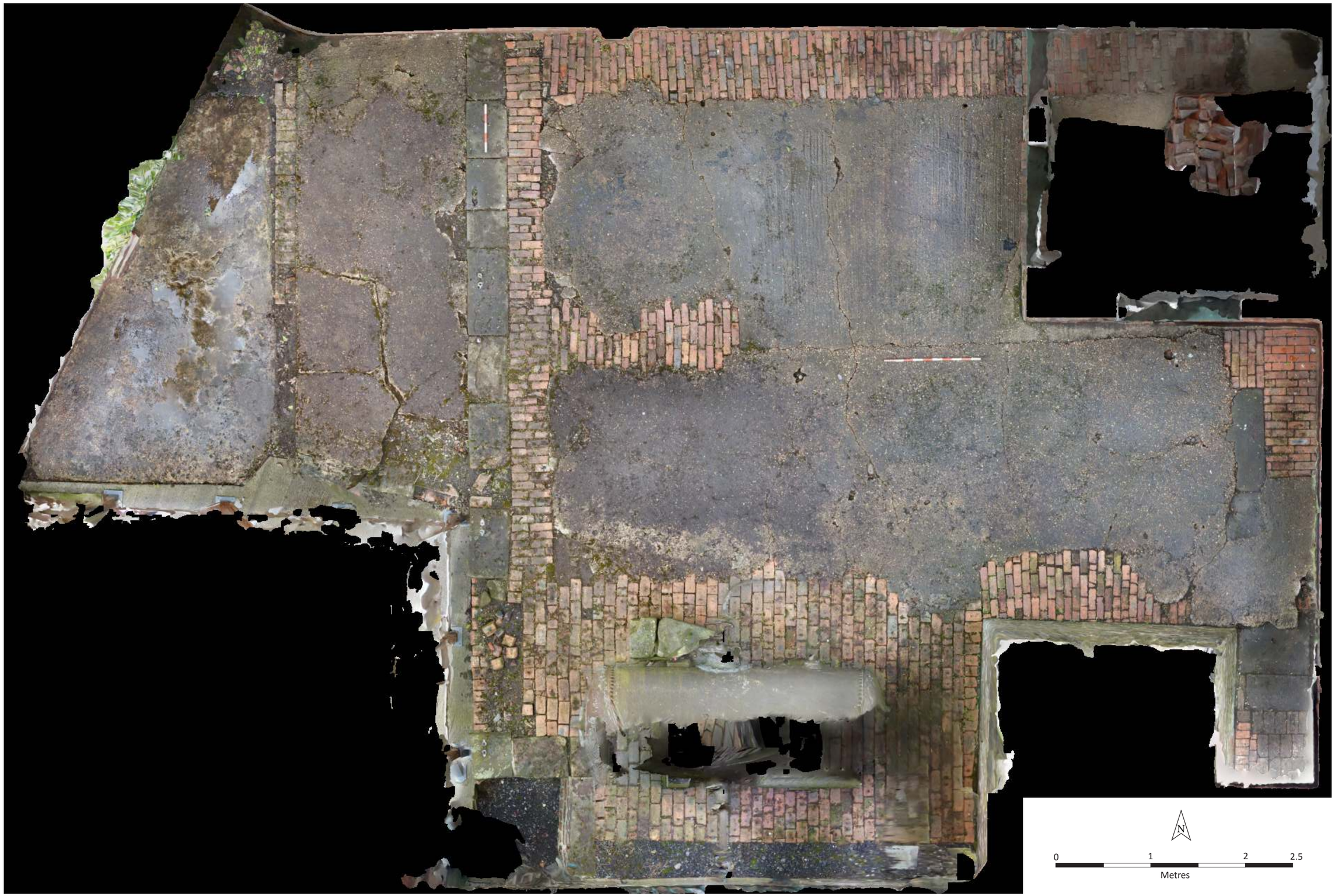


Figure 5: Ortho-rectified plan prior to concrete removal

Figure 6: Ortho-rectified post-cleaning plan

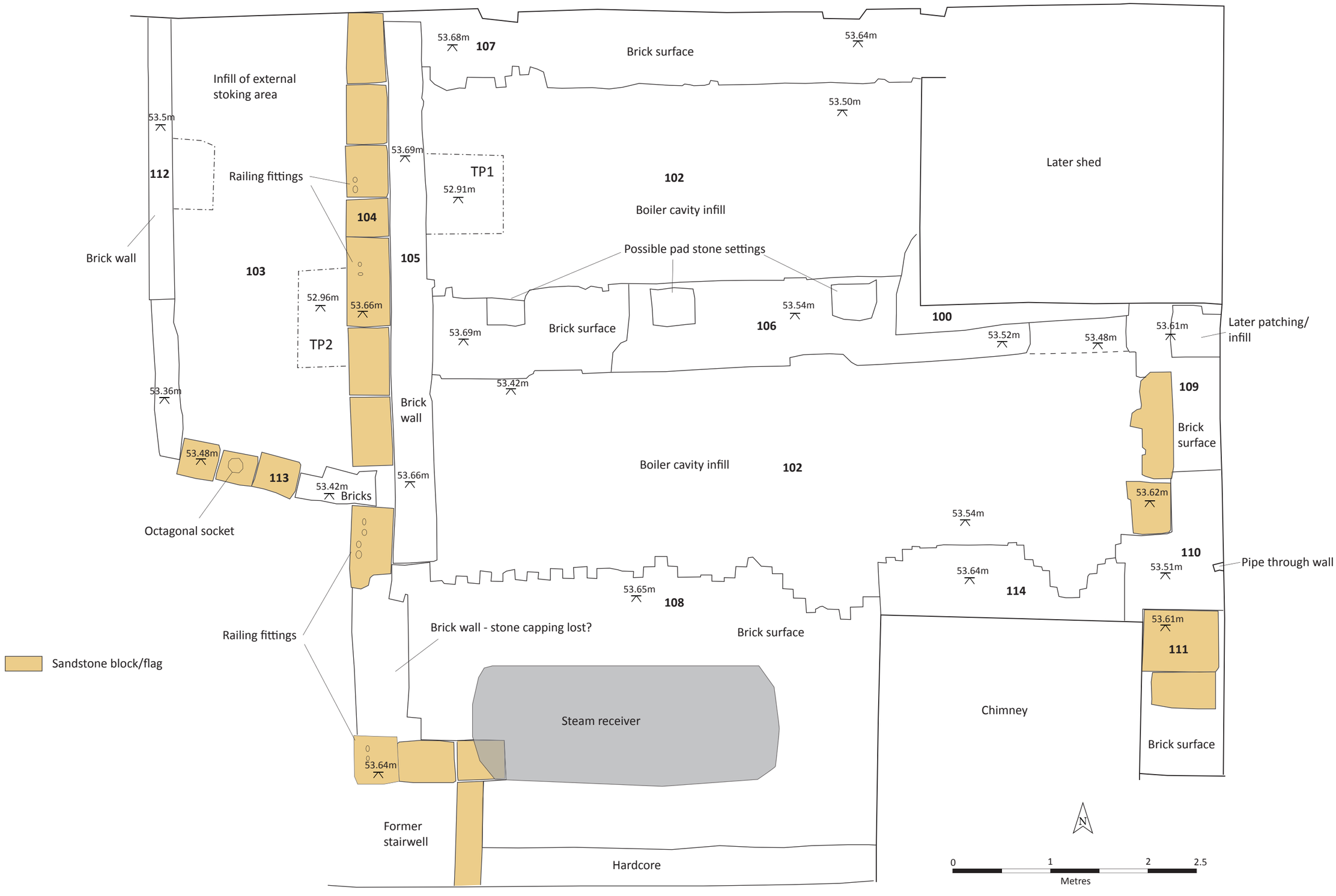


