ISSN 1478-7008

ENGLISH HERITAGE

Basingill Gunpowder Works and Garden, Cumbria:
an archaeological and architectural survey

Abby Hunt and Ian Goodall

SURVEY REPORT

Archaeological Investigation Report Series AI/42/2002

Basingill Gunpowder Works and Garden, Cumbria: an archaeological and architectural survey

Archaeological Investigation Report Series AI/42/2002

NMR Nos: SD 58 NW 35, 53-59
NGR: SD 507 867
SAM/RSM No: 27834
SMR No: 14224

Surveyed April-May 2002
Surveyed by A. Hunt, M. Jecock, T. Berry, N. Fradgley and I. Goodall
Report by A. Hunt and I. Goodall
Drawings by P. Sinton and T. Berry
Photographs by K. Buck and A. Hunt

ISSN 1478-7008

York Office: 37 Tanner Row, York YO1 6WP
Tel: 01904 601901 ***Fax:*** 01904 601998
National Monuments Record Centre, Great Western Village, Kemble Drive, Swindon. SN2 2GZ
Tel: 01793 414700 ***Fax:*** 01793 414707 ***World Wide Web:*** http//www.english-heritage.org.uk

CONTENTS

LIST OF ILLUSTRATIONS

1. INTRODUCTION, SITE LOCATION AND SUMMARY 1

2. GEOLOGY, TOPOGRAPHY AND LAND USE 4

3. HISTORY OF RESEARCH 6

4. THE DOCUMENTARY HISTORY OF THE WORKS AND GARDEN 7

4.1 Documentary evidence 7

4.2 Photographic evidence 13

5. DESCRIPTION AND ANALYSIS OF THE FIELD REMAINS OF THE GUNPOWDER WORKS 16

5.1 The Gunpowder Works 16

5.1.1 The water power system 16

5.1.2 The Incorporating Mills 21

Northern incorporating mill group 21

Middle incorporating mill group 24

Southern incorporating mill group 27

5.1.3 Blast walls 30

5.1.4 Other gunpowder buildings 30

5.1.5 The perimeter wall and area beyond 32

5.2 Modern features 33

6. DESCRIPTION AND ANALYSIS OF THE FIELD REMAINS OF THE GARDEN 34

6.1 The terraced walk 34

6.2 Informal woodland walks 36

6.3 Viewing area 37

6.4 Water features 38

7. DISCUSSION AND CONCLUSIONS 40

8. SURVEY METHODOLOGY 46

9. ACKNOWLEDGEMENTS 47

10. BIBLIOGRAPHY 48

Appendix 1: The process of gunpowder manufacture 51

Appendix 2: List of recorded explosions at Basingill 52

Appendix 3: The archive and photographic record 54

Appendix 4: List of NMR numbers linked with the survey 56

LIST OF ILLUSTRATIONS

1. General location diagram 1

2. Local setting diagram 2

3. Aerial view of Basingill gunpowder works from the north-west 4

4. Lithograph of Force Bridge, printed in 1826 7

5a. The site of Basingill gunpowder works and garden as mapped at 1:2500 scale in 1857 9

5b. The site of Basingill gunpowder works and garden as mapped at 1:2500 scale in 1896 and 1897 11

5c. The site of Basingill gunpowder works and garden as mapped at 1:2500 scale in 1912 12

6. Postcard of the northern incorporating mill group at Basingill, c 1900 13

7. Early 20th-century photograph of the northern incorporating mill group at Basingill 14

8. Basingill from Force Bridge looking south, probably taken in the 1960s 14

9. Northern incorporating mill group from the west bank of the River Kent, 1962 15

10. English Heritage earthwork plan of the Basingill gunpowder works and garden, reproduced at 1:1000 scale 17

11. Schematic diagram of the gunpowder works at Basingill 18

12. Entrance to covered leat 19

13. Rennie's Hatch in southern incorporating mill group 20

14. Plan of northern incorporating mill group 22

15. Flight of steps in mill 2 23

16. Plan of middle incorporating mill group 25

17. Middle incorporating mill group from the south 25

18. Floor joist sockets in mill 4 26

19. Plan of southern incorporating mill group 27

20. View over the southern incorporating mill group from the north-east *28*

21. Southern incorporating mill group with blast walls in situ *29*

22. Detail of more westerly blast wall in southern incorporating mill group *29*

23. Blocked gateway and doorway in the perimeter wall *31*

24. The archway of the terraced walk *34*

25. Schematic diagram of the garden at Basingill *35*

26. View over Levens Force *37*

27. The 'dropping well' *38*

28. Wall collapse below the terraced walk *39*

29. Small pond *39*

30a-c. Reconstruction drawings of the incorporating mill groups *42-43*

31. General view of the site showing vegetation cover *45*

1. INTRODUCTION, SITE LOCATION AND SUMMARY

During April and May 2002, English Heritage undertook an archaeological and architectural survey and investigation of Basingill Gunpowder Works, Cumbria. The survey was undertaken as part of a wider, thematic, project (Dunn 2000) investigating gunpowder manufactories across the whole of Cumbria, initiated in June 1999 as the logical progression to English Heritage's Monuments Protection Programme's (MPP) Step 3 and Step 4 reports for the gunpowder industry nationally (Gould 1993; Chitty 1996). Although there has been considerable interest and research into the Cumbrian works in recent years, directed at both the group as a whole and individual sites (*eg* Wilson 1964; Marshall and Davies-Shiel 1969, 75-88; Crocker 1988, 36-41; Crocker and Crocker 1992; Patterson 1995; Palmer 1998; Tyler 2002), this has mostly concentrated on the documentary evidence with little formal examination or detailed recording of the physical remains. English Heritage's Cumbrian Gunpowder Industry Project is intended to rectify this omission, and will aid conservation management of those powder works which have been designated in whole or in part as protected monuments; the inclusion of all sites irrespective of their current level of designation will also enhance our overall understanding of what was an important regional industry.

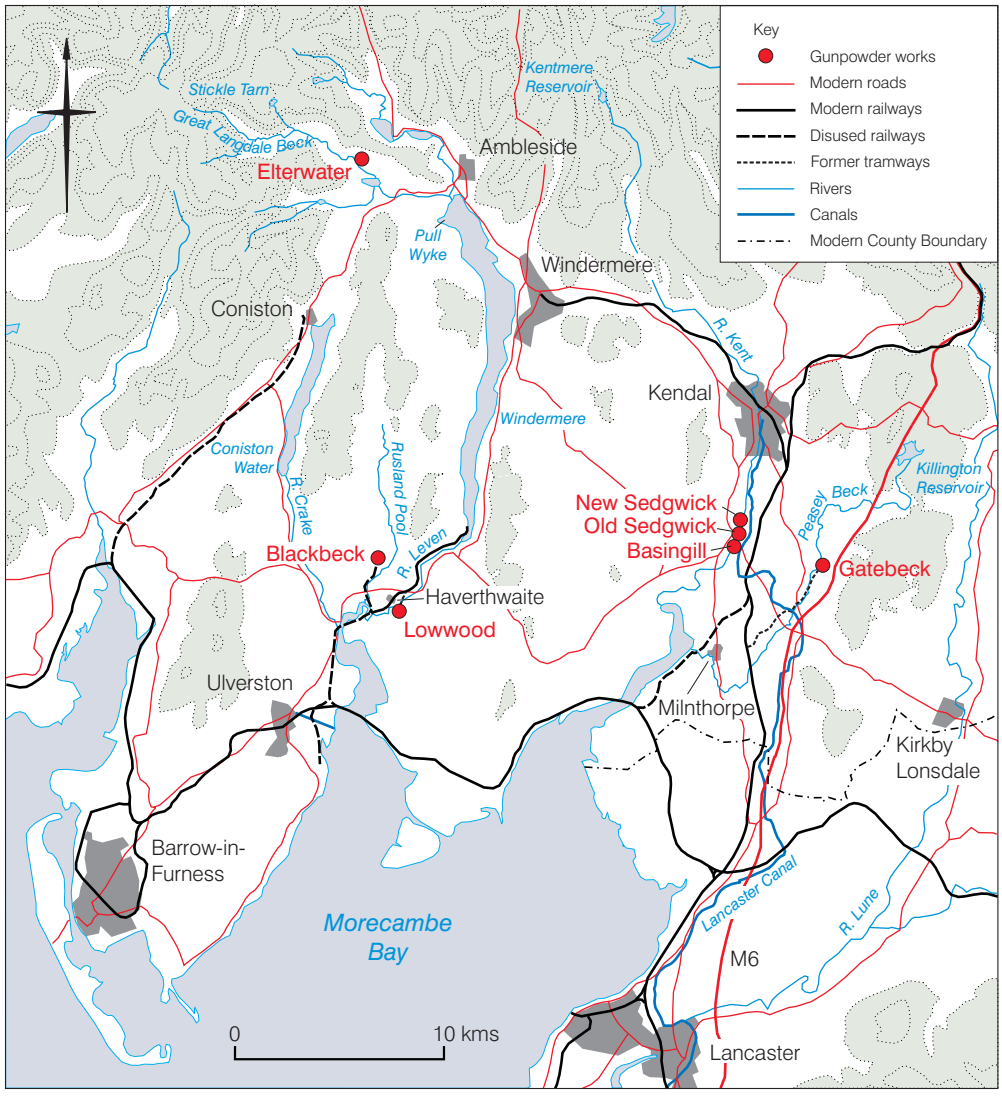


Figure 1. General location diagram

The Basingill works is one of seven powder manufactories (eight if Gatebeck is treated as two sites), which operated in the historic county of Westmorland and the Furness area of Lancashire (present-day south Cumbria), at various times between *c* 1764 and 1936. All produced gunpowder chiefly for the civilian, as opposed to the military, market. Geographically, the works are concentrated at four locales across the region: Basingill, New Sedgwick and Old Sedgwick lie in close proximity along the banks of the River Kent 5-6km south of Kendal; the Gatebeck High and Low Works are beside the Peasey Beck, south-south-east of Kendal; Blackbeck and Lowwood occupy neighbouring valleys close to Haverthwaite; whilst Elterwater forms an outlier at the foot of Great Langdale (Figure 1). The industry became established in Cumbria partly as a result of increasing demand nationally for blasting powder for mining and quarrying through the 18th century, but also because the southern Lake District provided a very suitable environment for powder manufacture. Besides having numerous fast-flowing and sizeable rivers whose waters could be harnessed to supply power, the rural and wooded riverside locations were commensurate with the need to site gunpowder works away from populous areas in order to minimise the consequences of accidental explosions. Later on, as more regard began to be paid to the safety of the workforce as well, several mills even incorporated trees and natural rock outcrops into their layouts as barriers to dampen and help contain blasts. In addition, timber was locally available both for charcoal manufacture and the making of barrels and packing crates, whilst proximity to the coast meant that other raw materials (sulphur and saltpetre) could be readily imported. As a result of these overseas contacts - mostly routed through Liverpool - the Cumbrian gunpowder industry was able to build up a healthy market for its products in parts of the British Empire as well as at home. After *c* 1860, alternative forms of explosive based on the nitration of a variety of organic compounds began to appear. Other English powder works diversified into producing the new explosives, but the Cumbrian mills stuck with their traditional stock-in-trade, now re-christened blackpowder to distinguish it from the newer forms. Despite this failure to diversify, the Cumbrian blackpowder industry continued to prosper until the end of World War I, when demand for the product collapsed catastrophically. The Cumbrian mills' response was to merge with their competitors as part of Nobel Industries (from 1926, itself incorporated into Imperial Chemical Industries (ICI)); but by 1928, ICI had started the inevitable process of rationalisation in order to concentrate blackpowder production at a single site: Ardeer in Scotland. Production in Cumbria finally ceased in 1936, with Gatebeck the last site to close (Crocker 1988, 1-2; Patterson 1995, 3).

