

The Centre for
Applied
Archaeology



University of
Salford
MANCHESTER

**An
Archaeological
Structural
Survey:**

Wellington Wheel
Pit at Mellor Mill,
Stockport

Client: Mellor
Archaeological Trust
Technical Report:
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Report No: 25/2011





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Summary

This report presents the results of an archaeological structural survey of the Wellington wheel pit of the Mellor Mill immediately to the south of Low Lea Road in Mellor, Greater Manchester (centred NGR SJ 9669 8844) commissioned by the Mellor Archaeological Trust. Mellor Mill was constructed between 1790 and 1792 by Samuel Oldknow and was a multi-storey, brick built, cotton spinning mill. The mill suffered a disastrous fire in 1892 and the site has been derelict since. The Wellington wheel pit was place central to the mill and was fed by a mill pond immediately to the east. This survey consisted of a measured survey and a 3D laser scan of the remains which was carried out after initial clearance of accumulated deposits and vegetation.



1. Introduction

Introduction

Mellor Mill was constructed during 1790 – 92 and was considered to be the largest mill of its day. It was grand in its architecture and became the design prototype for later cotton mills. The mill was constructed during the zenith of water power with its main power system provided by an integrated waterwheel placed central to and within the mill; the Wellington Wheel.

Samuel Oldknow, after becoming successful in nearby Stockport, realising the potential of the resources around Mellor created an industrial and agricultural landscape around the site of the cotton mill. He diverted the River Goyt and created several ponds to serve the waterwheels that would power his mill (Arrowsmith 1997, 134-8, 149-50; Hearle 2011, 55-8).

Two large wheel pits were connected to each other through a series of underground tunnels supplying water to the various buildings ancillary to the mill. The Waterloo wheel pit lay to the north of the mill and was a later addition. This wheel pit, which contained the Wellington Wheel, was located in the basement below the central entrance to the mill and was the subject of the current survey.

According to Owen Ashmore the Wellington Wheel was estimated at twenty-two feet in diameter, seventeen feet wide and was a breast shot type waterwheel (Ashmore 1989, 32). Water from the mill reservoir, situated along the southern elevation of the mill, fed the wheel via a leat that entered the mill at ground level to serve the breast shot wheel.

Water left the Wellington wheel pit via an underground tunnel to enter the later constructed Waterloo wheel pit and from there via a further underground tunnel to other buildings on the site eventually returning to the Rover Goyt some distance away (Fig. 1 - Plan of Mellor in 1867 after Ashmore 1989).

The mill suffered a disastrous fire in 1892 and the site has reverted back to nature over the last 119 years leaving the remains of the Wellington wheel pit visible as a depression in the ground with stone work, steps and tunnel entrances visible at surface level overgrown with vegetation.

A project was developed by the Mellor Archaeological Trust (MAT) during 2010 to restore the Wellington wheel pit by removing the vegetation and infill, and consolidating the stone work using a grant from the Association for Industrial Archaeology (AIA) and monies from the Trust's funds. The initial phase involved the removal of the infill of the wheel pit in order to conduct an archaeological survey to be conducted by the Centre for Applied Archaeology, University of Salford, which is the subject of this report.

The Setting

The Wellington wheel pit is located in the tree covered area immediately to the south of Low Lea Road in Mellor (centred NGR SJ 9669 8844). It is bounded on the south by the mill reservoir, to the west by Lakes Road and the River Goyt, and to the east by a small tree covered area and open hilly grassland. To the north the land slopes down to the River Goyt where other associated buildings and the Waterloo wheel pit are situated. The land is privately owned and is mainly given over to recreational activities such as water sports, angling, and walking.

Until this project began in June 2011 the Wellington wheel pit was overgrown with several mature trees growing through the masonry structures. The pit itself was filled with accumulated soil and rubbish and has been the subject of ‘fly tipping’ with over one hundred old vehicles tyre being dumped in the pit. Remedial work has recently been carried out as part of the project and to facilitate this survey, which included some removal of vegetation and the removal of the majority of the pit infill.

The water wheel pit is not listed, is not a scheduled monument; however, it is located in an industrial and agricultural landscape created by Samuel Oldknow in the late 18th century. There are several surviving buildings from this period along with below ground remains of the mill that has been subject to archaeological evaluations which have provided good evidence of the survival of the mill’s footprint. The potential for further below-ground remains is very good and these remains could be classed as being of at least medium significance; that is undesigned archaeological remains of regional importance.

Methodology

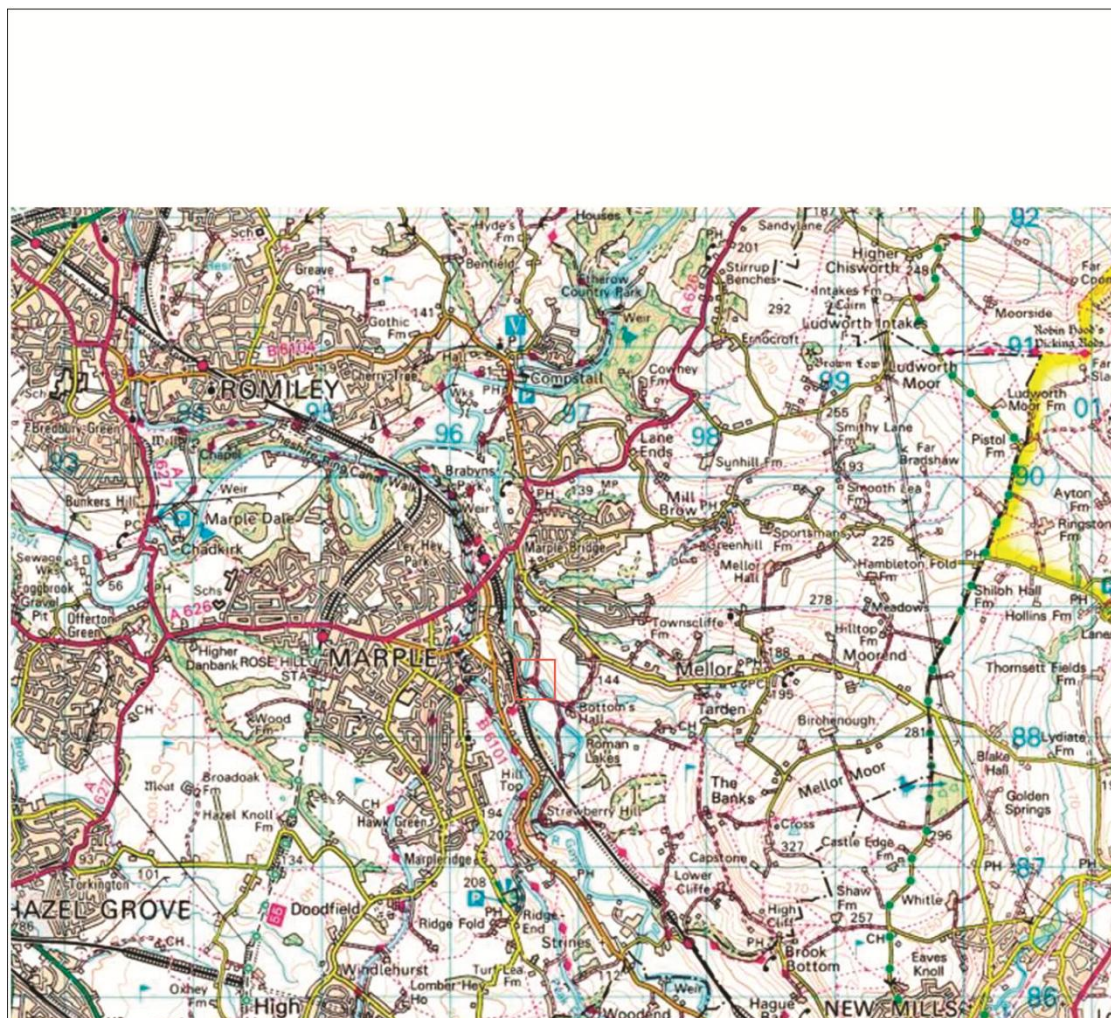
The objectives of the survey were to provide a plan of the wheel pit along with section drawings with appropriate digital format photographs of all sections and the wheel pit within its context. The objectives were decided during meetings between John Hearle (chair of the Mellor Archaeological Trust), Norman Redhead (County Archaeologist for Greater Manchester) and Adam Thompson (Principal Archaeologist for the Centre for Applied Archaeology). Further to these objectives a written buildings description and a short historical and archaeological background have been compiled for this report.

Photographs were taken using digital format and a photographic scale was used in all photographs, unless circumstances prevented this (see below). A record of each photograph taken was compiled including viewpoint location and a photograph description. All details were entered into a photographic catalogue which is included in the technical report.

Due to the depth of the wheel pit certain health and safety issues were apparent and compromises were necessary when carrying out the survey with regards to the placement of photographic scales and the measuring of certain inaccessible areas. Also, following clearance of the infill of the wheel pit and prior to the survey, a number of used vehicle tyres were again dumped in the pit. These dumped tyres compromised

certain of the photographic recording and the recording of the south-facing section and the bottom of the wheel pit.

The work was carried out in accordance with standards and guidelines for the archaeological investigation and recording of standing buildings or structures of the Institute for Archaeologists (IFA).