Figure 7: Post-cleaning plan

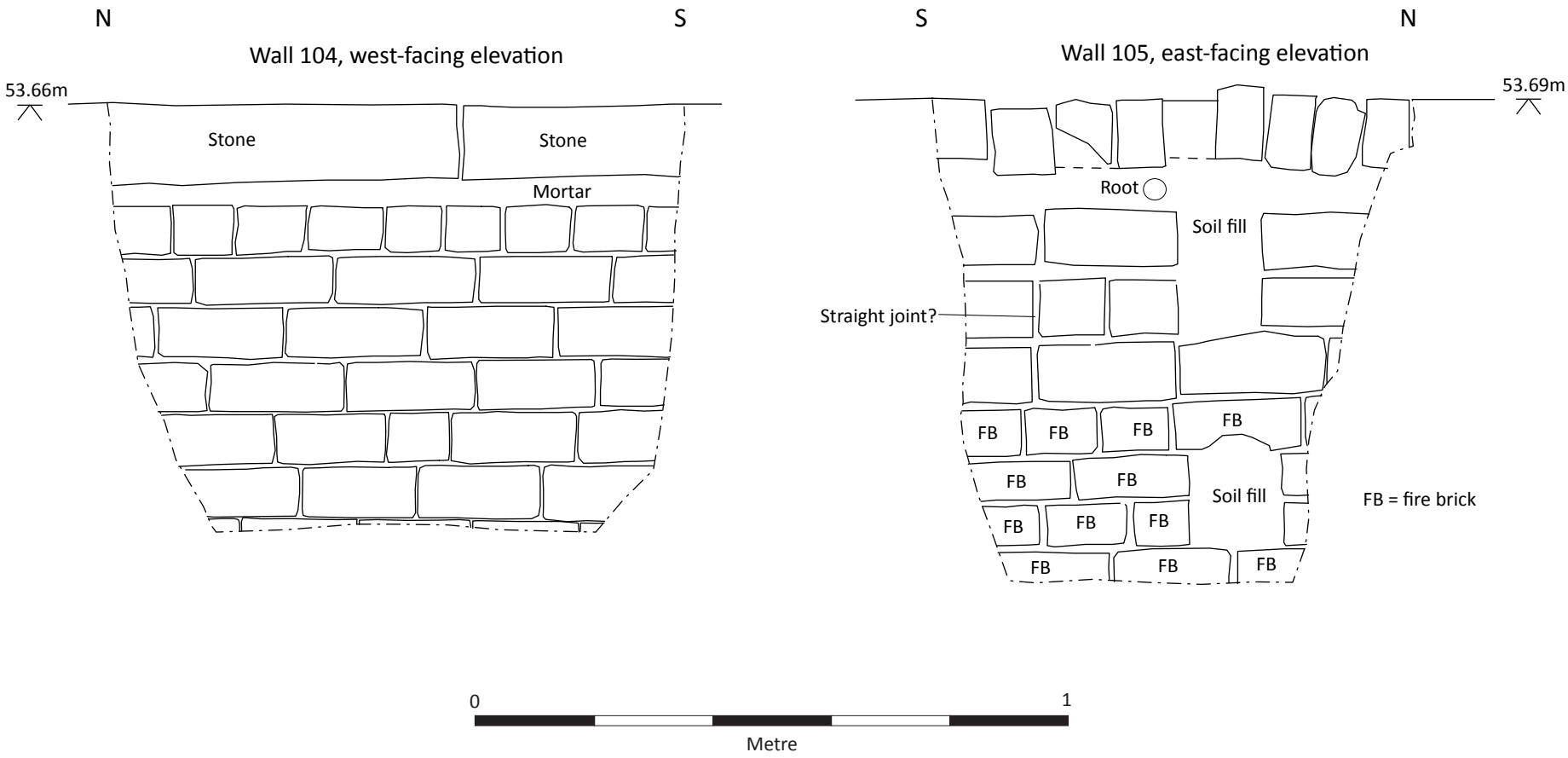


Figure 8: Elevations of walls 104 & 105

APPENDIX 1: INDEX TO ARCHIVE

Item	Number of Items
Context register	1
Context sheets	15
Digital Photographs	65
Photographic register	1
Drawing register	1
Original drawings	1
Levels register	2
Project brief	1
Report	2