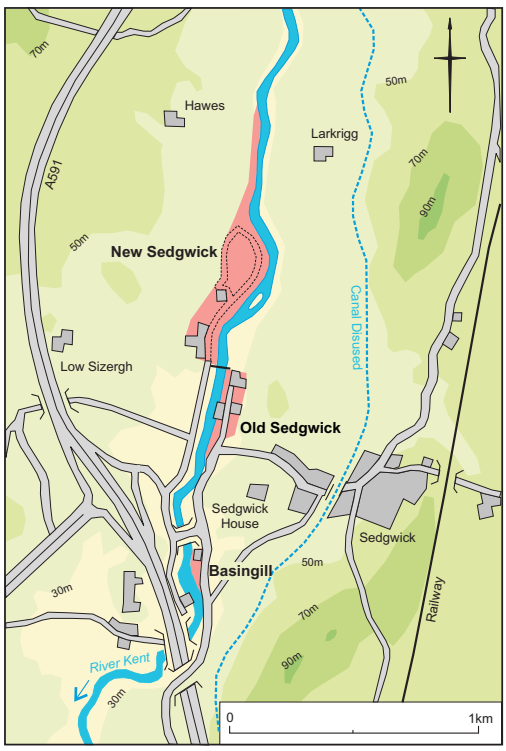


Figure 2. Local setting diagram

Basingill is the fourth of the Cumbrian sites to be investigated by English Heritage. Field survey was carried out to Level 3 standard (as defined in RCHME 1999, 3-5), backed up by less intensive documentary research confined to readily available published sources and limited search of historical archival

material. The works is situated on the east bank of the River Kent, centred at National Grid Reference (NGR) SD 507 867, some 6km south of Kendal and *c* 1km south-west of Sedgwick village, where it occupies an area of *c* 1 hectare. It was built by John Wakefield (1730-1811) in, or soon after, 1790, at the northern end of a narrow piece of land some 500m south-south-west of Sedgwick House, where the grounds of Sedgwick House bordered the River Kent (Figure 2). It passed down through the Wakefield family until the early part of the 20th century when it became part of Nobel Industries, later incorporated into ICI. Strictly speaking, Basingill is not a gunpowder works in its own right, but an outstation to Wakefield's main works situated some 500m up river at Old Sedgwick. That site was constricted, with insufficient room to expand (see Jecock and Dunn 2002), which led to the decision to build incorporating mills downstream at Basingill, giving Old Sedgwick much needed extra milling capacity. Although Old Sedgwick closed in 1852, Basingill continued to act as extra incorporating capacity for its replacement, Gatebeck. The gunpowder works at Basingill was finally closed in September 1935. Upon closure the upper, wooden levels of the mills and the ancillary buildings were burned down, a legal requirement, leaving only the large stone-built basements of the mills standing. The site is now owned by the Environment Agency and is in daily use for the monitoring of fish stocks in the River Kent. The site was evaluated as part of the Monuments Protection Programme (MPP), and is now a Scheduled Ancient Monument (SAM).

The surviving gunpowder structures consist of three blocks of incorporating mills, eight mills in total, and map evidence suggests the former presence of three other ancillary buildings, now demolished. Over the years, accounts of the site have referred to the mills using various names and numbers, but in this report, they will be referred to as the northern, middle and southern groups, and numbered individually from 1, for the most northerly mill through to 8 for the most southerly. However, during the course of the survey, it became clear that the gunpowder works were not the only archaeological remains on this site. Garden features dating from the early 19th century were also identified, extending for *c* 200m from near the southern end of the works to the southern extremity of the site. The garden was created in the early 19th century by Isabella Wakefield, granddaughter of the aforementioned John Wakefield. Although not surveyed at the same scale or level of detail as the gunpowder works, a study of the garden has been included in this study because it forms an integral part of the site. The remains of the garden include both built features and earthwork elements. For the purposes of this report, detailed descriptions of the gunpowder works and the garden appear separately, with the discussion bringing the evidence together. Other than the site's depiction on Ordnance Survey mapping, the remains of the garden had not been previously surveyed or recorded prior to this investigation.

Over the years, a number of spellings of Basingill have been used in various sources, including Basengill, Basin Gill, Bassinghyll and Basinghyll. However, in the interests of consistency, the spelling 'Basingill' will be adopted throughout this report.

2. GEOLOGY, TOPOGRAPHY AND LAND USE

Basingill gunpowder works occupies a narrow, artificial terrace on the east bank of the River Kent, at a height of *c* 20m above OD. Below Kendal, the Kent - which drains the southern fringe of the high Lakeland fells (east of Ambleside) south into Morecambe Bay (Figure 1) - flows through an undulating landscape of low hills and ridges of Carboniferous Limestone (Institute of Geological Sciences 1980). Lower Kentdale has the typical broad 'U'-shape profile of a glaciated valley (Figure 3). However, rejuvenation of the river has created a gorge in the valley floor, through which the river now flows. At Basingill, the western side of this gorge is near vertical, while the eastern side has been quarried back, creating the terrace upon which the site is located. It is likely that much of the stone extracted to create the terrace was used to construct the mills and other buildings and features. The quarry face was later incorporated as a major feature within the garden design.

The River Kent falls some 50m between Kentrigg to the immediate north of Kendal and sea level at Levens Bridge 2km south of Basingill. This fall translates into an overall gradient of *c* 1:160, which in the early industrial period made the river suitable for the construction of weirs and leats to power watermills. The River Kent is not fed by a large lake, and is heavily dependent on rainfall to maintain water levels, as witnessed first-hand by English Heritage staff during survey at New Sedgwick gunpowder works in the very wet autumn of 2000 and the dry months of November and December 2001. In the mid-19th century the building of a number of reservoirs in the hills above Kendal was proposed. However, only one was actually constructed, Kentmere Head, which, although small, improved the reliability of water flow which could be exploited on the Kent (Wilson 1964, 54). In 1929, it was stated that the water from the Kent was 'always adequate to drive three water-wheels' (Anon 1929, 338), an important factor in the decision to retain the incorporating mills at Basingill following the transfer of gunpowder production from Old Sedgwick to Gatebeck.

The Environment Agency now owns Basingill. Their modern usage of the site has necessitated some changes and additions, including the erection of small buildings and the insertion of unmetalled tracks for access, which has had some impact on the

Figure 3. Aerial view of Basingill Gunpowder Works from north-west (extract from NMR 17667/35 photographed 12 December 2001)

archaeology. The stone basements of the incorporating mills remain reasonably complete, with the exception of the partial demolition of two blast walls for safety reasons in 1996. A gunpowder building adjacent to the boundary wall, near the modern entrance, has been demolished, and a platform has been created in its place, upon which a modern storage shed is situated. Other small buildings shown on early maps of the site have also disappeared since closure of the works. Vegetation, predominantly ivy, has colonised many of the buildings and is beginning to cause structural damage, with roots widening the gaps between stones. The site generally is now covered with scrub and light, largely deciduous, woodland, some of which is managed by Environment Agency staff.

3. HISTORY OF RESEARCH

Prior to the present English Heritage investigation and survey, research into the Basingill gunpowder works has been largely limited to a few brief summaries of the available documentary evidence, as outlined below. It has been stated that for Gatebeck, and presumably also for Basingill, the company records were burnt on site at the time of closure (Tyler 2002, 81).

An early published account of the Cumbrian gunpowder works and the background to the companies involved in gunpowder manufacture appeared in the ICI company magazine of 1929 (Anon 1929). Basingill is mentioned briefly, but little detail is given about the actual site, the focus being on its role as an outstation to first Old Sedgwick and, subsequently, Gatebeck. In 1964 the seminal study of the gunpowder industry in Cumbria, by Paul Wilson, was published (Wilson 1964). While the study considered general issues relating to the industry in the area, it also presented concise descriptions of the individual sites. Basingill was covered in the section which discussed the Wakefield gunpowder mills, and Wilson asserted that the 'massive foundations and wheel-pits at Basingill are amongst the most striking remains of the northern mills' (Wilson 1964, 54). No plans of the site accompanied this study, but a photograph of the northern mill group at Basingill, taken in 1962, was published in it (reproduced below as Figure 9). Glenys Crocker visited Basingill in 1986 (Crocker 1988, 37), but does not appear to have gained access to the site, as her description is brief and, in places, inaccurate. The fact that the site was inaccessible is confirmed in a later publication (Crocker and Crocker 1992, 11), as it is described as being visible 'from the bridge or from across the river'. Patterson's 1995 study of the Cumbrian blackpowder industry includes a plan (Patterson 1995, plan facing p14) of Basingill. Although the source is not indicated, judging by the layout and labelling, it would appear to have been copied from one of the early editions of the Ordnance Survey map. The accompanying description is brief, drawing heavily on a 1929 ICI engineer's report following an explosion at the mills, and contains inaccuracies. A fabric survey of the blast walls of the southern mill group was carried out in 1996 prior to their partial demolition (Quartermaine 1996). Aside from a few sketch plans in some of the general articles about gunpowder and Basingill, this is the sole extent of previous archaeological work on the gunpowder works.

4. THE DOCUMENTARY HISTORY OF THE WORKS AND GARDEN

4.1 Documentary Evidence

Relatively little documentary evidence regarding the gunpowder works, or indeed the garden, at Basingill survives in readily accessible repositories, such as the Cumbria Record Office, Kendal (CRO(K)). However, the earliest documentary reference to the gunpowder works exists in the Kendal Quarter Sessions records (CRO(K) WQ/SR/493/14), with an entry on 28 March 1790 recording the intention of John Wakefield 'to apply for a licence to build a gunpowder works and other offices on his property called Basengill at or near the south east corner of Force Bridge in the township of Sidgwick.' This plan was approved on 16 April 1790, when the Order Book for Kendal 1786-1798 (CRO(K) WQ/O/11) records: 'John Wakefield shall have leave and licence to build and erect the said Gunpowder Mill and Offices at the place aforesaid and leave and licence is hereby granted to the said John Wakefield for that purpose accordingly.' It seems reasonable to assume that construction work began on the site soon after this date. In its first phase, the works is likely to have consisted of a single pair of incorporating mills at the north of the site, with a further pair to the south added by 1826. Ancillary buildings and a weir were part of this early phase of activity, but the details are not known.

Following these early references, the documentary record is silent for over 30 years, until a letter of 24th March 1826 refers indirectly to the site. A reference is made to Mr Wakefield's mills in a letter from D Huddlestone, founder of the gunpowder works at Elterwater, to his agent Mr Hyde. The letter, contained in a letter book (CRO(K) WDY 448), states that 'the Low Wood Co … have 3 mills and Mr Wakefield 4.' At this date, Wakefield was running Old Sedgwick and Basingill together. Old Sedgwick certainly had its own incorporating mills at its inception, although an 1857 map of the site includes in the key a reference to an 'ancient powder

Figure 4. Lithograph of Force Bridge, printed in 1826 (reproduced by permission of Dove Cottage, The Wordsworth Trust)

grinding mill' (discussed in detail in Jecock and Dunn 2002, 24). This suggests that the mills had been disused for some time, but no hint is given as to the exact date that they fell out of use. It is possible that they went out of use at a very early date, maybe in the 18th century, and that Basingill was built as a direct replacement. However, the letter from Huddlestone would certainly suggest that the Old Sedgwick mills were disused by 1826, as the evidence depicted in a lithograph of Basingill (discussed below) proves that a second pair of mills had been built by 1826. It is thus highly likely that the four mills referred in the Huddlestone letter were all at Basingill. Also dating to around 1826 is the lithograph of Force Bridge, referred to previously, in a book of ten drawings (Hullmandel 1826), which shows a gunpowder mill in the foreground (Figure 4). The lithograph is drawn from the south, with the artist apparently positioned on one of the islands in the river, looking up towards Force Bridge. The building at the right of the picture has a broken roofline to allow for a waterwheel below, and a hint of the roofline continuing suggests a matching building existed on the other side of the waterwheel. A number of trees screen the rest of the site, but given the location and aspect of the drawing, it is almost certain that the building is the second pair of mills, which later became the middle mill group (Figure 17). The lithograph shows the mill's stone-built basement surmounted by a superstructure, apparently constructed of timber. The roofing material is not particularly clearly depicted, and could be either timber or narrow sheets of metal. Two 'windows' are shown in the elevation of the mill facing the river, the upper one with wooden shutters and the lower one with latticework in the opening. While the windows would have been necessary to allow light into the mills, it is questionable whether the latticework played a functional role in the mill's operation. This mill would have formed the backdrop to the garden, so it is possible that these window 'dressings' were inserted to improve the aspect of the mill. Even though the depiction is subject to some degree of artistic licence, the lithograph is a useful early source of evidence for the appearance of an incorporating mill.