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M5 4NW

Site Name: Mellor Mill
Site Code: NI-MM-11
Drawing Ref: Figure 1
Date Drawn: 11.10.11
Drawn By: MB

Title:
Modern location map - OS Survey data copyright, OS reproduced by permission. Licence No. 100050261

Key:
□ Area of focus

Scale:
0 1km





2. Historical Background

Map Evidence

1849 Tithe Map

The map showed the main mill running in a north east/south west orientation with the mill pond to south east off the southern end of its south eastern elevation. The main mill was a long narrow structure with a central extension off the north western elevation and two wings at the far ends of the mill. Off the south western gable was a detached square building that was the corn mill.

The river that ran in a north/south direction turned approximately ninety degrees west a short distance before it reached the mill. Shortly after it turned ninety degrees to return to run in a north/south direction following the line of the mill and some distance away from it. Within the bend of the river was a structure that was Mellor Lodge, the house built by Samuel Oldknow. Almost on the banks of the river shortly after returning north, which was approximately opposite the southern end of the north western elevation of the mill, were four small rectangular structures that were a mechanic's shop, stable and coach house and two warehouses. Between the main mill and these four ancillary structures was a water wheel house known as the 'Waterloo' wheel.

Two leats were visible on the map running from the north western and south western corners of the mill pond. The north western leat ran into the central part of the mill where there was an extension off the south western elevation which would have fed the internal water wheel that was known as the 'Wellington' wheel. The leat off the south western corner of the mill pond fed into the dislocated structure off the south eastern gable of the mill that was the corn mill. An arm of the river extended southwards to end a short distance from the most northerly of the four ancillary buildings that was probably the tail race of the water feeding the two water wheels returning the used and overflow water to the river.

OS 1880's Map (Derbyshire)

The Ordnance Survey map of the 1880's showed a few substantial and important additions to the mill site. Off the north eastern gable of the main mill a detached square structure had been added that was the engine and boiler house that was installed sometime after the 1850's. Alterations had been made to the detached corn mill off the south western gable of the mill in that by this time although of similar shape it was now attached to that gable.

To the north of the most northerly of the ancillary buildings two further associated structures had been built the northern circular structure was designated as a gasometer and the rectangular structure to its south was the retort house.

The mill at this time was shown as '*Mellor Mill – cotton spinning*'

OS 1898 Map (Derbyshire)

It is known that the mill suffered a dramatic fire in 1896 and the map of 1898 showed this as the main mill was shown as having no cover (roof). All the other buildings were shown as being covered and presumably structurally unaffected by the fire. This map did, however, show a further addition to the mill site in the form of a long narrow structure of the southern end of the south eastern elevation that ran approximately half the length of the mill. It was connected to the central part of the mill via a curving walkway. The mill at this time was shown as '*Mellor Mill disused*'

OS 1907 Map (Cheshire) – OS 1923 Map (Derbyshire)

These maps showed no changes to the mill site.

1867 plan (from sale of mill and estate)

This plan with its associated description gives an outline of the mill its various components and its contents.

'Mellor Mill, brick built and slated, consisting of main building seven stories high, including the attic, has Four Rooms of 25 bays each, 7ft. 10in. in each bay, Three Rooms of 49 bays each 7ft. 10in. in each bay, including wings, separate Waste and Cotton Rooms, Warehousing, Countinghouse, Storerooms, Engine and boiler Houses, 3 main Stair-cases from bottom to top of Mill; detached are mechanic's smith's, joiner's and other workshops, Gasometer and Retorts, Reservoir, supplied by the river Goyt, and springs on the Estate. The Machinery comprises 23,000 throstle spindles by Wren & Hopkinson, with full complement of preparation by Parr, Curtis & Madely, of Manchester; Hoist by Hughes & Wren; the power consists of three Water-wheels of 120 (total) H.P.; Two Steam Engines each of 20 (nominal) H.P. by Goodfellow, of Hyde;'

A further plan of the site is available (Reference not yet obtained – probably from 1867 sale) that gives a stylised outline of the buildings on the mills site. The attached reference outlines the function of each area and its dimensions (**Figs. ? & ?**). The itinerary showed that the site was powered by water and steam with an octagonal chimney to the north east some distance away on the hillside. There is no mention of any of the rooms being concerned with weaving and together with the trade directories it would indicate that the mill from its inception to the 1870's was concerned solely with spinning cotton yarn.

Trade Directories

A suite of directories from 1828/29 to 1891 obtained.

1828/29 shows that Samuel Oldknow was at Mellor at that time and is shown as a *cotton spinner*

The next directory that of 1835 shows a John Clayton and Co. at Mellor. By this time Oldknow had died and left the company to Arkwright with John Clayton (a relative) as manager. Again the directory shows that the company was cotton spinning. John

Clayton and Co. are also shown as *lime burners* as it was in the life of Oldknow who built lime Kilns in the Mellor area.

The successive directories (roughly at ten year periods), the final one being from 1891, all show that Mellor Mill (sometimes referred to as Bottoms Mill) was run by John Clayton and Co. and were always shown as cotton spinners.

Worralls directory of 1887 nine years before the mill was destroyed shows that John Clayton and Co. , cotton spinners at Mellor Mill was managed by R. Furniss and the mill contained 26,656 spindles, 16”/32”. So even at this late stage of the mill’s life there is no mention of weaving even though the eastern range was shown on the maps. In 1896 there was the disastrous fire and the mill ceased production.

At no time according to the directories was the Mill shown as producing finished cloth i.e. they were not weaving. So the later building to the east along the water front may not have been a weaving shed.

The Oldknow Estate

The details of the early life of Samuel Oldknow are unclear though he originated from Nottingham. His father moved to Anderton in Lancashire where he married and had three children during their brief five years of marriage when Samuel snr. died young. Samuel jnr. was born in 1756 and was the eldest of the three children. His mother later re-married John Clayton and had three more children one called John who later became involved in the mill at Mellor.

The young Samuel was apprenticed to his uncle and in 1781 aged 25 he entered into partnership with him. The next year he returned to Anderton where he became one of the leading manufacturers of fine calico and muslin cotton products. In 1784 he obtained a loan from Richard Arkwright and purchased a warehouse and house (which still stands today) on Upper Hillgate in Stockport and began to produce cotton material becoming, over the next four years, probably the foremost muslin manufacturer in Britain.

Having made his money as a manufacturer of muslin in Stockport in the years before the construction of Mellor Mill he was attracted by the prospects of owning a landed estate with all that entailed and in 1787 he acquired the Bottoms Hall estate (Unwin G, 1924, 135). He was a local entrepreneur and constructed several buildings on his estate including Lime Kilns and a house for himself. He also was instrumental in the construction of the Peak Forest Canal.

With the Bottoms Hall Estate came water rights to the River Goyt and in 1790 construction began on the Mellor Mill. It would have been a massive undertaking with the main mill was brick built, four hundred feet long, forty-two feet wide, with six storeys high and a loft in parts. It had three wings on the north western elevation, one at either end thirty feet wide and a central wing that was also the entrance façade. Between the central and both end wings were stair towers. According to the 1867 plans (Reference) the southern wing that was of four storeys contained warehousing and the northern wing also four storeys contained had cotton rooms on the ground

floor and upper rooms for carding, warping and a lumber attic. The central wing, seven storeys high contained the offices on the ground floor with store rooms on the upper floors. The main body of the mill was divided into three areas with the central area being the largest. At the northern end, which was five storeys, were blowers on the ground and second floor with throstle spinning machines on the third. The larger central area contained throstles on the first three floors with carding rooms above. The southern area, four storeys high contained throstles on the first three floor with warehousing above.

The mill was to be water powered and contained within the basement level of the central wing was a large water wheel containing the 'Wellington' wheel estimated at twenty-two feet in diameter, seventeen feet wide and breast shot (Ashmore O., 1989, 32). It was probable that power was taken from the rim of the wheel via gearing to vertical shafts transmitting power to all floors of the mill. The water from this wheel left the wheel pit via a tunnel to another later built wheelhouse to the north west of the mill. The wheel here was known as the 'Waterloo' wheel suggesting a date of shortly after 1815 for its construction. The wheel was slightly small at twenty feet in diameter and also breast shot and supplied supplementary power to the mill suggesting an increase in machinery and production at the mill. Power from this wheel to the mill was apparently via an underground tunnel where evidence of anchor bolts and bearing supports were seen in the mill basement area. A similar shaft running in the opposite direction towards the complex of outbuilding to the north west of this second wheel would have supplied power for these buildings. Being lower than the River Goyt at this point the water went via a tunnel some six hundred metres further downstream by which time the river had dropped sufficiently in height so that the water could be returned to it. A further water wheel is known of that supplied power to stone built corn mill off the south western gable of the mill.

Water was supplied to these wheels via two headraces from the mill pond situated a short distance from the south eastern elevation of the mill. The most northerly headrace supplied the 'Wellington' wheel (and ultimately the 'Waterloo' wheel) and the one at the southern end of the mill pond to the corn mill. To supply sufficient water to power these wheels Oldknow had the course of the River Goyt diverted, built several mill ponds and constructed a whole series of underground tunnels built altering the whole landscape of the valley at this point. A visual and photographic survey of these tunnels was undertaken by the Derbyshire Caving Club who supplied a written report.

A gas holder and retort house can also be seen on the mapping to the north of the 'Waterloo' wheel house. This would probably have supplied lighting to the mill in the later parts of the 19th century.

Steam power came late to Mellor Mill but eventually in 1860 two steam engines and boilers were installed by the Hyde engineer Benjamin Goodfellow (Ashmore O., 1989, 37). Two new buildings off the north eastern gable of the mill were erected to contain the engines and boilers and a long flue contained within a tunnel was constructed to take the exhaust up the hill behind the mill to a brick chimney.