APPENDIX 2: CONTEXT LIST

Context no.	Description
100	Concrete surfacing covering boiler house remains
101	Dark black-brown gritty silt underlying concrete
102	Infill deposits within boiler cavities, east of walls 104 & 105
103	Infill deposits within external stoking area, between walls 104 & 112
104	Stone-capped brick wall on exterior of boiler house, facing west into the external stoking area
105	Brick wall on the interior of the boiler house, west side
106	Central brick wall/surface between boiler cavities
107	Brick wall/surface at northern end of boiler house
108	Brick wall/surface at southern side of boiler house
109	Brick surface/wall at eastern end of boiler house with stone settings
110	Mortar-covered brick wall/surface below 110 & 111
111	Brick and stone flagged surface adjacent to chimney
112	Brick wall at western side of external stoking area
113	Stone and brick blocking at south side of external stoking area
114	Brick wall/surface at southeast side of the boiler house

APPENDIX 3: PROJECT BRIEF

Newcomen Beam Engine Boiler House, Elsecar

Project design prepared for a Community Archaeology Project

Funded by Great Place Wentworth and Elsecar and Elsecar Heritage Action Zone

Supported by Heritage Lottery Fund, Arts Council Fund, Barnsley Metropolitan Borough Council, Rotherham Borough Council and Historic England.

Compiled by Megan Clement and Dr Tegwen Roberts

Heritage Action Zones
Historic England

Elsecar Heritage Centre

Wath Road

Elsecar

Barnsley

S74 8HJ

Tel. 01226 773728

Facebook Great Place Wentworth and Elsecar

Twitter: @GreatPlaceWE @ElsecarHAZ

Purpose of this Document

This document has been prepared to as a project design for the reinstatement of the capping and investigation of the boiler house adjacent to the Newcomen Beam Engine House. The work is being carried out as part of the Great Place Wentworth and Elsecar and the Elsecar Heritage Action Zone (HAZ). The work which will be done on the boiler house will consist of two stages; the purpose of this document is to lay out the research questions and methodology for Stage 1.

Partners

Great Place Wentworth and Elsecar

Great Place Wentworth and Elsecar is a 3-year funded project supported by the Heritage Lottery and Arts Council England. The project is hosted by Barnsley Metropolitan Borough Council (BMBC), with support from Rotherham Metropolitan Borough Council and Wentworth Woodhouse Preservation Trust. The project is based at Elsecar Heritage Centre, part of Barnsley Museums. The remit of the project is to work with deprived communities within Rotherham and Barnsley to help instil pride, raise aspirations and work with young people using heritage, arts and culture to achieve this.

Elsecar Heritage Action Zone

The Elsecar Heritage Action Zone (HAZ) is a 3 year partnership project between Barnsley Museums and Historic England. The key aims of the Elsecar HAZ are; improve understanding of Elsecar's heritage and its significance, support the conservation and future protection of historic sites within the HAZ area, and encourage local people and community groups to get involved in shaping the future development of the village and wider HAZ area.

Elsecar Heritage Centre, Barnsley Museums

Elsecar was developed from the late 1700s onwards by the Earls Fitzwilliam as a model industrial village. Elsecar Heritage Centre sits within the impressive historic buildings of the former Elsecar workshops and ironworks. It is part of Barnsley Museums; with Wentworth Woodhouse, the stately home for the Fitzwilliam's, just over a mile away in Rotherham. The jewel in crown of the Heritage Centre today is the Newcomen Beam Engine, the oldest steam engine in the World to survive in its original location.