It is at about this time, around 1820, that the garden at Basingill seems to have been laid out. Although there are no direct, contemporary references to it, a later history of the Cropper family makes reference to a garden here (Conybeare 1925). The Cropper family is local to Burneside, some 3km north of Kendal, where they acquired a paper mill in the 19th century which is still flourishing today. Edward Cropper, the second son, married Isabella Wakefield, granddaughter of John Wakefield (1738-1811) *c* 1820, following which they moved to Dingle Bank on Merseyside. Conybeare refers to how Isabella 'excelled in landscape gardening' and briefly describes the garden she laid out at Basingill prior to her marriage. The garden is described thus: 'fitted into a disused quarry of her father's, an enchanting place though marred by a gunpowder mill erected there long before, sadly out of harmony with the otherwise peaceful gardens' (Conybeare 1925, 33). The description of the garden features suggests that they were laid out as one coherent unit in a single phase of activity. The existence of the garden at this date is a strong suggestion that the gunpowder works was still limited to the two groups of mills at the northern end of the site, as the southern mills would have significantly encroached upon the northern part of the garden. In addition, garden features which survive as faint earthworks are overlain by the southern mill group (discussed in section 6.1).

It is possible to estimate the date of construction of the third, most southerly group of gunpowder mills through brief references to Old Sedgwick, and thus, by association, Basingill, in 19th century histories and directories of Westmorland. In 1829, Old Sedgwick was reportedly producing about 80 barrels of powder a week (Parson and White 1829, 627), whilst 20 years later, production had increased threefold to some

250 barrels (Mannex 1849, 275). Bearing in mind that Basingill was providing the ripe charge for gunpowder production at Old Sedgwick, it follows that an increase in the final output of gunpowder must correlate to an increase in ripe charge being processed, and therefore in milling capacity, most probably through the commissioning of an extra group of mills. The first edition County Series 25-inch Ordnance Survey (OS) map (hereafter referred to as OS first edition) was surveyed in 1857 and published *c* 1860 (Ordnance Survey *c* 1860 a and b) (Figure 5a). It clearly shows the existence of a third group of mills to the south of the two pairs already mentioned, which gives a *terminus ante quem* of 1857 for this most southerly group of mills. It may be possible to narrow this date bracket to 1829-1849 if we accept that the increase in total output of gunpowder is a direct result of the construction of three new incorporating mills.

The OS first edition map depicts not only the three groups of incorporating mills, but also three ancillary buildings, close to the northern and middle mill groups. From information contained within a newspaper report of a fatal explosion in July 1874 (*Westmorland Gazette*, 1 August 1874), we know that one of these buildings was a watch-house, while later reports refer to charge houses. Access routes into and around the site are shown as dotted and solid lines on the map, including what appears to be the main access route, abutting the site wall between two of the ancillary buildings. The head- and tail-races appear to be covered over at this date, in order to allow safe and unfettered access to the working level of the mills. To the south of the gunpowder works, the paths, terraced walk and steps of the garden are all depicted, interspersed with scrub vegetation. Also shown is a sub-rectangular feature, almost certainly a pond, with a stream flowing into and out of it. This feature is not obviously connected with the gunpowder works, and appears rather to be a garden feature. Thus, the tail-race from the gunpowder works had not been extended south to its full extent at this date. Across the road, to the east of the site and roughly opposite the middle mill group, is a rectilinear enclosure which appears to have a structure within its northern end. This has been interpreted as a magazine (Tyler 2002, 42), although the basis for this identification is unclear. There is no indication on the map as to the form or function of this building, but this is discussed in more detail in section 5.2. This edition of the OS map shows a widening of the road opposite what appears to be the main entrance to the site. It seems likely that this feature would have allowed carts and wagons a greater area in which to make the

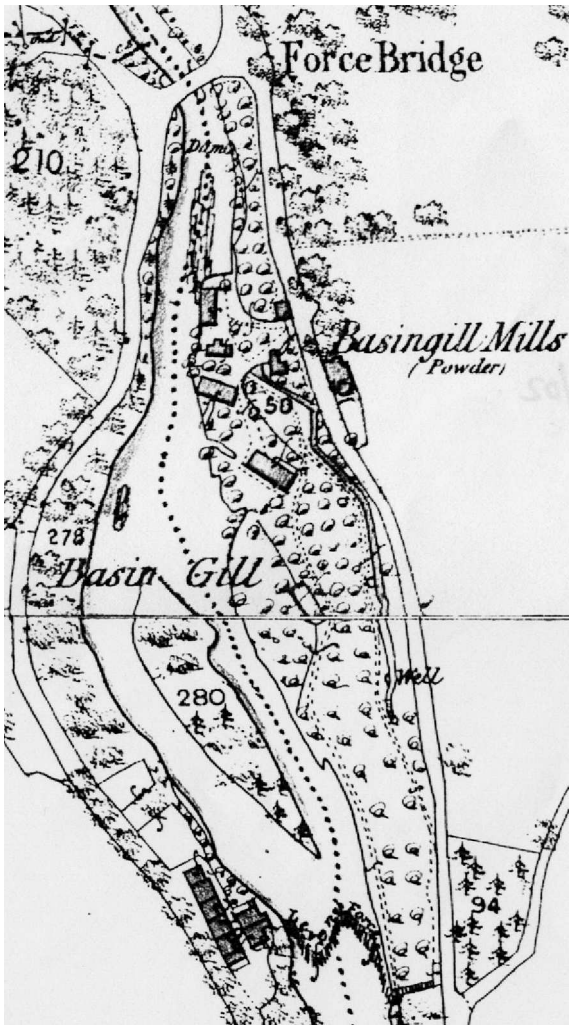


Figure 5a. The site of Basingill Gunpowder Works and Garden as mapped at 1:2500 scale in 1857 (reproduced from c 1860 Ordnance Survey map, held at Cumbria Record Office (Kendal))

turn into the site, presumably making such a manoeuvre safer for gunpowder-laden vehicles.

The watch-house is again mentioned in the report of another fatal explosion in the following year (*Westmorland Gazette*, 16 and 23 October 1875). Interestingly, on 16th October, the newspaper reports that there were nine mills at Basingill. There is no other evidence to corroborate this and it is certainly a factual inaccuracy, as it is contradicted by the report of 23rd October, which states that there were in fact eight mills. Further evidence of the construction of the mills at this date comes from the description of the damage to one of the mill buildings from the explosion, which this time was limited to 'the removal of two or three planks from the wooden roof'.

1875 saw the passing of the Explosives Act, which amended laws governing the manufacture, selling, carrying and importing of explosives. Following this legislation, fatal explosions at gunpowder works had to be investigated by government officials who then produced reports on the attendant circumstances. June 1883 saw a spectacular explosion at Basingill caused by a lightning strike, which ultimately cost one of the mill workers his life. The subsequent official report gives a detailed overview of how the accident occurred, and also details about the layout of the site (Cundill 1883). The report starts with a list of buildings on site, which were: a charge-house for the reception of 'green' and 'ripe' charges; a group of three mills; another group of two mills; a third group of three mills and a watch-house. The report also refers to a 'very high and stout blast wall' between the northern group of three mills and the middle group of two mills. This indicates that at some time prior to this explosion, but after the OS first edition was surveyed in 1857, the northern mill group was expanded from a pair of mills to a group of three. A rare documentary reference to the garden at Basingill is also contained within this report: 'Only a small portion of this area is actually in use for the making of gunpowder, the remainder was at one time laid out as a garden, but is now neglected, though still in part cultivated' (Cundill 1883, 2). The report also refers to rosebushes, sweet pea plants and a 'potato ground', implying that part of the garden was utilised, possibly by mill workers in their spare time. The appearance of the garden features is described, indicating that the many of them were still in a recognisable form at this date: 'a gravel terrace path, some 4 feet [*c* 1.4m] wide … bounded by a stone coping … and on this coping runs a light iron fence consisting of three horizontal bars, with the usual standards leaded into the coping' (Cundill 1883, 5-6). Throughout the report on this explosion, the gunpowder mills are referred to as groups 2, 3 and 4 to correspond with a list of the buildings on the site, shown at the start of the report. This is a different system from that used in later, ICI reports and has led to confusion in the interpretation of this report. Patterson, for example, states that the explosion started in no. 3 mill group (the southern mill group), when in fact the explosion originated in the middle mill group, which was numbered as no. 3 in the official accident report.

Although references to the timber superstructure of the gunpowder mills are frequent, they were not always constructed as such. A report on an explosion from May 1891 (*Westmorland Gazette*, 9 May 1891) records that the 'whole of the buildings were blown to pieces', as they were built of timber. It goes on to say that 'mills were formerly built of stone, but when so built explosions are much more severe than when the mills are built of wood, and they all are now, therefore, built of wood'. There is also a reference to one of the workers who ran 'into a shed behind a large tree'. This 'shed' could the green- and ripe-charge house referred to in previous reports, but no more details of its form and location are given. The report also states

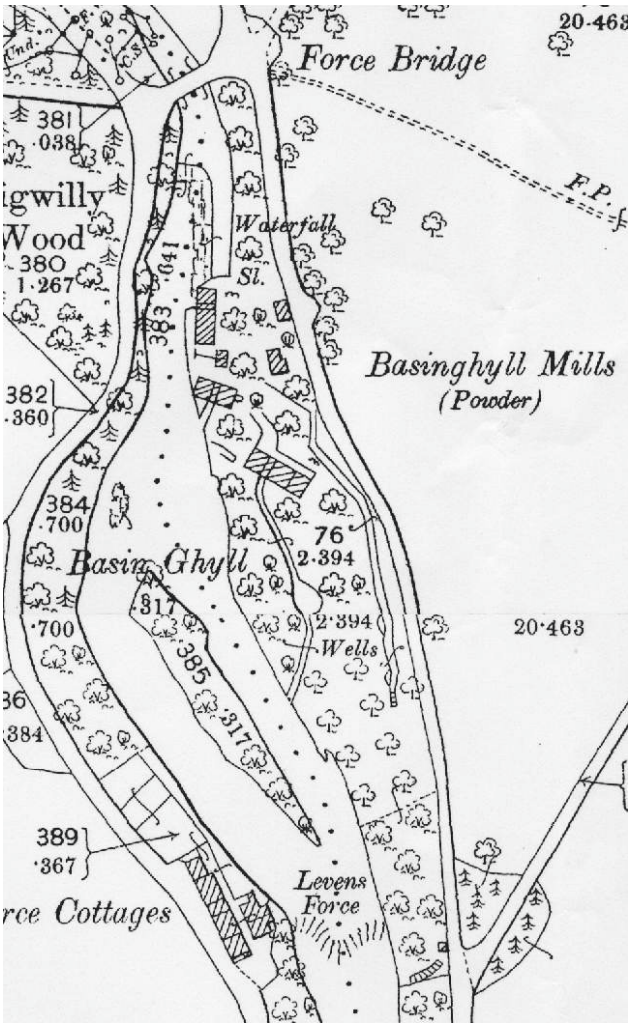


Figure 5b. The site of Basingill Gunpowder Works and Garden as mapped at 1:2500 scale in 1896 & 1897 (reproduced from the 1898 Ordnance Survey map)

that there 'are eight powder mils in all at Bassinghyll', further confirming that the site had reached its full extent by this date.

The OS second edition County Series 25-inch map (hereafter referred to as OS second edition) was published in 1898, following revisions in 1896 and 1897 (Ordnance Survey 1898 a and b) - the site is located on the join between two sheets, hence the different revision dates (Figure 5b). The depiction of the mill buildings again confirms that the northern mill group has been extended, with a total length of just over 12m on the previous edition of the map compared with a length of slightly over 18m on this edition. The small structure previously shown between the northern and middle mill groups is depicted in a different form on this edition, with the 'building' part of it much smaller and a wall protruding from its western face. This structure corresponds to the position of the blast wall referred to in the 1883 accident report. Detail around the southern mill group shows an access route, or platform, adjoining the north of the mills, not previously illustrated. By this date though, the pond that was previously depicted unconnected with the gunpowder mills is shown as having been incorporated into a tail-race flowing away from the southern mill group for a distance of some 80m. The depiction also suggests that part of the tail-race was formed by the widening of the pre-existing stream. The character of the garden is somewhat different in its depiction on this edition of the map, with only the terraced walk and southern steps and viewing platform shown. The mapping conventions also indicate that the most southerly section of the garden was covered with woodland, while the area around the southern end of the terraced walk is depicted as an area of orchard plantation. This evidence seems to indicate a shift away from the original layout of the garden as a single entity, with the possible retention of a small formal garden area to the south adjacent to an area of orchard to the north.