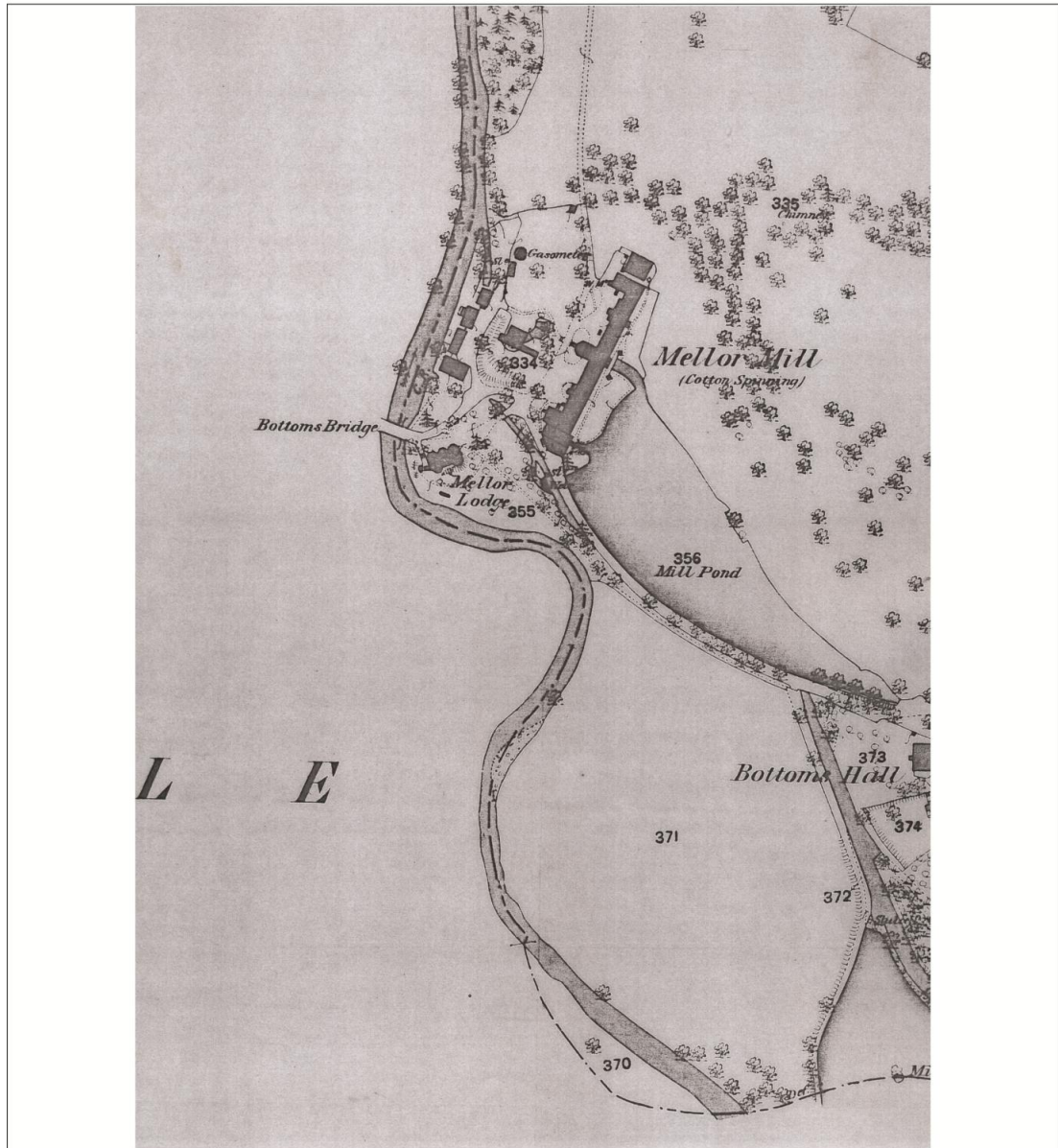
It has been suggested that this was a low single storey structure unsuited to contain machinery and may have been for extra storage. It is improbable that the mill



expanded to take on a weaving capacity and indeed evidence from trade directories would suggest that the mill was concerned only with spinning. Although the mill was producing large amounts of cotton thread from the more than 10,000 spindles in production in 1804 and Oldknow's vision for his Marple estates was considerable he was none the less easily diverted from the mill. He was heavily in debt to Richard Arkwright jnr. And on his death in 1828 his estate that was probably equal to his debt went to Arkwright in settlement. This probably did not have a great effect on Oldknow as he was unmarried and had no children. In 1824 John Clayton his half brother was appointed manager of the mill and took over the manufacturing business on Oldknow's death and the business became known as John Clayton and Company and remained so until the demise of the mill.

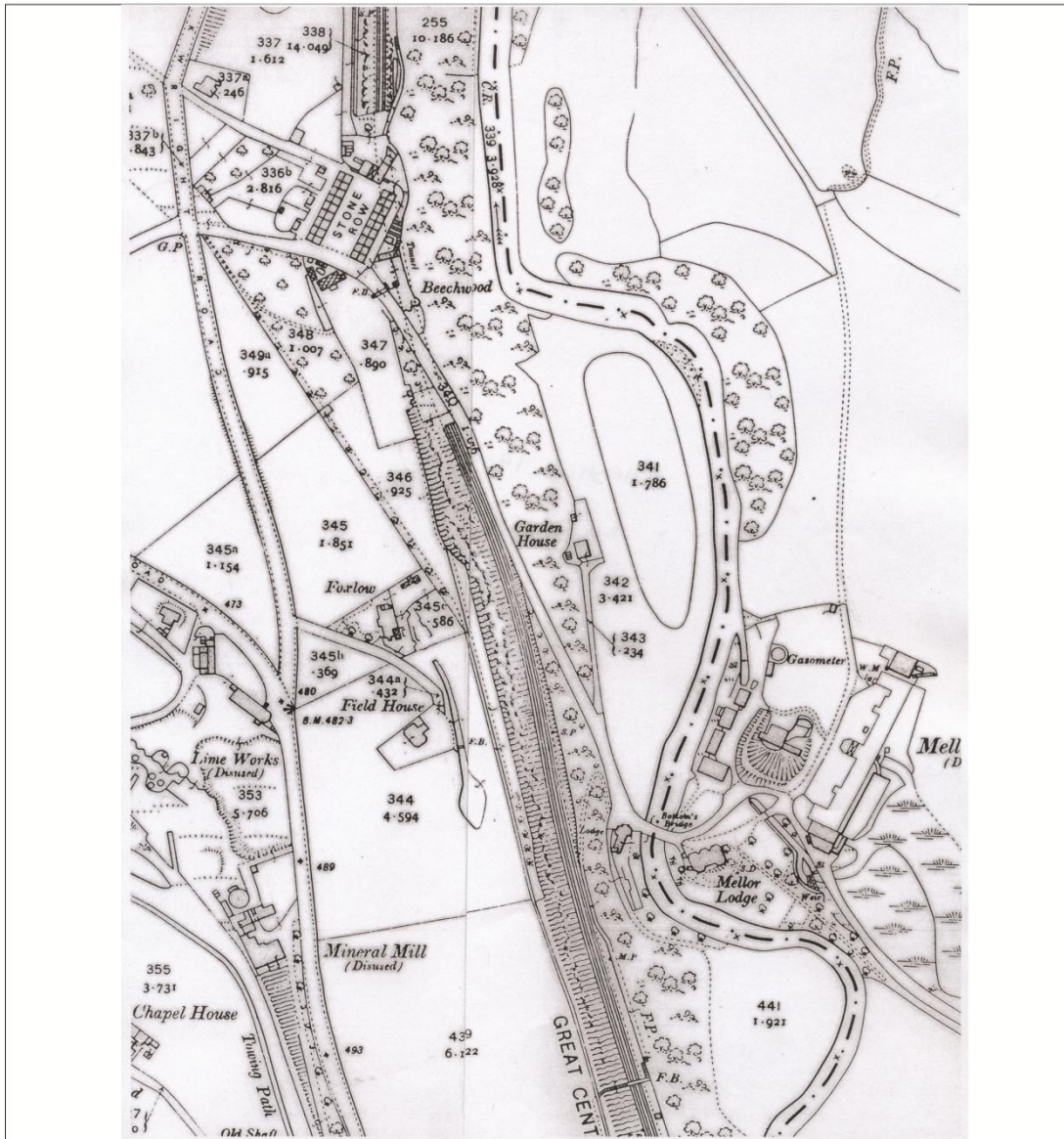
In November 1892 a disastrous fire took hold in the mill and by early morning nothing remained but the external wall of the building. Several of the outbuildings and portions of the mill remained standing after the fire and the corn mill which survived the fire intact was not demolished until the 1930's (Noble P. & Grimsditch B., 2009)