1. Introduction

1.1 This project design outlines the methodology, aims and objectives for a proposed two-stage archaeological investigation on the former boiler house of the Elsecar Newcomen Beam Engine House (Scheduled Ancient Monument). The work carried out will be in accordance with this project design, advice from Historic England and the Chartered Institute for Archaeologists (CIfA) Codes of Conduct (2014) and all relevant standards and guidance.

1.2 The work will be aligned with chapters from Historic England's "Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment" (Drury and McPherson 2008). The three chapters most relevant are: Repair (2008, 52), Intervention to increase knowledge of the past (2008, 54) and Integrating conservation with other public interests (2008, 60). See appendix 3 for the justification statement.

1.3 There are two proposed stages of work; Stage 1 will be the recording of the present boiler house area, the removal of the current (failed) concrete surfacing across area of the former boiler house and the subsequent removal of any overburden below the concrete to the top of the archaeological horizon. This will be subject to a watching brief by an archaeological contractor. The archaeological contractor will also oversee recording of the boiler house area before the concrete removal starts.

1.4 Stage 2 will be informed by the results of the watching brief. Depending on the extent and condition of any archaeological features that are uncovered at Stage 1, we are hoping to undertake a targeted community-led excavation to assess and record the full depth, nature and condition of surviving archaeological features within the boiler house. However, if the nature of the archaeology and/or the underlying ground conditions, do not permit this, we will not carry out Stage 2.

1.5 Once the work is complete, Historic England will be consulted on the best approach, assessment and future protection of the monument. As a minimum, a breathable membrane will be installed with a new concrete surface on top (as per the current surfacing on site) no more than 6 months after the concrete removal, unless by prior agreement with Historic England.

2. Site Location and Description

(Figure 1) Site location

2.1 The site is part of Elsecar Heritage Centre, one of Barnsley Museums visitor attractions (Figure 1). The site is owned by and under the care of Barnsley Museums, part of Barnsley Metropolitan Borough Council. The site is a small area adjacent to the Newcomen Beam Engine House (centred NGR SK 38702 99974) (Figure 2). This is approximately 6 miles south of Barnsley town centre. The site lies on the western side of Distillery Side.

2.2 The site is a small area, approximately 40m square, which is located to the north of the Elsecar Newcomen Beam Engine. It is thought to be the location of the former boiler house(s) related to the running of the engine.

(Figure 2) Location of Newcomen Beam Engine House and Boiler House

3. Topography and underlying Geology

3.1 The site is currently capped by concrete. The concrete is deteriorating and therefore requires replacement to ensure that the archaeology is not compromised. Undertaking this essential conservation work also offers a unique opportunity to work with the local community to find out more about this nationally significant heritage site.

3.2 The geology of the local area is a mixture of middle coal measures and sandstone (British Geological Survey).

4. Archaeological and Historical Background

The Elsecar Newcomen engine was installed in the mid-1790s, as part of the development of the Elsecar New Colliery by the landowner, the Earl Fitzwilliam. The new colliery was part of a new, planned industrial development at Elsecar. The colliery site was adjacent to the intended basin of the new Elsecar branch of the Dearne and Dove canal, which was approved by an Act of Parliament in 1793 and completed to Elsecar by 1796. It was also adjacent to the site of the new Elsecar Ironworks, which was also founded in 1795, and the two sites were closely connected.

Elsecar New Colliery was the first deep colliery to be sunk in Elsecar. It was sunk to the Barnsley Seam, approximately 120ft below ground. The Newcomen engine was required to drain water from the mine, as the new colliery was deeper than the underground soughs (deep drainage levels) that had been used to drain earlier collieries in the area (Clayton, 1964; May 2011). The engine was first used in 1795 and continued to be used for up to 12 hours a day for the next 128 years. At its peak it could raise 600 gallons of water per minute (ibid).

The Elsecar Newcomen Engine has been subject to detailed research in recent years, but little is currently known about its boiler provision. It is possible that it had an original haystack boiler, but there is currently only circumstantial evidence for this, and there are questions over whether the original boiler was internal or external.