The OS third edition County Series 25-inch map (hereafter referred to as OS third edition), published in 1914 following revisions in 1912 (Ordnance Survey 1914 a and b), shows no major changes in the depiction of the gunpowder works (Figure 5c). The development of the site seems to have peaked around the end of the 19th century, with few changes seen after this date. This may have been as a result of the changing nature of the gunpowder industry. The early 20th century saw the merger of many of

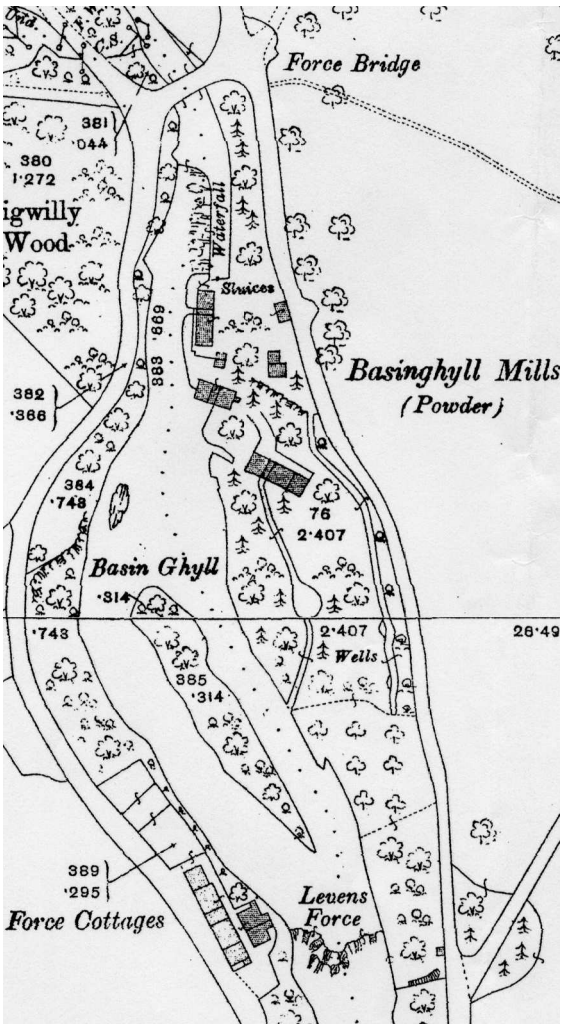


Figure 5c. Site of Basingill Gunpowder Works and Garden, as mapped at 1:2500 scale in 1912 (reproduced from the 1914 Ordnance Survey map)

the Cumbrian sites with larger national companies, a trend which ended with the closure of the Cumbrian works and the transfer of production to Ardeer in Scotland. Parts of the garden were evidently still in existence at this stage of the site's history, although again, the depiction differs little from that on the previous edition of the OS mapping. An area of orchard is depicted at the southern end of the terraced walk between two areas of mixed woodland and brushwood. The main built features of the garden are shown in broadly the same manner, although the steps at the southern end of the terraced walk are not in evidence, possibly overgrown and redundant at this point.

The final decades of the gunpowder works at Basingill are not at all well served by the documentary record. The primary reasons for this, and the general lack of surviving company records, is that once the gunpowder sites had been closed, company papers were often burnt at the site (Tyler 2002, 81). Some records relating to the period when the site was under ICI management seem to have been transferred up to Ardeer, for copies survive in the Patterson Collection. The originals cannot now be located. A copy of the notebook of a former ICI employee, Alfred Bush, lists explosions at the Basingill mills between 1923 and 1929. These explosions appear to have been non-fatal, and details are given as to the length of time the mill had been running before the explosion occurred. A note accompanying this list states that the explosion that occurred in mills 2 and 3 on 18th October 1929 was the last recorded at Basingill.

A copy of a letter and report written by the engineering section of ICI concerning the aforementioned explosion in 1929 appears to indicate that Basingill was no longer in full operational use after this date: 'it has been decided that we are to use them only as and when there is an emergency'. The mills, therefore, assumed 'standby' status and were, it seems, effectively mothballed. The accompanying report provides a detailed description of mills 'nos. 1, 2 and 3' - the northern mill group. The roofs of the mills are described as being 'covered with Canadian Pattern Galvanized iron sheets' and there were no blast walls between the mills. A *c* 1900 postcard of the northern mill group (Figure 6) confirms that the roofs were covered with metal sheets and also shows evidence of a wooden walkway attached to the exterior of the mill (discussed in full in section 4.2). The report also confirms that the mills were underdriven, with the mill bed situated on a floor of pitch pine beams. The letter recommended that due to the explosions which had occurred, if and when the mills were used again, 2 and 3

should not be used together. Following this description, mills 'nos. 4 and 5', presumably the middle mill group, are described, which had a 'heavy stone wall on each side of the water wheel', although the rest of the superstructure was timber-built. The report goes on to describe mills 'nos. 6 and 7' as very similar in form to 'nos. 4 and 5'. Logically these mills should be the southern group, but we know this group comprised three mills. The conclusion to be drawn must be that the works was operating one group of three mills (but not all three simultaneously) and two pairs of mills by 1929, and if a logical numbering sequence was used, then mill 8, the most easterly of the southern mill group, was the one that was redundant. There is no indication in the document as to when or why the mill went out of use, but it must have happened some time after 1891, when eight mills are referred to in an accident report, and before the appearance of this report in 1929.

Manufacturing Method Books (MMBs) exist for a number of the Cumbrian gunpowder works. These books tend to date from the late 1920s and early 1930s, and provide a detailed description of the processes and structures at each site. As Basingill was operating as an outstation to Gatebeck, it had no MMB of its own, but was briefly mentioned in the Gatebeck MMB. In the section of the MMB regarding milling, Basingill is said to have 7 edge-runners (see Appendix 1), similar to those at Gatebeck (Low Works), but it also states that 'the mills there are not in use at present, nor have they been for some considerable time' (Gatebeck MMB, 12). Unfortunately this document has no date on it, but it accords with the evidence from the 1929 ICI engineer's report that there were only 7 functioning mills at Basingill. The fact that the mills are described as not having been in use for 'some considerable time' indicates a date in the early 1930s for this MMB, which is quite plausible, as those for Lowwood and New Sedgwick were not compiled until 1934 and 1935 respectively.

4.2 Photographic evidence

During the search of the publicly available archive record for this report, no contemporary photographs of the gunpowder works at Basingill were found. However, a black-and-white photograph, which was turned into a postcard, from *c* 1900 exists in a private collection (Figure 6). The image shows the northern mill group fully intact, roofed with metal sheets, with a timber superstructure, shuttered windows, and a covered waterwheel. There is also a wooden walkway attached to the

Figure 6. Postcard of the northern incorporating mill group at Basingill, c 1900 (reproduced by permission of Mike Davies-Shiel)

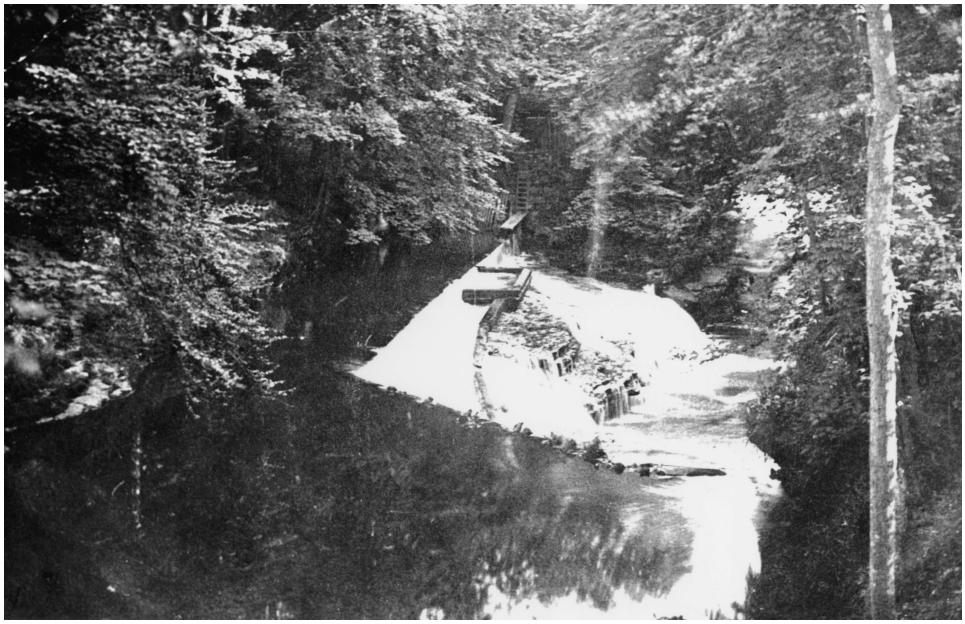


Figure 7. Early 20th-century photograph of the weir at Basingill, taken from Force Bridge (reproduced by permission of Gordon Powell)

exterior of the mills. In the background, water can be seen flowing over a weir. Another photograph, kindly loaned by Mr Powell, a local resident, shows a view of the site from Force Bridge (Figure 7). The photograph clearly shows a weir across the river, and a fish pass. Parts of the northern end of the northern group of mills can just about be made out amongst the foliage cover and, in particular, some vertical bars can be seen across the entrance to the head-race, presumably to stop any large pieces of debris from becoming entangled with the waterwheel. The date of this photograph is unknown, although it is probably from the early part of the 20th century and is likely to be only slightly later than the postcard. There is no evidence to show whether or not the gunpowder mills were functioning at the time of the photograph. A handful of photographs showing views of Basingill and Environment Agency staff working at the site during the 1960s also survive. One of these provides a clear view of the site from Force Bridge (Figure 8), showing the arch at the mouth of the covered leat completely blocked by a stone wall. P N Wilson published an article accompanied by a photograph of the northern mill group taken in 1962 from the west side of the river (Wilson 1964, plate XVIIa, reproduced here as Figure 9). This photograph shows that the southern wall of mill 1, adjacent to the wheel-pit, was still *in situ* at this date. Features of mill 1 such as two doorways mirroring those in mill 2 are also visible, details which have since been lost through the collapse of this wall.

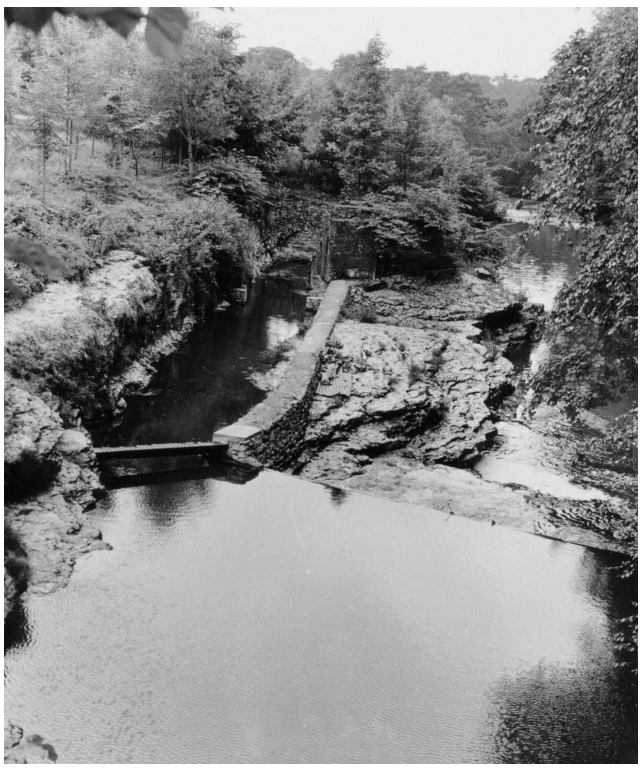


Figure 8. Basingill from Force Bridge looking south, probably taken in the 1960s (reproduced by permission of John Foster)

Figure 9. Northern incorporating mill group from the west bank of the River Kent, 1962 (reproduced by permission of The Newcomen Society)

5. DESCRIPTION AND ANALYSIS OF THE FIELD REMAINS OF THE GUNPOWDER WORKS

The hachured site plan of the earthworks and other features recorded by English Heritage is shown in figure 10. The plan was surveyed in the field at 1:500, and shows both archaeological and modern detail. The principal remains are three groups of incorporating mills, the stone-built basements of which survive to heights well in excess of 2m. For the purposes of this report, they will be named according to their geographical situation, that is, the northern, middle and southern groups. The individual mills are also numbered from 1, for the most northerly mill, through to 8 for the most southerly one (Figure 11), matching with the numbering in the 1929 engineer's report, but not representing the order of construction. In addition to the three groups of mill buildings, three ancillary gunpowder buildings are marked on the OS mapping of the site. The original form and extent of these buildings has been lost, with only a few traces remaining.