Recent works

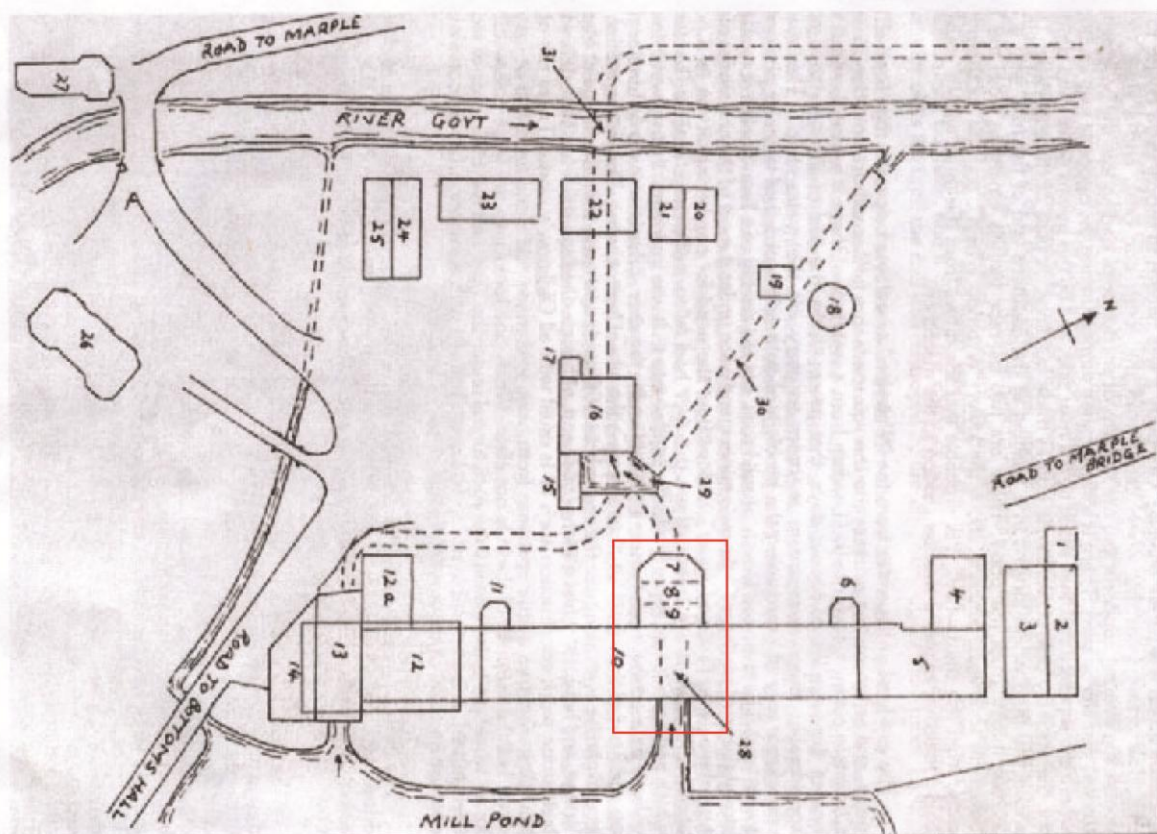
Archaeological evaluations were carried out in 2009 and 2011. The 2009 evaluation was carried out by the members of Mellor Trust supervised by Peter Noble and Brian Grimsditch and concentrated on southern end of the mill. The results of this evaluation recorded the footprint of the southern gable of the Oldknow Mill along with the remains of the corn mill and later added storage/warehouse structure along the banks of the mill pond. The evaluations of 2011 conducted by the Mellor Trust members were able to locate the central section of the western elevation. These evaluations demonstrated that there were substantial remains of the mill.




	<p>Centre for Applied Archaeology Joule House The Crescent Salford M5 4NW</p>	<p>Title: OS Edition 1880 map of Derbyshire</p>	
<p>Site Name: Mellor Mill Site Code: NI-MM-11 Figure 2 Date Drawn: 11.10.11 Drawn By: MB</p>		<p>Scale: Based on 6:1 Mile</p>	



<p>The Centre for Applied Archaeology</p>	<p>Centre for Applied Archaeology Joule House The Crescent Salford M5 4NW</p>	<p>Title: OS 1907 map of Cheshire</p>	
<p>Site Name: Mellor Mill Site Code: NI-MM-11 Drawing Ref: Figure 3 Date Drawn: 11.10.11 Drawn By: MB</p>	<p>Scale: Based on 6:1 Mile</p>		



<p>The Centre for Applied Archaeology</p>	<p>Centre for Applied Archaeology Joule House The Crescent Salford M5 4NW</p>	<p>Title: Plan of Mellor Mill based on 1860's survey</p>	<p>Key:</p> <div style="display: flex; align-items: center;"> <div style="border: 2px solid red; width: 30px; height: 30px; margin-right: 10px;"></div> <p>Wheel pit</p> </div>	
<p>Site Name: Mellor Mill Site Code: NI-MM-11 Drawing Ref: Figure 4 Date Drawn: 11.10.11 Drawn By: MB</p>		<p>Scale: Not to scale</p>		



3. Archaeological Description

Building Description

The Wellington wheel pit is located in an area of undergrowth and trees. To the east was the remains of a stone lined leat that ran from the mill reservoir to a sluice at the eastern side of the wheel pit. To the north and south the land is relatively flat and consists of further undergrowth and trees. The wheel pit lies central to the mill and the northern and southern wings of the mill lie in this narrow flat piece of land with the possible remains of an engine and boiler house constructed in the 1860's as a supplement to the water power. To the west the land is relatively flat and there is a road (Low Lea Road) that runs parallel to the western elevation of the mill after which the land slopes down to the later wheel pit (Waterloo Wheel), remains of other associated buildings and finally to the River Goyt. The trees around and within the pit vary from young seedlings to relatively mature trees some of which are compromising the masonry of the wheel pit.

The wheel pit was almost completely emptied of its infill, prior to the survey, which consisted of soils, vegetation, modern rubbish, tyres and a significant amount of rubble and masonry, probably from the collapse of the mill during the fire of the 1890s.

No water flowed through the wheel pit at the time of the survey though the bottom of the pit did have a layer of accumulated water about 0.25m – 0.30m deep and a considerable number of used tyres had been thrown back into the pit. Also on the southern side of the pit the banking was very steep and consisted of loose dry soils. These factors made it unsafe and practically impossible to conduct survey on that side and from the bottom of the pit. Consequently the survey was conducted from the three remaining sides and from the present ground level.

The overall structure of the wheel pit was rectangular in plan with its longest sides running approximately east to west. It consisted of the retaining wall of the wheel pit at its lower part with a narrow platform on three sides (north, south and west) that in turn was surrounded by a retaining wall. The eastern side comprised the leat and penstock for the waterwheel pit. It was not possible to determine the thicknesses of any of the walls. The fabric was constructed of fine ashlar, grey, sandstone of various sizes ranging from blocks 0.30m x 0.40m to 0.20m x 0.60m. The structure of the tunnels and access routes to the wheel pit were of a similar material though laid as coursed rubble. It is probable that the more visible areas of stonework may have been lined by ashlar stonework.

The wheel pit itself measured 8.05m east to west (orientation of the water wheel) and was 5.37m wide at the western end (tail race) and 4.87m wide at the eastern end (penstock). The depth was measured at 5.40m though there was still an amount of deposited material in the bottom of the wheel pit at the time of the survey and a large amount of tyres dumped by fly tippers.

Each of the four sections of the wheel pit are described in detail below:

East Facing Section

The upper part contained a stone wall in coursed rubble along its southern edge, running in a roughly east-west direction, with a gap to the north, sloping upwards to the west, of approximately 1.00m that served as an access way to the wheel pit. This wall measured c. 3.00m before it terminated running into the soil overburden. To the north of this access gap was another wall in coursed rubble running north to south. This wall measured c. 4.00m and was the same length as the width of the wheel pit being approximately c. 2.00m west from its edge. From the wheel pit running west at the northern end of the north-south wall was another possible access with the remains of stone steps. This access, which again sloped upwards to the west, terminated at a semi-circular arched tunnel in coursed rubble c. 2.00m high. This upper level was heavily overgrown and had several trees roots growing through the stonework. Also above the wheel pit edge the narrow platform between the north-south wall and the edge of the wheel pit was covered in a large amount of used tyres.

The lower part of this south facing section was the wheel pit itself and consisted of fine ashlar sandstone with blocks of various sizes. Central to this lower part of the wheel pit was a semi-circular arched opening leading to a tunnel that was the tail race for the water wheel. This arched opening directed the 'used' water through an underground tunnel to the Waterloo wheel pit and then onto the other buildings and eventually the River Goyt. On either side of the south facing section in the corner formed by the northern and southern facing sections of the wheel pit were remains of a stone water wheel rebate that formed a curve at the bottom of the pit. Running diagonally from the top southern end to the lower northern end of this lower section was a single course of much smaller stone blocks.

South Facing Section

This side of the wheel pit was again at two levels. At the eastern end of the upper level was a semi-circular arched tunnel c. 1.00m wide with stone steps that led down to the wheel pit. Opposite these stone steps at the western end were another set of stone steps also leading down to the wheel pit. The tunnel was of coursed rubble, although the rear retaining wall was of fine ashlar. At the bottom of the sets of steps was an opening that although central to the wheel pit wall contained no structural evidence for bearings or other attachments for the wheel axle. However, this opening was mirrored in the north facing section opposite suggesting that the ashlar stones containing the fixing bolts for the axle brackets had been removed either during the demolition of the mill or sometime during the 20th century.. The retaining wall of the wheel pit that was the lower part of this section was of fine ashlar of similar sized blocks. However, the second course from the top of the surviving wall was much narrower being approximately one third of the thickness. In the western corner of this section of the wheel pit was the remains of the wheel rebate that was of fine ashlar block shaped on the eastern side to follow the form of the curve of the wheel.