The first known historic plans/maps of the site date from the 1840s. These plans suggest that, at this time, the boiler was probably a large, waggon-type boiler housed in a long rectangular boiler house, orientated north-south, immediately to the north of the engine house (ArcHeritage, 2011). This boiler configuration appears to have changed in the late 1850s when a shorter, wider boiler house was created, probably to house two cylindrical boilers with an east-west orientation (ibid). A report

and cross section drawing from 1918 shows the boiler house in this configuration, with two egg-ended boilers in situ.

The latest boiler house was demolished in the late 1940s. A steam receiver was installed on the site at some point, probably at the same time (although it may be have been earlier if it was originally housed within the boiler house, perhaps after the boilers had been decommissioned) to allow the engine to be operated for occasional demonstrations, with steam being brought in from the nearby workshops (ArcHeritage, 2011).

A desk-based assessment was carried out by ArcHeritage in 2011, covering the whole area of the scheduled monument (including the boiler house, engine house, later pump house and environs).

A watching brief was carried out by Wessex Archaeology on groundworks undertaken as part of the HLF-funded Newcomen restoration project in 2015. They recorded a number of features within, and close to, the area of the boiler house. This demonstrates that there is high potential for further archaeological remains to survive within the footprint of the boiler house (Wessex Archaeology, 2015).

In 2016, Historic England carried out a geophysical survey to the North of the engine house, on the boiler house site. Their results showed a number of linear features – interpreted as walls or structures relating to the boilers – surviving below the concrete to a depth of up to 2.15m. Their data also suggests that there are a number of voids below the current concrete pad (Linford, Linford and Payne, 2017).

The boiler house area has a number of visible features (including areas of brick surfacing and faced sandstone blocks with the remains of bolt fixings) that may relate to the last phase of boilers. These will be recorded before any work is carried out.

Further details and extract maps can be found in Appendix 1.

5. Aims

5.1 There core aims for the archaeological investigations at Stage 1 are:

- Record the boiler house in its current condition, including any visible archaeological features such as fixing bolts and brick surfaces
- Establish and evaluate the nature and condition of any underlying archaeological deposits following the removal of the failed concrete capping across the boiler house,

along with any future potential risks to the archaeology (such as tree roots or water ingress)

- Inform the approach for a potential future community excavation on the site (Stage 2)
- Inform the approach for managing the site in future (including reinstating a protective surface layer)

6. Public Engagement and Consultation

6.1 The public consultation has two aims attached to it; to record and shape future research questions for the site based on what questions the local community have about it, and to understand what creative responses the local community would like to see and co-create in response to the archaeological and historical finds. This consultation will be carried out by Elsecar Heritage Action Zone and Great Place Wentworth and Elsecar in advance of and following Stage 1. The results of the consultation will inform the project design for Stage 2. See Appendix 2 for the approach and group which will be engaged as part of this consultation.

7. Methodology

7.1 This part of the document outlines what will be expected of the archaeological contractors commissioned to support the project. At Stage 1, this will comprise creating an archaeological record of the site before work begins, maintaining a watching brief during the removal of the concrete and overburden (down to the top of the archaeological horizon) and producing an assessment report following the completion of the watching brief. There are likely to be opportunities to engage local volunteers in different elements of the work, and this will be explored with the contractors before work begins. Great Place and HAZ staff will provide additional support.

7.2 The concrete capping will be removed by hand. A mechanical digger with a toothed bucket will be used to gently lift the concrete where necessary. The use of percussive tools (e.g. pneumatic drills, jack hammers or mechanical breakers) will not be permitted under any circumstances.

7.3 The contractor will carry out sufficient safety checks (CAT scan etc.) before work commences, to satisfy themselves and BMBC that no services, including but not limited to; electrical cables, gas pipes and sewer/water pipes, will be disrupted during the excavation.