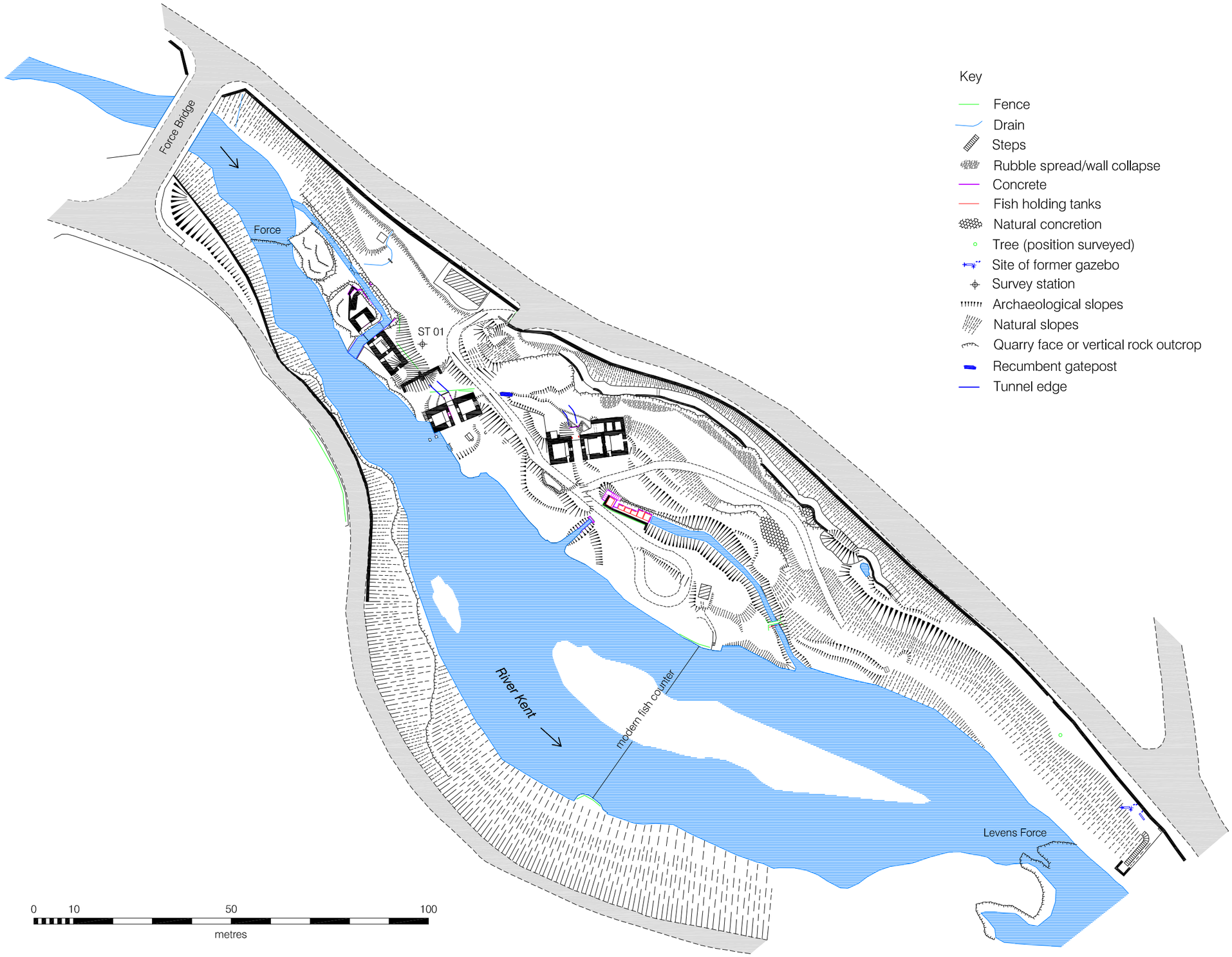
5.1 The Gunpowder Works

5.1.1 The water power system

A short distance to the north of the main part of the gunpowder works at Basingill, the River Kent flows under Force Bridge and over a natural rock ledge, creating a substantial force of water. The first edition OS map surveyed in 1857 depicts a 'dam' just to the north of this increase in the depth of the river. There are no obvious remains of a weir here today, but there is a section of stone-built wall under a natural rock overhang on the west side of the river. At times when the water level is low, the river appears to break over a slight obstruction, possibly marking the location of a previous weir. An early 20th century photograph (Figure 7), shows a long, angled weir lying across the river, with a section heading north-south towards the northern mill group. This weir would have been essential for directing water into the head-race to provide the force of water required to power the incorporating mills. Just beyond mill 1, on the northern face of the revetment wall, facing the weir, are the remains of brackets that once supported a ladder; while at the base of the wall is a rectangular opening, 28cm by 36cm. The photograph shows the ladder and a length of timber walkway protruding from the northern end of the mill, in roughly the same location as the opening (Figure 7). The walkway may have been connected with the fish-pass also shown in the photograph, or it may be related to the weir, possibly providing access for maintenance.

The head-race consists of a channel some 2.5m wide adjacent to the east bank of the river, cut slightly deeper than the surrounding bedrock. A short distance along the head-race, an east-west channel has been blasted through rock on its west side, with a number of blast-holes still visible at times of low water. One of the holes shows evidence of having housed a metal rod, possibly to support the structure of a fish-pass, visible on the aforementioned photograph (Figure 7). The head-race flows south between mill 1 and the rock face of the east bank of the river, with a spur at 90 degrees to feed the waterwheel powering the northern incorporating mill group. Originally the head-race may have been constructed along a course from this area down to what would later become the wheel-pit for the middle mill group (mills 4 and 5). Initially, the full length of the head-race would not have been utilised, but it could have served as a bypass channel when needed, with the flow of water diverted away from the wheel-pit of the northern mill group to allow waterwheel maintenance and

Figure 10. English Heritage earthwork plan of the Basingill gunpowder works, reproduced at 1:1000 scale.



ENGLISH HERITAGE

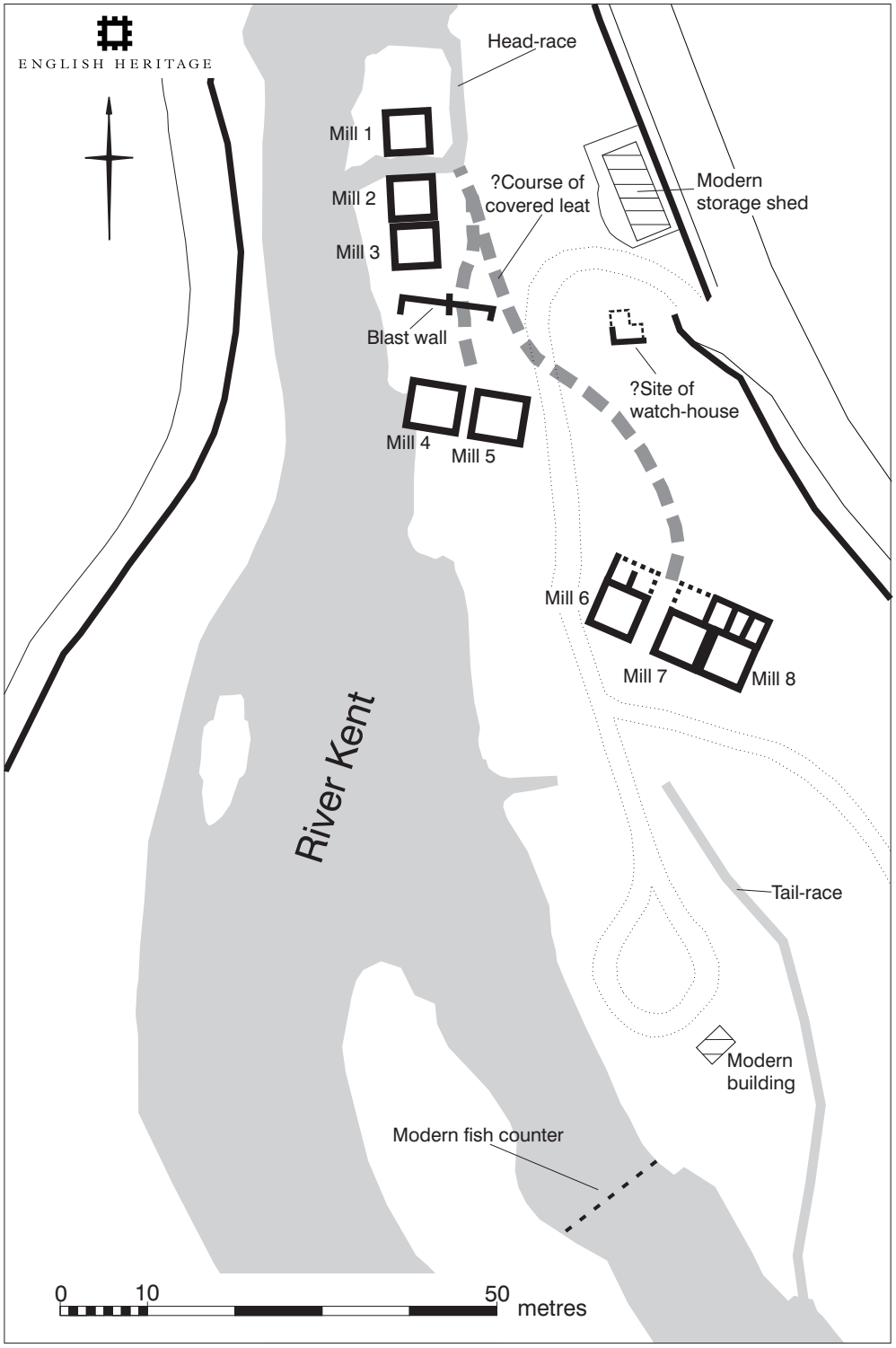


Figure 11. Schematic diagram of the gunpowder works at Basingill

repairs to be undertaken. To the north-east of mill 2 a stone-built arch spans the entrance to the covered leat (Figure 12). In this photograph, concrete facing, a pre-closure alteration, is visible across the base of the arch, while collapsed stone rubble blocking the lower part of the arch post-dated the closure of the works. The exact route of the covered leat is unknown, but heavy flooding some seven years ago caused part of the tunnel's fabric to collapse approximately 10m from the entrance, close to the location of one of the English Heritage survey stations, ST01 (shown on Figure 10). The void created by this collapse was subsequently filled with concrete to prevent any further settlement (John Martin, *pers comm*). The leat would have

Figure 12. Entrance to covered leat (NMR: AA038832)

carried the head-race beneath the main part of the works, initially exiting beneath another stone arch where it drove the waterwheel of the middle mill group. If this section of the leat had been built at the inception of the works, then minimal extra construction would have been needed at the time when the middle mill group was added. The leat must then have been extended to carry a branch of the head-race to the wheel-pit between mills 6 and 7 at the time the southern mill group was built. Parts of the leat sides and roof close to these two mill groups have been partially faced with concrete. This is likely to relate to refurbishment of the site in the early 20th century, possibly under the management of ICI.