North Facing Section

This section appeared to be a mirror image of the south facing section though in a less well preserved state. There appeared to be two access points at its western and eastern ends but any tunnel had collapsed and only two steps at the western end were visible, the rest having either been removed or were covered in a thick layer of soil and debris. The wheel pit itself contained a similar opening to that seen directly opposite in the south facing section, though again no bearings or other wheel attachments were evident (see above). This section also had the narrow course of ashlar, two courses down from the top of the remaining wall and at the same level as the opposite wall.

West Facing Section

The lower part of this section was the waterwheel pit formed by fine ashlar sandstone with the central stone of the top course having been damaged. This was the location of the penstock to the original wheel, a sluice mechanism designed to control the flow of water onto the wheel. The ashlar wall on this section curved at the bottom towards the west to accommodate the curvature of the water wheel. At the northern and southern ends of the wheel pit curving wall were two walls running in an east west direction that formed the walls of the head race. The walls that formed the upper part of this section varied in height due to parts having collapsed and were of coursed rubble with facings of large fine ashlar. At the western end of these two walls, close to the edge of the wheel pit, was a rebate measuring c. 0.10m wide that was probably the rebate for the sluice gate associated with the penstock.



4. Discussion

Mellor Mill and the Archaeology of the Waterwheel in the North West

Waterwheels (wheels rotated by water to generate mechanical power) are amongst the oldest form of mechanical power systems (Jones 1996, 420; Rynne 2009, 85). They have provided power for driving machinery, corn mills and fulling mills for instance, since Roman times (the earliest example in North West England being a Roman watermill excavated in 2010 on the River Derwent at Cockermouth in Cumbria), but are best known from the Post-medieval and Industrial Periods, like that which once stood in the wheelpit at Mellor Mill.

There are two categories; firstly, the primitive horizontal, low power, waterwheel which is sometimes known as a Norse Wheel (Rynne 2009), and secondly the common vertical wheel, the type installed at Mellor Mill. Within the latter category there are three main types of vertical water wheel. Firstly, the undershot wheel, where floatboards or later buckets, dipped into flowing water, the wheel being turned by the water striking the floatboards. Secondly, the breast wheel where the water hits the wheel below the top of the wheel. Thirdly, the overshot wheel, where the water hits the top of the wheel which then rotated in the same direction as the water flow. Where the wheel rotated backwards, or in the opposite direction to the water flow, this was known as a pitchback wheel. The waterwheel at Mellor Mill was a high breast shot type wheel with the lip of the penstock c. 5.40m above the base of the wheel.

The power of a vertical water wheel depends upon many factors but the three most important are; its diameter, width, and the velocity of the water. Undershot wheels give only low power whilst greater force comes from breast, overshot and pitchback wheels. With the use of buckets instead of floatboards the water was arranged so as to fill the buckets on one side of the wheel so as to upset the balance of the wheel which then rotated through the action of gravity. Water velocity was important since the power a wheel can develop varies with the square of water velocity. Velocity could be varied in two main ways; firstly, by the speed of the water horizontally so that fast moving 'infant' streams that could generate the same power with less water than slow moving 'mature' rivers; secondly, by the height of the fall of water, that is the potential energy of the water falling vertically whilst in the buckets. However, in both cases in order to achieve the given point of contact between the water and the wheel (ie undershot, breast or overshot) it was often necessary to build long leats, or canals, to bring the water onto the wheel at the desired height. At Mellor the flow and depth of the water falling onto the wheel are unknown so a precise calculation of the horsepower output cannot be given. However, the size of the waterwheel, which is recorded at 22 feet diameter and 17 feet wide and (6.71m x 5.18m) is roughly two-thirds the size of that at Quarry Bank Mill, where a high breast waterwheel of 31 feet 6 inches diameter and 20 feet 8 inches wide (9.6m x 6.3m) was installed in the period 1817-20 to produce 100 horsepower (Callindine & Fricker 1993, 61-2). This suggests that the Mellor Mill waterwheel would have produced more than 50hp.

In the 18th and 19th centuries the design of the water wheel developed rapidly. At first waterwheels were of massive all-wood construction, of compass or clasp arm design. Compass arms were fastened to the axle tree by mortice and tenon which weakened the wheel at the point where the strength was most needed. Clasp arm designs made a stronger wheel as the arms formed a square claspings the axle tree without weakening it. Power was transmitted directly through the axle to a secondary adjacent wheel known as the pit wheel and from the pit wheel line shafting ran either horizontally or vertically to run machinery. Around 1770 cast-iron axles were introduced and the suspension water wheel was introduced by Thomas Hewes (1768-1832) around 1802 (Jones 1996, 423; Rynne 2006, 37). This light-weight all iron version of the water wheel replaced the pit wheel with gear teeth mounted on the rim or shroud of the wheel, known as rim gearing. Furthermore, the drive shaft gear could rotate at greater speeds, which greatly enhanced mechanization by permitting power to be transmitted at higher speeds and greater distances. And finally, the rim gearing reduced the strain on the axle and spokes, which allowed a lighter construction similar to a bicycle wheel. Although the axle seat has been located at Mellor Mill, the position of any pit wheel has not. In theory there should have been two, one on either side of the wheelpit to run throstle spinning machines in each half of the mill, a layout seen in many East Cheshire mills in the late 18th and early 19th century (Calladine & Fricker 1993). Since rim-gearing was not invented until round 1802, the original 1790 wheel in the Wellington Pit must have been driven from the axle via one or two pit wheels and these must have been filled in at a later date when the wheel was upgrade or replaced to take rim gearing. There is no structural nor archaeological evidence found by the current survey to suggest that this primary wheel was in fact two wheels which were later replaced by a single wheel.

Water-power continued to be used in textile mills throughout the 19th century, despite the growing dominance of steam power. Water-powered textile mills were built as late as the 1840s in North West England, as at Diggle Mill in Saddleworth, and often new suspension waterwheels replaced earlier claps arm ones, as at Dale End Mill, Lothersdale, North Yorkshire, which was installed in 1861 (SD 96 45). It is therefore unsurprising that steam power, although introduced in 1860 at the north-eastern end of the mill, did not replaced but rather supplemented, the original water power systems at Mellor Mill.

There are a number of excavated examples of textile wheelpits from the cotton and silk mills of the 18th and 19th centuries in North West England (Brennand with Chitty & Nevell 2006, 185-8). These include the Old Mill at Congleton, built in 1753, where the primary low breast shot waterwheel, 19ft 6 inches (5.94m) in diameter and 5ft 10 inches (1.78m) wide, ran silk throwing machinery. This was excavated in 2003 which also revealed the location of the pit wheel (Fletcher 2008, 49-50). The wheel pit for the cotton spinning mill known as Castle Mill, Stockport, built in 1778, was excavated in 2003 and proved to be a narrow low breast shot wooden structure, 40ft (12m) in diameter and 6ft (1.8m) wide with paddles (Nevell 2010, 156-8). Finally, the primary breast shot wheel pit at Quarry Bank Mill on the River, built in 1784, was rediscovered and excavated in 1994 along with the secondary breast shot wheel pit from 1796, which contained an iron waterwheel (Milln 1995, 8-10).

All three excavations demonstrate that a fuller understanding of the form and development of Wellington Wheel can only be achieved by detailed excavation in and around the wheel pit itself.



Appendix 1: Photographic Catalogue

Figure number	Description	Orientation – Looking
6	East facing section	West
9	South facing section	North
12	North facing section	South
15	West facing section	East
18	View down onto south facing section and steps	North
19	Shot of steps on northern axle bed.	West
20	View from leat	West
21	View from above wheel pit.	East
22	View from south side axle bed. Top of east facing section visible and in background.	North
23	View from east facing section towards leat and steps on left	East



Appendix 2: Archive

The archive comprises annotated field drawings and digital photographs. This archive is currently held by the Centre for Applied Archaeology. A copy of this report will be deposited with the Greater Manchester Sites and Monuments Record held by the Greater Manchester Archaeological Unit.