7.4 All archaeological features will be drawn, following standard conventions. Context numbers will be assigned to each identifiable soil layer and structure. Plans should be drawn at a minimum of 1:20 and sections at a minimum of 1:10.

7.5 A standardised pro forma record sheet will be used to record all archaeological contexts and soil horizons. Each context will be described in full on each sheet in accordance with accepted context recording conventions. Each context will be given a unique number and a register of numbers will be kept. Each of these records will be checked after completion.

7.6 Any in-situ archaeological features or deposits that are uncovered will be recorded and left undisturbed. All archaeological features/deposits will be photographed. A combination of working shots and post-excavation shots will also be taken during the watching brief, including general and more detailed views. The photographic record will comprise 35mm format back and white film. Digital photography may be used in addition, but will not form any part of the formal site archive. All site photography will adhere to accepted archaeological photographic recording guidelines.

8. Dissemination

8.1 It is expected that the archaeological contractor will provide a grey literature report following the completion of Stage 1. The contractor will also be responsible for depositing the primary site archive with Barnsley Museums and Archives, providing a digital copy of the report to the South Yorkshire Archaeology Service and uploading a copy of the report to OASIS.

9. Reinstatement

9.1 Once the work is complete, Historic England will be consulted on the best approach to assessment and future protection of the monument. As a minimum, and regardless of whether Stage 2 goes ahead or not, a breathable membrane will be installed with a new concrete surface on top (as per the current surfacing on site – i.e. a like-for-like repair), no more than 6 months after the concrete removal, unless an alternative approach is agreed with Historic England.

10. Health and Safety

10.1 Health and safety issues will take priority over archaeological matters and all archaeologists will comply with relevant Health and Safety Legislation.

10.2 A risk assessment will be produced by the archaeological contract commissioned for the work and provided to Great Place and HAZ prior to work starting.

10.3 Appropriate Personal Protective Equipment and other archaeological equipment (e.g. gloves and trowels) should be provided to participants. Members of staff and contractors on site will wear Hi-Viz jackets and there must be a first aider on site at all times.

10.4 The site should be appropriately secured out of hours to ensure that no damage to members of the public and the archaeology can occur when members of staff are not on site.

10.5 Welfare can be found within the Heritage Centre where there are toilet and hand washing facilities. There is a small, covered, brick shelter on the boiler house site, which can also be used if needed.

11. Timetabling and staffing

11.1 The archaeological contractor will be expected to provide a list of the staff who will undertake the work, their roles and a copy of their current CV detailing previous experience of work with school and community groups. It is expected that the staff will be experienced and knowledgeable in archaeological investigation, particularity in regards to industrial archaeology, and community outreach.

Bibliography

ArcHeritage, November 2011. Elsecar Newcomen-type Engine and Environs, Barnsley, South Yorkshire. Enhanced desk-based assessment.

British Geological Survey 2017 from http://mapapps.bgs.ac.uk/geologyofbritain/home.html Accessed 18.03.19

Chartered Institute for Archaeologists (CIfA) 2014. *Code of Conduct* https://www.archaeologists.net/sites/default/files/CodesofConduct.pdf Accessed 15.05.18

Drury P. and McPherson A. 2008. *Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment*. London: English Heritage. https://content.historicengland.org.uk/images-books/publications/conservation-principles-sustainable-management-historic-environment/conservationprinciplespoliciesguidanceapr08web.pdf/ Accessed 15.03.19

Linford N, Linford P and Payne A, May 2017. Elsecar, Barnsley, Report on Geophysical Surveys. Historic England.

Mitchell, J. 2003. Elsecar Engine Report. Industrial Heritage Consulting Ltd (unpublished).

Wessex Archaeology, August 2015. Newcomen Engine, Elsecar, South Yorkshire, Archaeological Watching Brief report.

ArcHeritage
54 Campo Lane, Sheffield, S1 2EG

tel: +44 (0)114 2728884
email: archeritage@yorkat.co.uk

www.archeritage.co.uk