Control of the flow of water entering and exiting the head-race was vitally important. There are still some surviving traces of this water management. At the northern end of the head-race, just above mill 1, a wooden beam *c* 2.8m long is attached to the rock face of the eastern bank of the river and there is a small recess in the concrete cladding. On the opposite side of the head-race, part of a wooden upright survives within another recess, with further notches in the concrete. These features are undoubtedly part of a sluice system, possibly the remains of the sluice gates, which are labelled at this location on both the OS second and third edition maps. The photograph taken from Force Bridge in the early 20th century (Figure 7) appears to show metal bars across the entrance to the head-race between the river bank and mill 1; these presumably prevented debris from entering the channel and becoming entangled with the waterwheel or lodged in the tunnel. As well as areas of concrete consolidation around the former sluices, much of the wall to the west of the head-race, and part of mill 1, is clad with concrete up to a height of approximately 1.8m. As mentioned previously, most of the concrete cladding at Basingill is believed to date to the 1920s, when changes in ownership and refurbishment of the site took place. At other gunpowder sites, similar types of refurbishment using a similar type of concrete mix have been seen. This type of refurbishment occurs late in the history of the sites, which suggests that it was done under new ownership, in this case ICI. In the side walls at either end of the wheel-pit of the northern mill group are two pairs of slots, the westerly pair of which align with a groove in the floor of the wheel-pit. These would presumably have housed some kind of hatch or planks, to enable the water flow to be stopped when repairs and maintenance of the wheel were undertaken. Just over 1m beyond the end of the covered leat by the middle mill group, in the side walls of the channel carrying the water to the wheel-pit, a similar pair of slots still contain wooden uprights, the westerly one with attached screws and bolts surviving. Again, these slots are likely to have functioned as housing for a gate to control the water flow. Concrete has also been used here to consolidate the leat

walls between the mouth of the tunnel and the wheel-pit. The base of the leat is at least 1.75m higher than the bottom of the wheel-pit, creating a significant curved drop into the wheel-pit. At the junction of the channel and wheel-pit, impressions in the stone indicate the site of seatings for a metal Rennie's Hatch (see below), but the hatch itself no longer survives. Although the base of the wheel-pit of this mill group is significantly silted up, a metal fitting, apparently still *in situ*, protrudes from the bottom of the wheel-pit through the accumulated debris. The fitting is somewhat bent out of shape, but it seems likely that it was originally part of the sluice system, possibly a support for or part of the operation of the Rennie's Hatch.

The southern incorporating mill group demonstrates some of the best evidence for methods of water control. Located at the junction of the channel and wheel-pit, as described above for the middle mill group, are the partial remains of another Rennie's Hatch (Figure 13). This hatch would originally have stood to *c* 2.4m high and 1.8m wide, with metal uprights on either side. Between these uprights were five horizontal, angled metal slats, supporting face-on wooden boards above. The metal slats would have been adjustable, allowing the angle of the water on to the wheel to be controlled, while the wooden planks would have ensured that a sufficient force of water was pushed through the slats below. The regulation of the force of the water was vital for the efficient operation of the wheel; if the pressure of the water was too great, it would foam up upon contact with the buckets of the wheel, thus becoming much lighter and providing less power. The Rennie's Hatch in the southern mill group survived virtually intact until 1996 when, despite efforts to prevent it, it was badly damaged when an adjacent blast wall was dismantled. The area between the point where the leat emerges from underground and the Rennie's Hatch shows evidence of originally having been lined with tongue and groove boarding. The sides and top of the covered leat are reinforced with concrete and metal bands for some 2m back from its mouth, again presumably dating to ICI's tenure of the site.

The evidence shows that all the waterwheels at Basingill were breastshot. The wheel-pit of the northern incorporating mill group is cut into the natural rock, with masonry walling on the southern side. The south wall of mill 1 would have formed the northern side of the wheel-pit, but this has collapsed. The lower part of the side wall to the south of the wheel-pit has been reinforced with concrete. The dimensions of the wheel-pit suggest that, allowing for clearance of the stonework, the wheel was *c* 5.4m in diameter. This also allows for a central axle to line up with the apertures in the mill walls. The wheel-pit of the middle mill group has silted up much more than the one in the northern group, primarily because water does not now flow through it regularly as happens

Figure 13. Rennie's Hatch in southern incorporating mill group (NMR: AA038849)

at the latter. The pit is approximately 1.9m wide, and there is evidence of it having had a concrete lining, with a curved cill a few centimetres proud of the mill walls on either side. The rear of the pit is faced with thin, edge-laid stone slabs. The dimensions of this pit suggest that the wheel it housed would have had a diameter of around 5m. Like the wheel-pit of the middle mill group, the wheel-pit of the southern mill group has been subject to silting up over the years. The accumulation of debris in this pit has built up to a depth in excess of 1m, but given the visible curve of part of the wheel-pit, the wheel would probably have had a diameter of *c* 5.6m.

The tail-races carrying the water away from the northern and middle incorporating mill groups were both simple affairs. The tail-race of the northern mill group merely consists of a channel extending about 5m from the edge of the wheel-pit and feeding straight back into the River Kent below the weir. This channel is concrete lined, which again suggests that it was refurbished in the early 20th century. There is no surviving trace of the tail-race from the middle mill group, as the area in front of these mills has been levelled and redeveloped into an area of grass within the last 50 years. The map evidence suggests that originally, up until the early 20th century, a short tail-race extended from the wheel-pit to the river's edge. However, by 1912 and the revision of the OS third edition map, the riverbank had been cut back, and the wheel-pit discharged directly into the river.

The location of the southern incorporating mill group, further away from the river than the other two mill groups, required a more substantial tail-race to carry the water from the mills back to the river. The tail-race survives for much of its length as an earthwork, in varying states of preservation. The first section leading away from the wheel-pit comprises of a pair of opposing scarps defining a slight depression. The eastern scarp is very slight and fades out a short distance from the mills, having been disturbed by the insertion of a recent access track and obscured by rubble used to build up one side of the track. The western scarp extends further, but is similarly faint where the track has been constructed over it, and it merges with a modern slope that defines a grassy area, just beyond the track. The track now separates this northern section from its southern part, although the OS second and third edition mapping indicates that the tail-race was originally a complete and uninterrupted channel. South of the track it commences again as a feature which has been extensively remodelled as a result of the relatively recent insertion of a number of fish-holding tanks. This and the use of rubble to build up a level surface for the modern track has destroyed any evidence of the original form of the tail-race in this area. To the south of the fish-holding tanks the tail-race survives as a steep-sided earthwork channel with traces of revetment walling visible in places. The scarp defining the eastern edge of the leat bows out towards the middle of the feature and has a further slight, curved scarp above it to the east. This broadening out coincides with the depiction of a pond (associated with the garden) on the OS first edition map, which had been incorporated into the tail-race by the late 19th century.

5.1.2 The Incorporating Mills

Northern incorporating mill group

The northern incorporating mill group consists of a pair of mills (mills 1 and 2) arranged one on either side of a wheel-pit, with a third mill (mill 3) added to the southern end of the pair (Figure 14). Mills 1 and 2 are the original mills on the site, and must have been constructed shortly after the licence for the site was granted in 1790. Mill 3 was added sometime between 1857 and 1875.

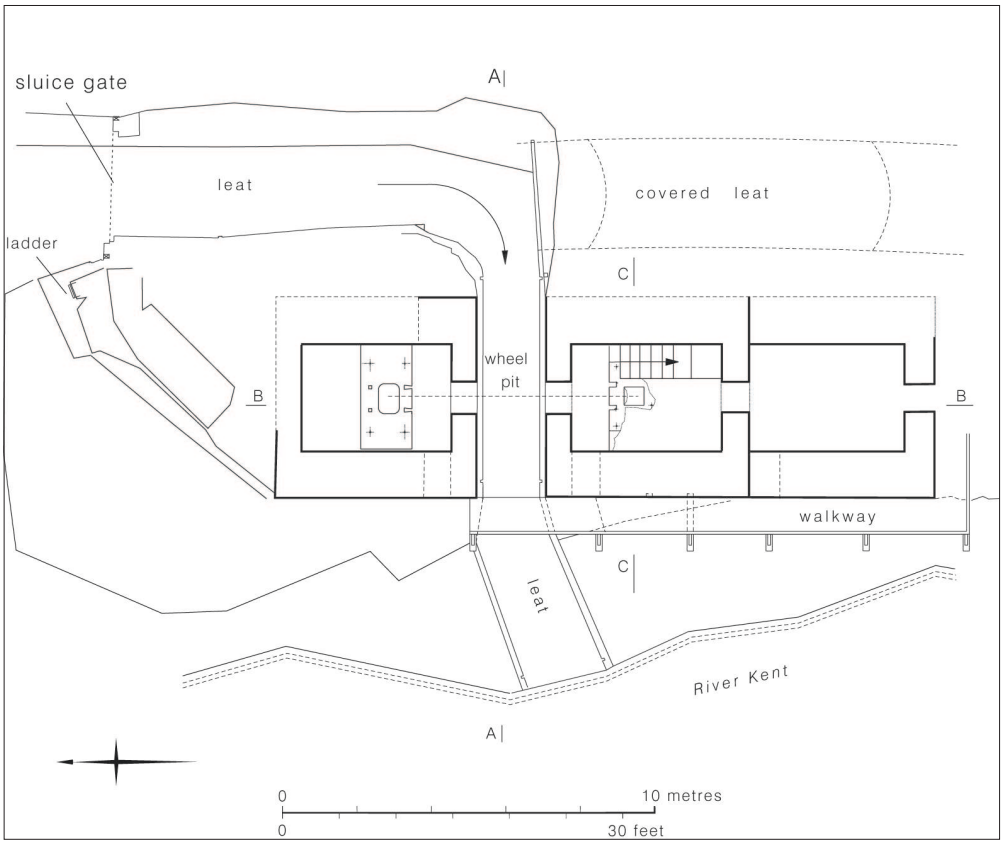


Figure 14. Plan of northern incorporating mill group

The original pair of incorporating mills was built on a rocky outcrop which was partly quarried away to create the head-race and wheel-pit. The mills occupied an exposed position, end-on to the flow of the River Kent, and to create the strength to withstand the full force of the river in spate, the northern end of the outcrop was built up with rubble to the same height as the mill walls, its north face being revetted with rough-cut stone blocks. Mills 1 and 2, and their central wheel-pit, formed a rectangular building. The mills, north and south of the wheel-pit, were originally mirror-image in plan, and had rectangular stone-built basements housing machinery which both supported and drove the grinding mills in the timber-framed superstructures above. The basement walls are all that now survive, the southern wall of mill 1, to the wheel-pit, having collapsed and been cleared away since 1962, when it is shown on a photograph (Figure 9). The east and north walls of the basement are built either back to earth or into the rubble outcrop, but the outer faces of the west and south walls are both built of coursed, irregularly-sized, roughly-squared rubble with dressings only on the corners of the wheel-pit. The inner faces of all the surviving walls are of more regularly-sized rubble. The basement chamber of mill 1 is *c* 3m long by *c* 2.8m deep, while mill 2 is *c* 4m long by *c* 2.9m deep. They are both partially filled with tumbled rubble and vegetation, but each can be seen to have a flywheel pit along the inner side of the wall to the wheel-pit, and a substantial, centrally-set bedstone. The bedstones carried the framework which not only supported the grinding mills above but also held the machinery which transferred drive, via flywheels and gearing, from the waterwheel to the vertical shaft which powered these mills. The surfaces of the bedstones differ slightly in that that in mill 1 has a sub-rectangular depression, while that in mill 2 has a square depression. Both have other associated cuts in the stone, as well as the sockets for four iron bolts. The basement chambers were both lit from windows, in line with the flywheel pits, in the walls overlooking the river. The window in mill 1 has been lost since 1962, but that in mill 2 survives, its south reveal cut away later, mistakenly giving the opening a splayed shape. It had no lintel, its top being level with and thus formed by the floor of

Figure 15. Flight of steps in mill 2 (NMR: AA038833)

the grinding chamber. After the construction of mill 3, if not before, a walkway ran along in front of this opening. Rectangular openings in the walls flanking the wheel-pit supported the axle of the waterwheel - again that in mill 1 has been lost since 1962, and that in mill 2 no longer retains its lintel. The base of the surviving opening has a plain stone slab - there are no boltholes to secure whatever supported the axle. The south wall of mill 2 has a doorway in line with the two openings just described. It has slightly tapered sides, a feature which gave it strength, and is a primary feature which must have been used to give access to the chamber. The irregular flight of stone steps built against the east wall of the chamber, which provide access from ground level down to its floor, are late in date. They are not properly bonded into the walls, and a tree has grown up alongside them, displacing some of the stones (Figure 15). Given their size and position, the mill must have been out of use when they were built, and they are likely to have been inserted after the abandonment of the site, perhaps by the Environment Agency, to give easier access to the river. The displacement of masonry in the window opening in the wall overlooking the river must also be related to access through the building.