Appendix 3: Sources

Sources

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Appendix 4: Illustrations

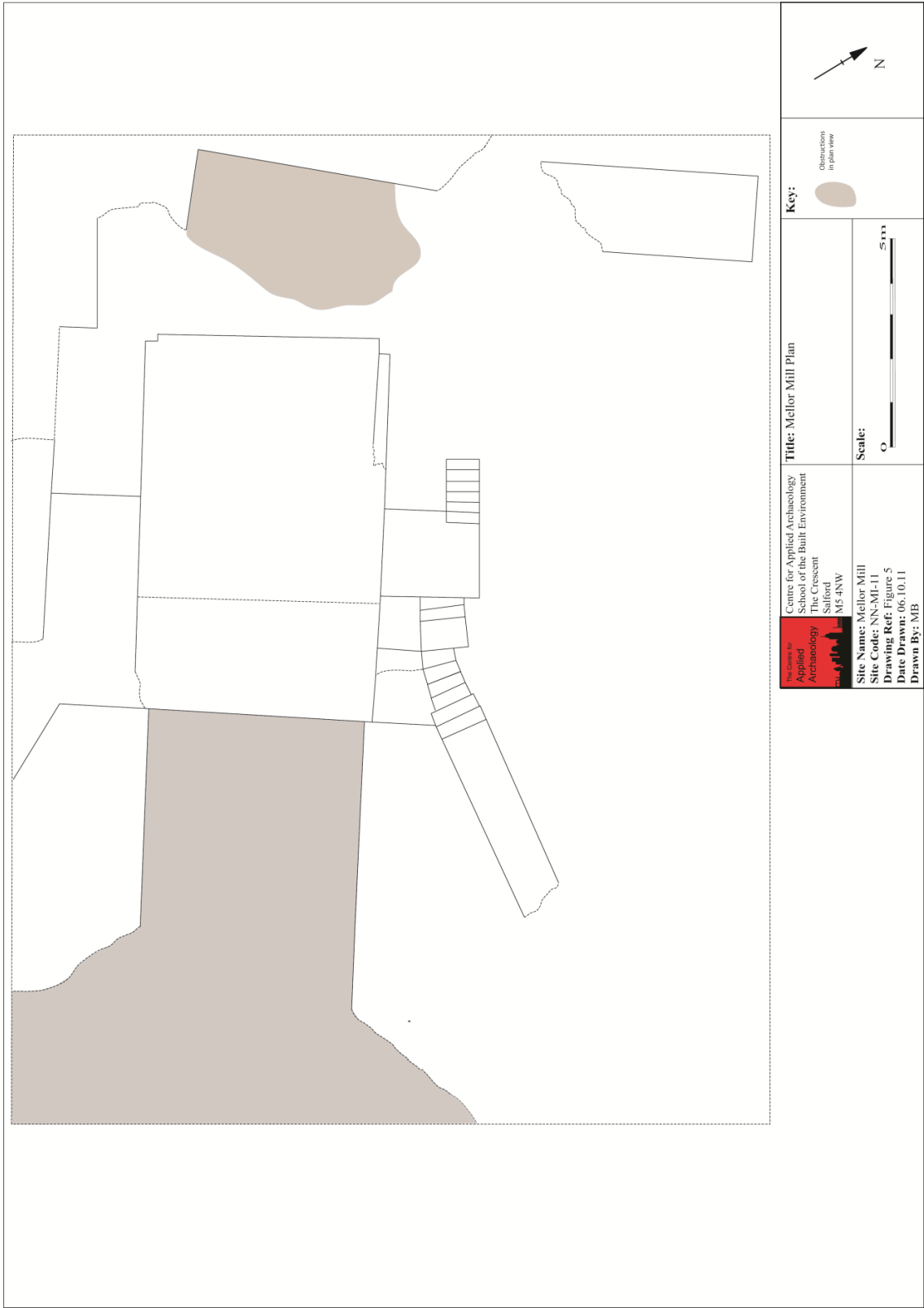




Figure 6: East Facing Section

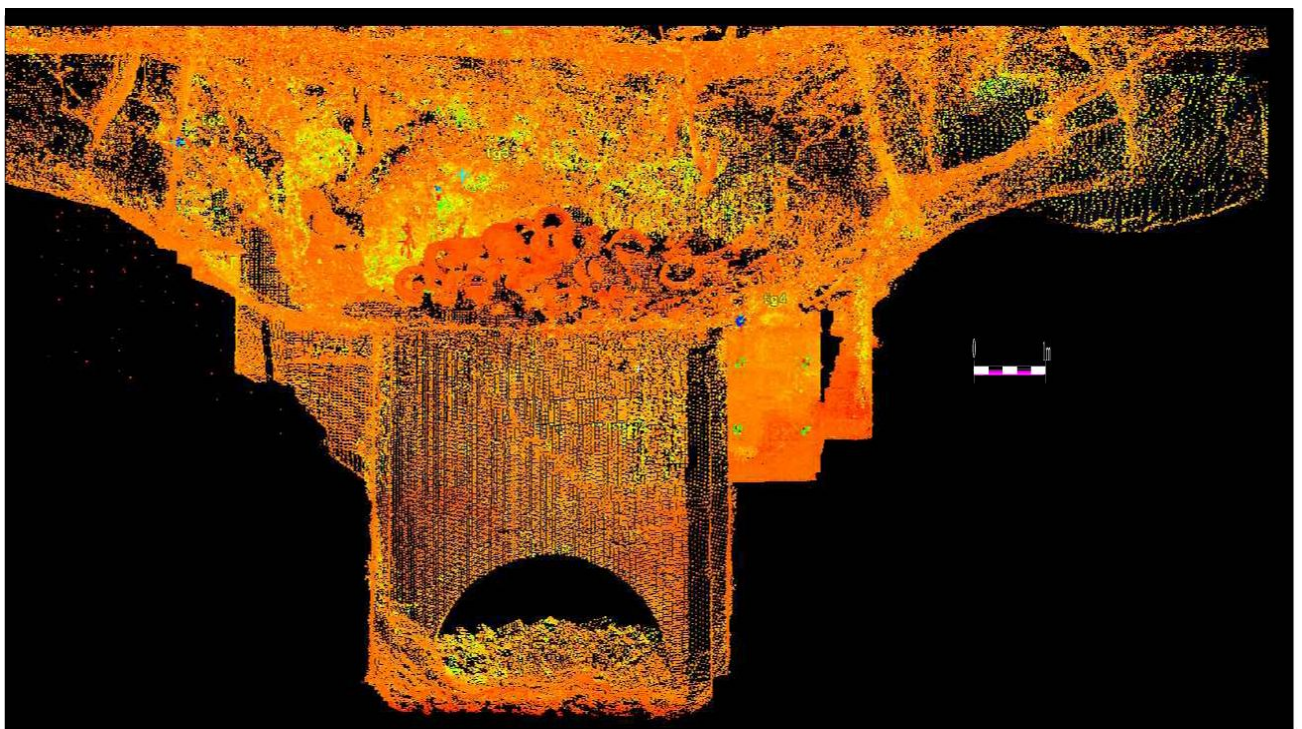
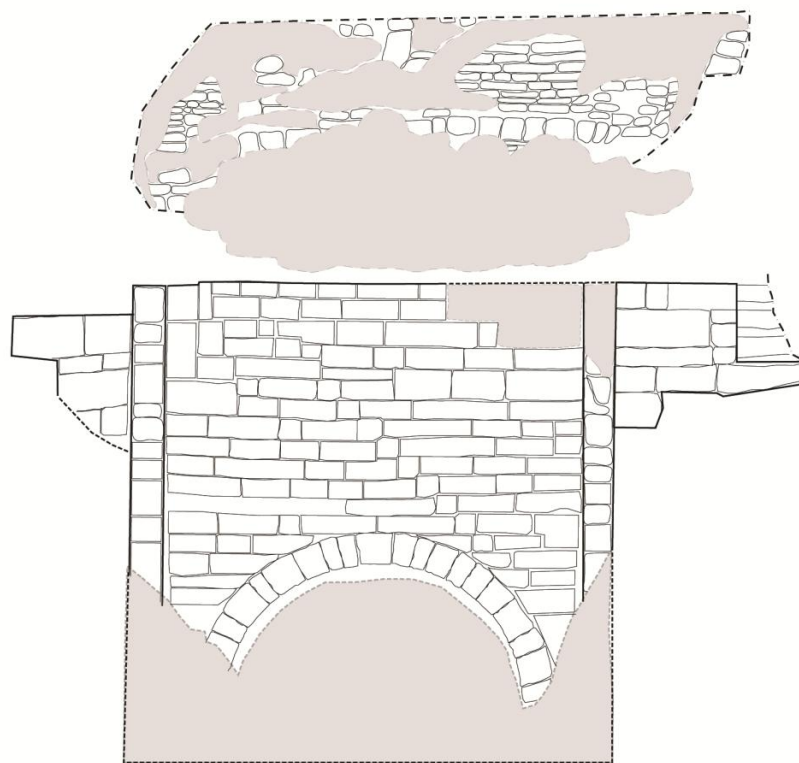


Figure 7: East facing section scan. Point cloud data image.



Centre for Applied Archaeology
 Joule House
 The Crescent
 Salford
 M5 4NW

Site Name: Mellor Mill
Site Code: NI-MM-11
Drawing Ref: Figure 8
Date Drawn: 10.10.11
Drawn By: MB

Title:
 East facing
 section

Scale:



Key:



Foliage obstructing
 visibility



N



Figure 9: South facing section.

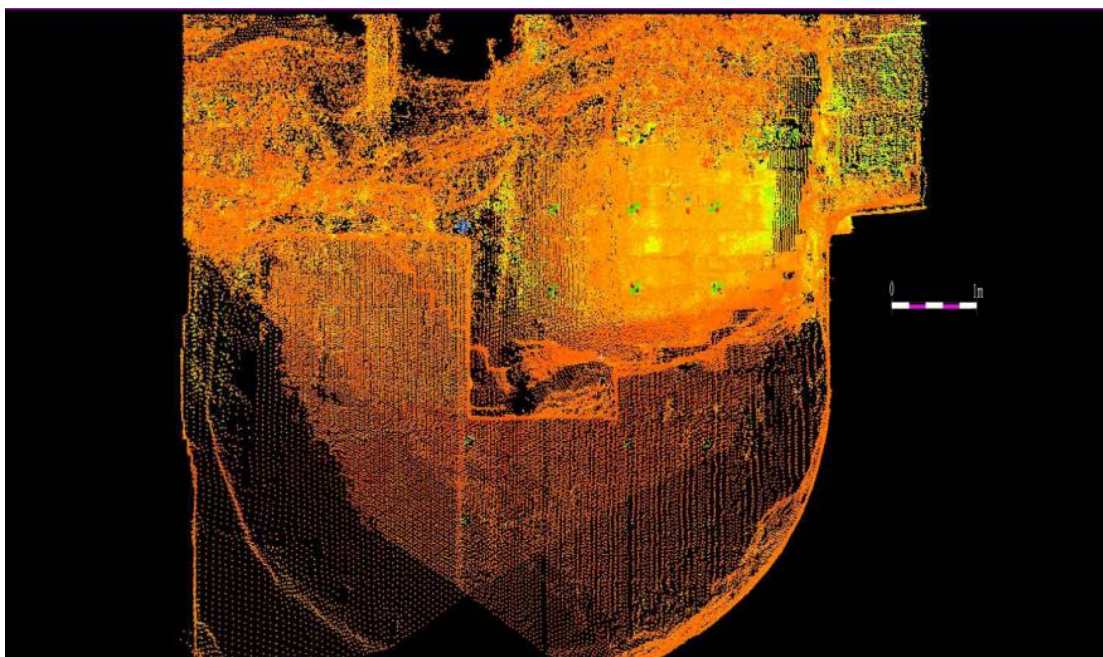
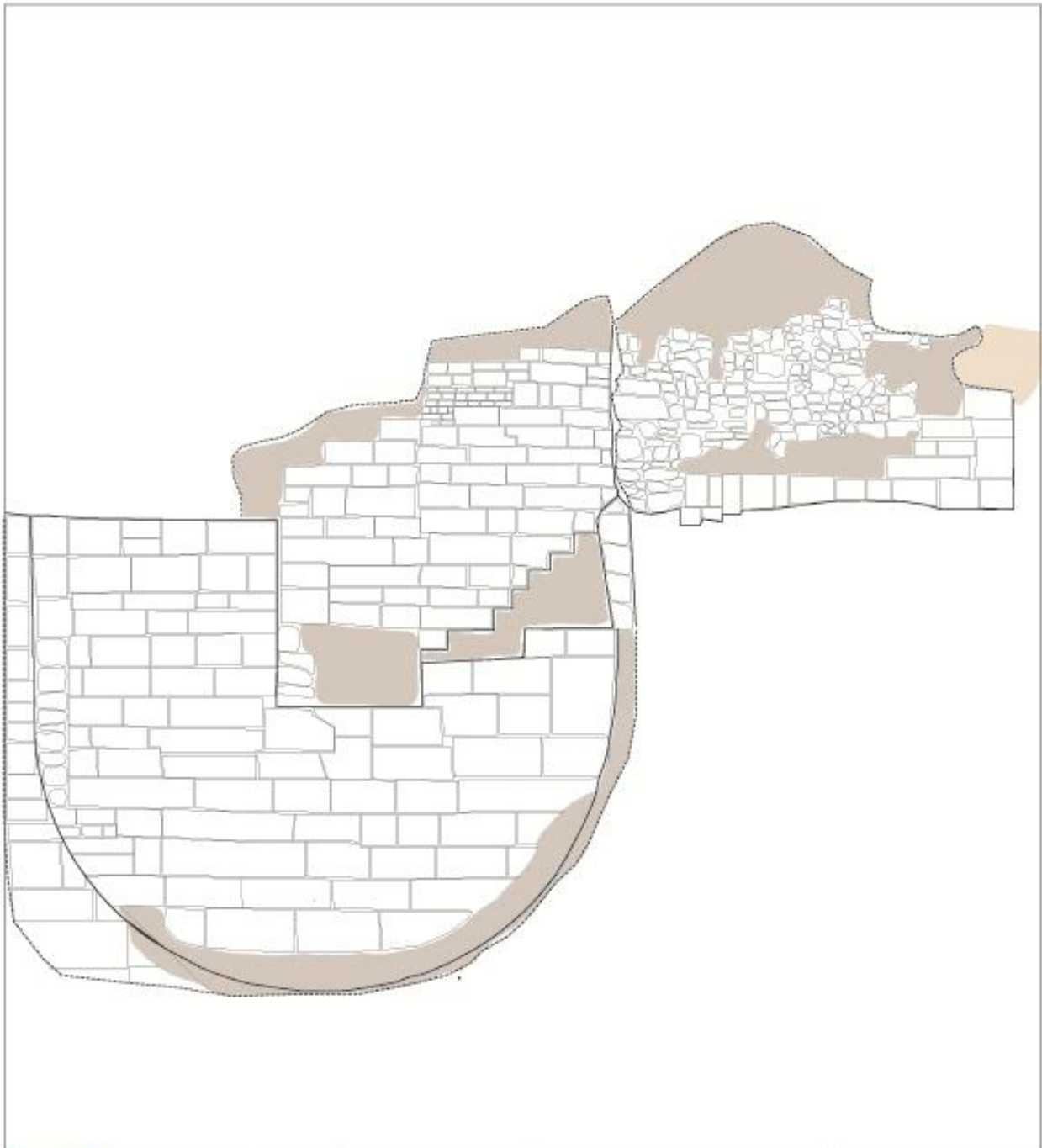


Figure 10: South facing section scan. Point cloud data image.







<p>The Centre for Applied Archaeology</p>	<p>Centre for Applied Archaeology Joule House The Crescent Salford M5 4NW</p>	<p>Title: South Facing Section</p>	<p>Key:</p> <p> Foliage obstructing visibility</p>	
<p>Site Name: Mellor Mill Site Code: NI-MM-11 Drawing Ref: Figure 11 Date Drawn: 07.10.11 Drawn By: MB</p>	<p>Scale:</p> 	<p> Tree</p>		



Figure 12: North facing section

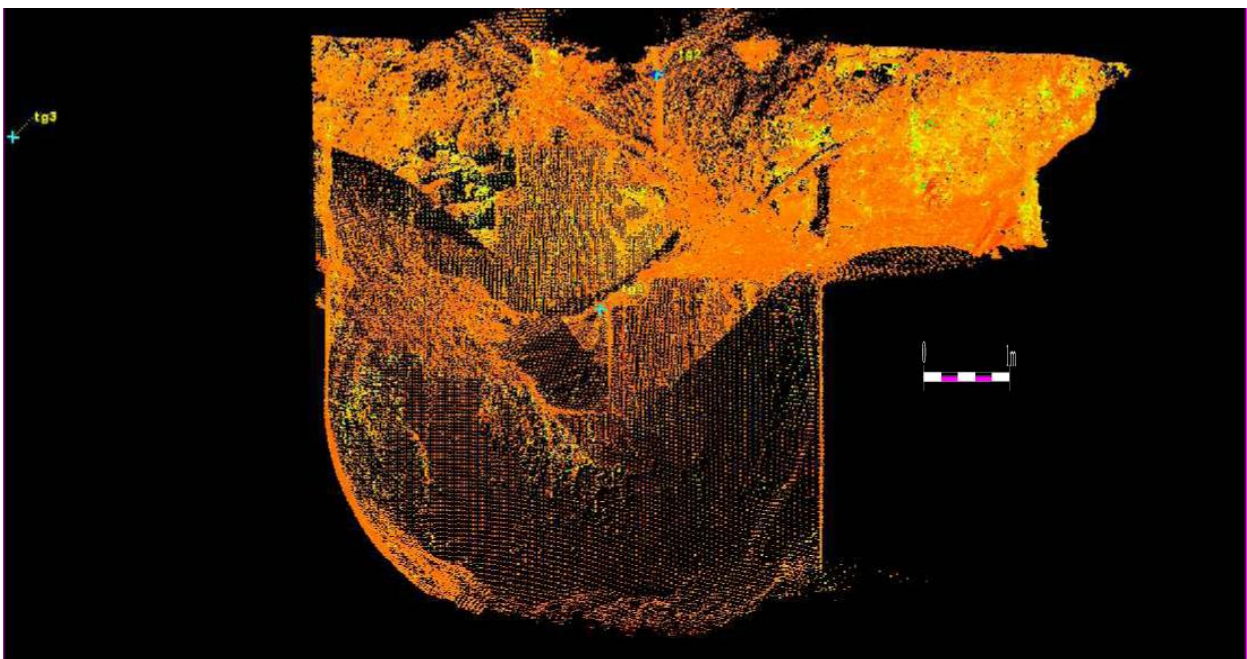
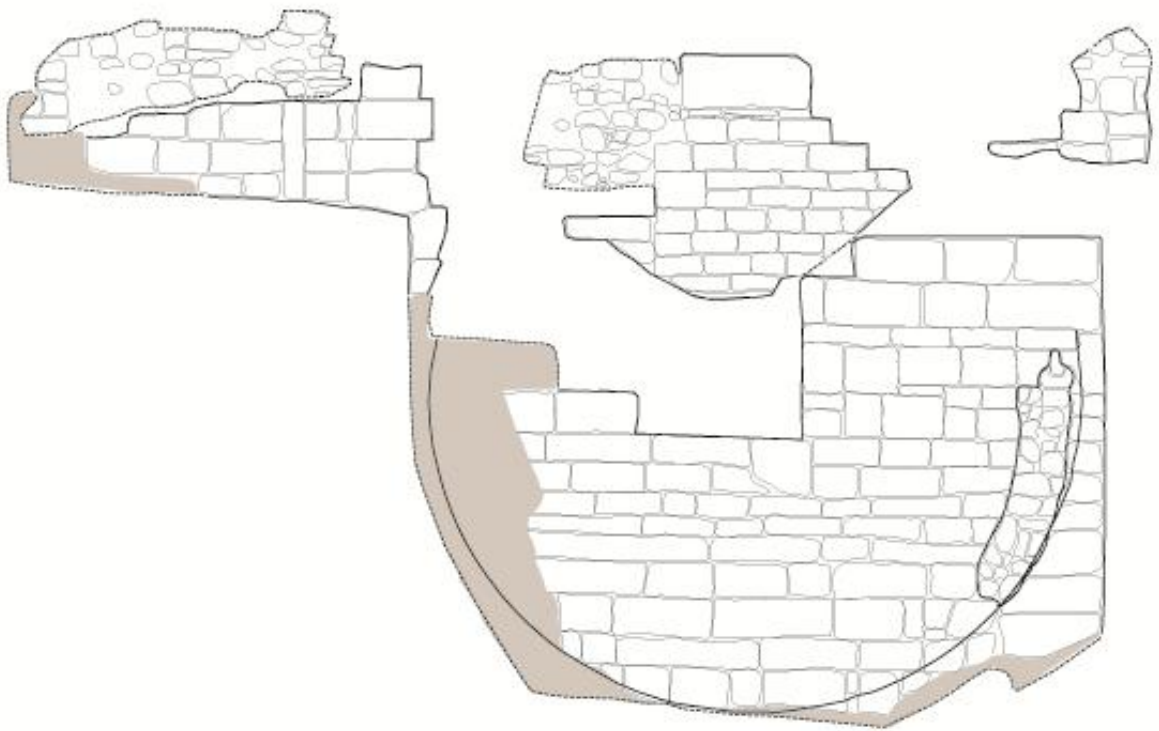


Figure 13: North facing section scan. Point cloud data image.