The superstructure of mills 1, 2 and 3 as it was in about 1900 is shown on a postcard (Figure 6). Mills 1 and 2 predate mill 3, and differences between the construction of the shutters of the grinding chamber windows in mills 1 and 2, and in mill 3, as well as similar differences to the form of the roof covering, indicate that the superstructure is of two dates. This confirms the evidence of the report on the 1883 explosion, which stated that structural damage was ‘very trifling’, and was restricted, in this mill group, to ‘a few boards’ (Cundill 1883, 4). The postcard shows mills 1 and 2 to have had a gabled, single-storey superstructure, evidently timber framed, which was faced with vertical wooden boards. The wheel-pit is roofed in with the mills, but its front was not enclosed, although for structural integrity it was cross-braced here by timbers at first-floor level. The two mills each had a more or less central window in the west walls of their grinding rooms: the windows were unglazed but had externally-opening wooden shutters of ledge and batten construction. The roof was evidently covered with a series of metal sheets, with five sheets in each row up the slope. Inside, none of the stone cross walls rose above basement level, indicating that there were neither blast walls nor gable walls. The waterwheel must have risen above the level of the working floor, and the waterwheel bay must have been separated from the grinding chambers by timber partitions.

The wheel-pit between mills 1 and 2 has stone side walls of roughly-dressed squared rubble, which are in part also those of the mills. Part of the bottom and much of the base of the north and south sides of the wheel-pit are overlaid with concrete which was added during the early 20th century. This has slots for a sluice gate above, or east, of the waterwheel, and for a shallow wash-board below the wheel.

Mill 3, added to the south end of the original incorporating mills, is similar to them in size and form, and must have been powered by an extension of the line shaft in mill 2. It has a stone-built basement whose east side is built back to earth, but rubble tumble and general slippage of the surrounding earth partially obscure the south wall, and a substantial build-up of rubble internally totally obscures the original floor. The walls have an outer face of variously-sized rusticated rubble with dressed-back edges at the corner and to the openings. This masonry, though squared, is not laid in regular courses, but in more 'geometrically' arranged courses of differing depths, much like the external walls of the southern group of mills (mills 6-8). The inner face of these walls is of simple squared rubble. An opening, probably a window, in the west wall, in line with the presumed flywheel pit, has one straight and one splayed reveal. Another opening, in the centre of the south wall, is in line with those through which the line shaft passes in mills 1 and 2. The line shaft can never have approached this opening, which may have served as a doorway into the chamber. A postcard of the site from *c* 1900 (Figure 6) shows a wooden walkway running along the riverfront of mills 2 and 3, level with the base of the windows, supported on iron brackets, and with a handrail. Sockets in the face of the external masonry, some still containing fragments of iron, is all that remains of this walkway, which was evidently used to gain access to the mills. The superstructure of mill 3 no longer survives, but the postcard shows that it ran in continuation with that of mills 1 and 2. It was single storeyed and timber framed, with an external face of vertical wooden boards and a roof of sheet-metal plates. The window lighting the grinding chamber had an external shutter with battens set higher than those on the shutters to mills 1 and 2, and the metal plates on the roof are markedly longer than those over the earlier mills, confirming that the superstructure over the two phases of mills, like their basements, are also of different phases.

The earthworks associated with the northern mill group are on the whole related to modern alterations on the site and to the general spread of rubble and soil. To the east of mills 2 and 3, a fairly steep scarp extends down to the top of the southern and eastern walls of mill 3. This is mainly made up of modern material, presumably the result of alterations to the access trackway and the creation of a gradient suitable for vehicles. A short but steep north-south slope abuts the southern end of mill 3, the bottom of which coincides with the vertical rock-face at this point. Again, this slope consists mainly of soil and debris which has been recently deposited.

Middle incorporating mill group

The middle incorporating mill group, which consists of a pair of mills (mills 4 and 5) on either side of a central wheel-pit (Figure 16), was built after the construction of the first pair of mills in 1790, but before 1826. As with the other mill groups, only the stone-built basements survive (Figure 17)

An early lithograph of the mills, published in 1826 (Figure 4), shows half the building obscured by trees. Mill 4 is depicted with a stone-built basement surmounted by a superstructure evidently of timber - perhaps horizontal boards - and a roof with six rows either of wooden boards or, perhaps less likely given the evidence of the report

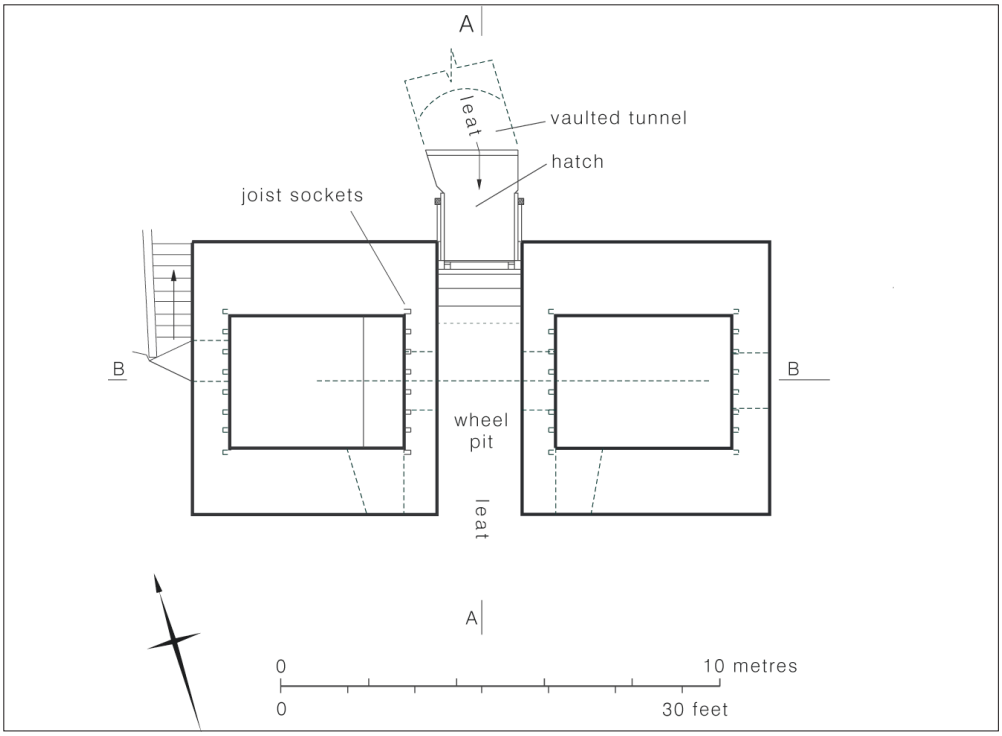


Figure 16. Plan of middle incorporating mill group

into the 1883 explosion, of metal sheets. A corner of the roof of mill 5 is shown, and this is identical to that of mill 4. The waterwheel, which was set between the two mills, is shown projecting out into the river, the result of artistic licence, since it cannot have done so, but more significantly, a clear gap between the roofs of the two mills shows that the wheel-pit was not roofed. The evidence of this drawing, which also shows two windows in the south wall of mill 4, can only be partially confirmed, since so little survives.

Mills 4 and 5, and their central wheel-pit, were built next to, but at right angles to, the River Kent in a position determined by topography and by the course of the head-race, which was most likely to have been created contemporaneously with the construction of the northern mill group. The building, rectangular in overall plan, was built into the slope to the north and east. The mills, east and west of the

Figure 17. Middle incorporating mill group from the south (NMR: AA038844)

wheel-pit, were virtually mirror-image in plan and, like the earlier mills on the site, had rectangular stone-built basements housing machinery which powered grinding mills in the timber-framed superstructure above. Only the stone-built basements and the stone-lined wheel-pit survive. The basement walls have external faces of coursed, rusticated masonry with tooled edges only at the outer corners and to the wheel-pit opening which itself has side walls of squared, not rusticated, masonry. The internal basement walls are of roughly-squared rubble. The basement chambers are *c* 4m long by *c* 3m deep. Both are partially obscured by a mixture of rubble and vegetation, but the flywheel pit, defined by an otherwise hidden bedstone, is visible in mill 4, and an equivalent must be presumed in mill 5. Both have windows in their south walls, in line with the flywheel pits, one side straight, the other splayed, both with externally-rusticated rectangular stone lintels. Neither retains a window frame, but that in mill 4 must equate with the two-light lattice window shown on the drawing published in 1826, even if it has been drawn in the centre of the wall, immediately below the timber superstructure, and not closer to the wheel-pit edge and further down the wall. Rectangular openings in the walls to the wheel-pit supported the axle of the waterwheel, which must have driven lineshafts in both mills. The west basement wall of mill 4 has a doorway, approached by an external flight of stone steps, close to one corner; mill 5 was entered through a doorway in its east wall, its exterior now partly hidden by soil and debris.

The superstructure of mills 4 and 5 has been lost, although its depiction in the drawing published in 1826 has been discussed above. The official report on the 1883 explosion indicates that when these two mills exploded, structural damage was very trifling - nothing beyond 'blowing off the light wood boarding', evidently because the mills were being laid with green charges which were but feebly explosive compared with gunpowder in a more advanced stage of manufacture (Cundill 1883, 4). The 'light wooden boarding', part of the superstructure, may have been part of the roof covering rather than the wall covering. Evidence does survive for the floor of the superstructure in the form of a series of rectangular sockets for timber joists in the tops of the east and west walls of both mills (Figure 18). These sockets indicate that eight joists supported the floorboards over each mill, one joist along each wallhead, and six in between. The 1929 engineers' report for ICI describes the construction of the incorporating mills, and confirms that the floors were of timber.

Figure 18. Floor-joist sockets In mill 4 (NMR: AA038842)

The base of the wheel-pit of this mill group is significantly silted up. However, a metal fitting, apparently still *in situ*, protrudes from the bottom of the wheel-pit through the accumulated debris. It is somewhat bent out of shape, but was probably originally part of the sluice system, possibly a support for, or part,

of the operation of a Rennie's Hatch, which would have been positioned above the wheel-pit, where impressions in the stone indicate the site of seatings for it.

A ramp abuts the northern side of mill 4, which would originally have provided access to the latter's working level. Another slight scarp leads up to the northern side of mill 5, although this is likely to have been caused by soil slippage along the edge of the wheel-pit. A steep scarp that buts up to the south-east corner of this mill and extends *c* 15m to the south is a modern feature, created to lessen the gradient of the natural slope for the modern access track. A curving scarp to the south of the mills, defining a slight depression, is also of a modern origin. The area south of this mill group has been greatly disturbed during the second half of the 20th century due to attempts to improve access around the site; the earthworks which are present, therefore, are of recent origin.

Southern incorporating mill group

The southern group consists of three incorporating mills (mills 6-8), mill 6 on the north-west side of the wheel-pit, mills 7 and 8 in line on its south-east side (Figure 19). The mills were built between 1826 and 1857. The feature that sets the southern incorporating mill group apart from the others at Basingill, is the presence of at least four small, square chambers abutting the external north-eastern walls of the mills (Figure 20). Mills 6-8 stand well back from the River Kent, are built at an oblique angle to it, and are built close to the base of the valley slope. The three mills themselves are not built back to earth, but the chambers to their rear are, and these not only held back the pressure of the soil, but also created an access walkway with a ventilated area beneath it behind the mills.

The three mills, their wheel-pit, and the rear chambers, form a rectangular building, but as elsewhere, only the stone basement levels survive, the less permanent superstructures having been lost. The three mills, like all the others at Basingill, had stone-built basement chambers housing the machinery which powered the grinding mills on the floor above. The external and the internal walls of the three mills, the side walls of the wheel-pit, and the outer face of the platform support along the north

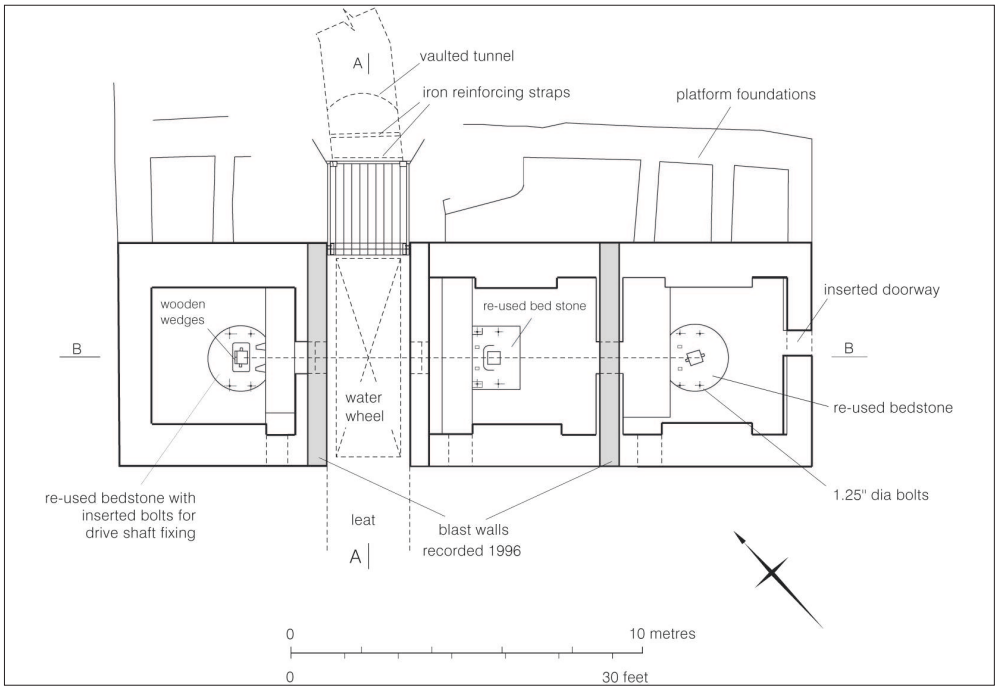


Figure 19. Plan of southern incorporating mill group

Figure 20. View over the southern incorporating mill group from the north-east (NMR: AA038824)

side, are all built of rusticated masonry which is virtually identical to that in mill 3. Though coursed, it is laid not in regular rows but in interrupted rows which differ in depth. The stones at the corners of the three mills, to the wheel-pit, and to the original openings, all have tooled-back edges. Two blast walls, one on the south-east side of mill 6, the other between mills 7 and 8, were integral parts of the mill and they stood to their full height until 1996 when they were taken down for safety reasons.