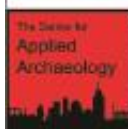



	Centre for Applied Archaeology Joule House The Crescent Salford M5 4NW	Title: North Facing Section	Key:  Foliage obstructing visibility	 N
Site Name: Mellor Mill Site Code: NI-MM-11 Drawing Ref: Figure 14 Date Drawn: 10.10.11 Drawn By: MB	Scale: 			



Figure 15: West facing section

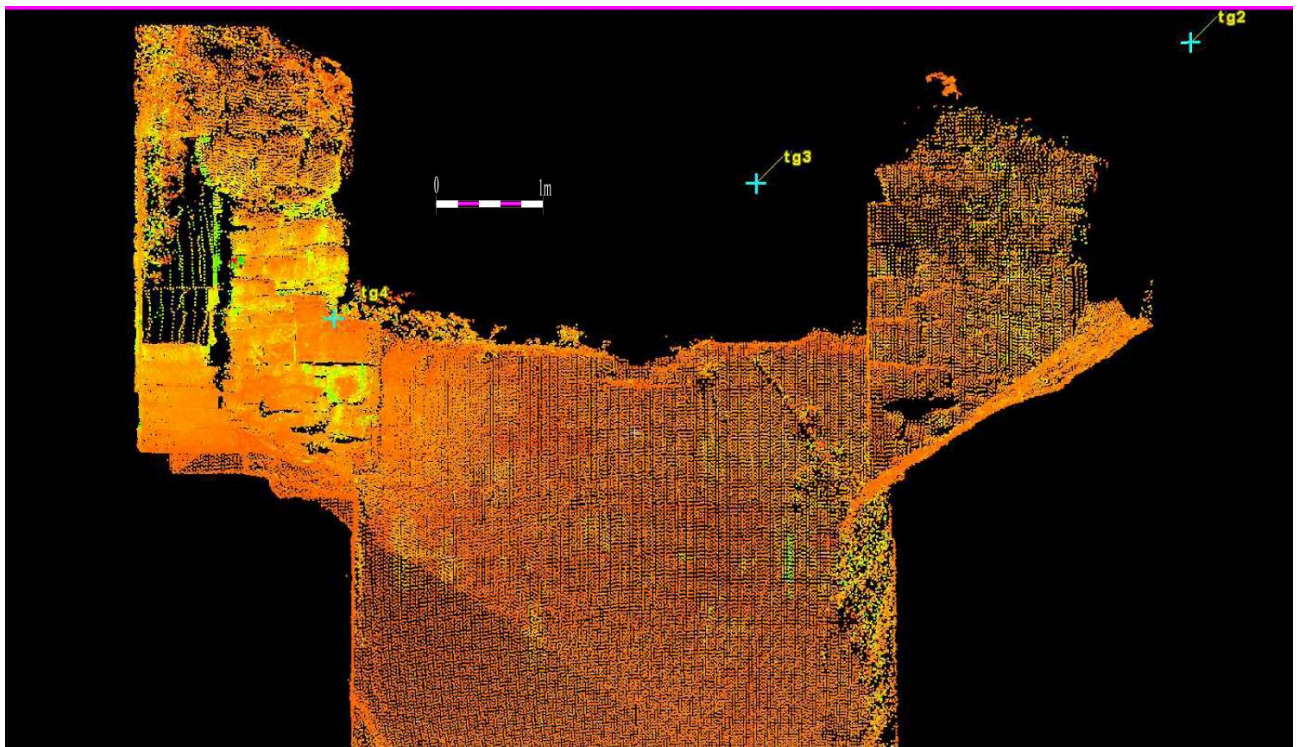
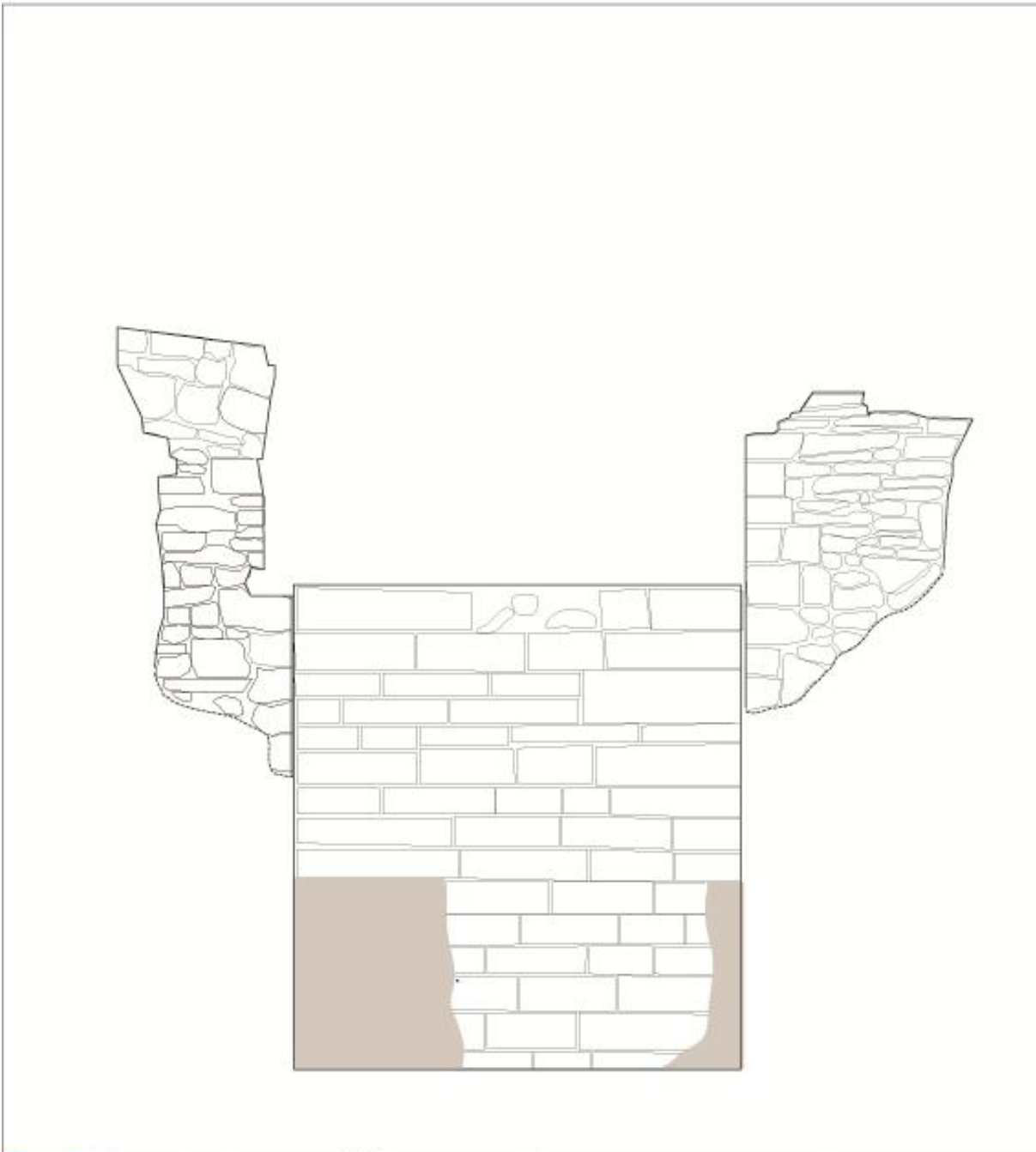


Figure 16: West facing section scan. Point cloud data image.



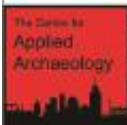



	Centre for Applied Archaeology Joule House The Crescent Salford M5 4NW	Title: West Facing Section	Key:  Foliage obstructing visibility	 N
Site Name: Mellor Mill Site Code: NI-MM-11 Drawing Ref: Figure 17 Date Drawn: 10.10.11 Drawn By: MB	Scale: 			



Figure 18: View down onto south facing section and steps. Looking north.



Figure 19: Looking west. Shot of steps on northern axle bed.



Figure 20: View from leat. Looking west.



Figure 21: View from above wheel pit. Looking east.



Figure 22 – View from south side axle bed. Top of east facing section visible.



Figure 23: View from east facing section towards the leat and steps on left. Looking east.