The three mill basements are not of the same internal shape or size: mill 6, the smallest, is rectangular, measuring 4m by 3.85m, whereas mills 7 and 8 are larger, are an elongated H-shape, and are almost identical in size (mill 7: 3.85m by 4.4m; mill 8: 3.85 by 4.55m). The interiors of the mill chambers are partially obscured by rubble and vegetation, but it was possible to confirm that all three mills had flywheel pits, those in mills 6 and 7 flanking the wheel-pit, that in mill 8 repeating the layout in mill 7. All three mill chambers had windows in their south-west walls, lighting the flywheels, and all with straight-sided reveals. Bedstones were set into the floors of all three mills. The one in the floor of mill 6 is a circular stone with a central depression which has had part of one side removed to give a flat surface, so that the stone sits flush with the pit, and is held in place with four metal bolts. The stone in mill 7 is rectangular and measures *c* 1.9m by 1.35m, with a central rectangular recess, while the stone in mill 8 is similar to the one in mill 6, a circular stone, *c* 1.9m in diameter, with one part removed to form a flat surface. A number of metal bolts are also present in the upper surface of this stone. The differing shapes and sizes of these stones and the various bolts in their surfaces suggest that they were not contemporary and may have previously been used elsewhere for other purposes. Power was led into the three chambers by lineshafts through the tall openings with segmental-arched heads which are set centrally and in line in their cross walls. The off-centre doorway in the south-east outside wall of mill 8 is a later insertion, the lack of doorways into the chambers suggesting that access to them must have been through hatches and down ladders from the working floors above.

The blast walls, demolished in 1996, were a further 5.75m higher than the walls of the mill basements, giving an overall wall height in excess of 8m (Figure 21). The

Figure 21. Southern incorporating mill group with blast walls in situ (reproduced by permission of Oxford Archaeology North)

walls were constructed of rusticated masonry, apparently in regular courses of dressed stone, although vegetation obscures much of the detail on the archive photographs. The faces of the blast walls that would have formed part of the interior of the mill superstructure appear to have been smoothed off, and do not have a rusticated appearance (Figure 22). This was probably to prevent any accumulation of loose gunpowder occurring in the irregular faces of the masonry. The face of the blast wall adjacent to the wheel-pit has not been smoothed, and its appearance is similar to the rest of the external masonry of this mill group.

The chambers abutting the north-east of the mill group are constructed of fairly small pieces of rubble masonry, in contrast to the large pieces of dressed masonry used in the south-west face of these mills, and have no entrances or openings. The walls of these chambers are still standing to the same height as the walls of the mills. The most likely explanation is that they are the foundations of a former platform. The platform would thus have been on a level with the working floors of the mills, and would have

Figure 22. Detail of more westerly blast wall in southern incorporating mill group (reproduced by permission of Oxford Archaeology North)

been easily accessible from the main part of the works to the north. Debris has obscured the full extent of these structures, but there is evidence of a platform adjacent to all three mills, although it may not have been continuous, possibly breaking for the wheel-pit and leat. The view that these structures were part of a platform is further strengthened by the existence of an earthwork to the north of the mills. A flat tongue-like area, *c* 12m long and defined by slopes on either side, extends from north of mill 6 in the direction of the wheel-pit, although only the eastern scarp continues all the way to the leat at the head of the wheel-pit. This flat area slopes gently down towards the site of the platform, thus providing an easy access route. There are further scarps around the tunnel entrance and wheel-pit, created by debris slipping into the area occupied by the wheel-pit.

At the northern end of this access platform, under a dense covering of ivy, a recumbent stone pillar was surveyed on to the English Heritage plan. The pillar has two hinges at either end, designed for hanging a gate on, but is clearly no longer *in situ*. Given the size of this gatepost, it is possible that it formed part of an earlier entrance to the site, but unfortunately there is now no indication of its original location.

5.1.3 Blast walls

In between the northern and middle incorporating mill groups is a section of stone-built wall, *c* 10.5m long, aligned east-west. It has south-facing buttresses at either end, with opposed stub walls on both sides in the centre. A south-facing slope consisting mainly of rubble debris butts up to the southern side of the wall, presumably formed by the collapsed or demolished wall. A wall with a small building adjoining its eastern end is depicted on the OS third edition map, revised in 1912. Unfortunately, vegetation and tumbled masonry has obscured any further detail in this area, with the result that no remains of the attached building are visible any longer. The wall was undoubtedly a blast wall designed to prevent the communication of an explosion between the northern and middle incorporating mill groups. On the OS first edition map, surveyed in 1857, a building is shown in this location, but by the time of the revision of the map in 1896 and 1897, this has been replaced by a wall with a much smaller structure adjoining its eastern end, as mentioned above.

5.1.4 Other gunpowder buildings

Adjacent to the perimeter wall of the site is a stone-built platform. This is now occupied by a modern storage shed, but its position clearly corresponds with that of a building depicted on the late 19th century OS mapping of the site and the shaped stone-built platform may incorporate parts of the earlier building. Its southern end has been rebuilt and enlarged, but the eastern section which butts up to the wall is probably original. A short flight of steps was observed, in November 2000, in the south-western side of the platform near its southernmost corner, but they have since been destroyed, possibly during recent remodelling and repointing. They had the appearance of an original feature (C Dunn, *pers comm*). Behind the storage shed, within the fabric of the perimeter wall of the site, is a pair of gatepillars. These are most clearly visible on the eastern side of the wall, facing the road (Figure 23). The pillars, constructed of rusticated masonry blocks with dressed-back corners, are *c* 0.5m wide and 2.2m high (on the road-side of the wall), and stand some 2.5m apart. They have lost their capstones, and the gateway between them has been blocked with

Figure 23. Blocked gateway and doorway in the perimeter wall (NMR: AA038836)

rubble of a different build from the adjacent perimeter walls. This gateway is likely to have been the original entrance to the site, as it leads straight on to the platform, which may have been used for unloading, with an associated building beside it. On Patterson's plan this building is labelled as the works watch-house, where the workers would have waited in relative safety for the incorporation process to finish, but this seems unlikely (Patterson 1995, plan facing 14). The location is more conducive to it being a charge-house, given its vicinity to the road, the works entrance and the platform. In addition, the inner face of the perimeter wall behind the storage shed is covered with a light mortar wash. The rendering of stone walls in this manner was a requirement for gunpowder buildings, as it prevented the build up of loose powder within the cracks between the stones. This treatment of the wall adds further weight to the assertion that a building containing gunpowder originally stood here. Just to the north of the blocked gateway is a much smaller doorway, now filled in with bricks. This doorway is 1m wide, and though only 1.2m high when measured from the modern ground level by the road, the ground level inside the site is approximately 50cm lower. The doorway has a shallow segmented-arched head, constructed of individual stones, and is visible only on the external face of the perimeter wall; there is no trace of this feature on the inner face of the wall, as it has been covered by a thin layer of mortar. While the larger gateway would have allowed vehicular access to the site, for example, horse-drawn carts, this smaller doorway would only have been big enough for people, possibly with barrows, to access the site.

In the area to the west of the modern site entrance are a number of scarps and rubble spreads. Most of the scarps are related to the access trackway and modern efforts to make the gradient more suitable for vehicular access. It is in this area that an L-shaped building is depicted on the OS mapping of the site (Ordnance Survey *c* 1860a, 1898a, 1914a). There are no significant standing remains of this former building, but there are a number of rubble spreads, which incorporate original, as well as modern, material. Within this rubble is one particular scarp, which forms a well-defined right angle and incorporates a short section of *in situ* walling. This building is probably incorrectly identified as a wrought-charge house on Patterson's plan of the site (Patterson 1995, plan facing 14). It is much more likely to have been

the works watch-house, as it occupies a relatively central position, a location which would have provided good views of all the mills. A building, pre-dating the construction of the blast wall between the northern and middle incorporating mill groups, is shown on the OS first edition map (see section 5.1.3). Above ground traces of this feature no longer survive.

5.1.5 The perimeter wall and area beyond

The wall surrounding the site shows evidence of a number of alterations, and does not stand entirely in its original form. The former doorways and gateways in the wall have been discussed above, and the doorway for the southern section of the garden is discussed in section 6.3. The present entrance to the site which was created by the Environment Agency relatively recently, close to the storage shed, appears to be a new build so is unlikely to incorporate any original features. A short distance to the east of the entrance and new walling, a butt joint is visible in the eastern face of the perimeter wall. This may indicate that the original wall of the gunpowder works terminated here, and that the continuation of the wall to the south beyond this point is a later addition, perhaps built when the garden was created and/or the works expanded. If this is correct then at the butt joint the original wall of the works may have turned through ninety degrees and extended south-west to the river, thus enclosing only the northern part of the site. This reduced extent of the works must belong early in its history, because later structures, including the southern incorporating mill group, are outside it. There are now no traces on the ground of this possible earlier course of the perimeter wall. Any traces are most likely to have been destroyed by the later expansion of the site. Certainly by the time of the OS first edition map, the perimeter wall was a continuous feature extending from Force Bridge to the southern extremity of the gardens.

The limit of the area surveyed did not extend beyond the road to the east of the site. However, some documentary sources indicate that there may have been activity connected with the gunpowder works adjacent to the eastern side of this road. The OS first edition map, surveyed in 1857, shows a rectilinear enclosure, roughly opposite the middle mill group. The enclosure has a building depicted within its northern end, but there are no clues on the map as to the purpose or form of this structure, with only its proximity to the works suggesting a connection. The structure, labelled as a magazine on a plan drawn by Tyler (2002, 37), is said to have been used for loading and unloading carts to prevent them from having to enter the site (Tyler 2002, 42). This seems somewhat unlikely as restrictions on entering gunpowder sites did not come into force until the implementation of the 1875 Explosives Act, and yet the building is not shown on the later OS second edition map of 1896. In the early days of the works and even as late as the 1860s when the OS first edition map was produced, access would not have been so problematic, with no need for an external magazine. In addition, there is no turning circle associated with the ‘magazine’, which casts doubt on its regular use by the gunpowder works, as safe manoeuvring of wagons laden with barrels of gunpowder must have been paramount. However, it is just possible that a circular route from Sedgwick village was used to arrive at and depart from the site. Recent widening and upgrading of the road in this area has destroyed any traces of the building and its attendant enclosure.

5.2 Modern features

As Basingill is a working site in constant use by the Environment Agency, it is inevitable that in recent years a number of changes have occurred at the site. As mentioned previously, there is a platform adjacent to the perimeter wall, close to the modern entrance, with a modern storage shed on it (Figure 11). This has obscured any original details of the building that previously stood here (see section 5.1.4). Various other structures have been added, including a tank some 17.5m north of the modern storage shed. Just to the south of the middle mill group is a stone-built rectangular basin, which was once used as a fish-skinning station. Adjacent to the south-west corner of mill 4, are two pillars with three associated metal uprights, which stand in the river. At first it was thought that these might relate to the gunpowder mills, as supports for a walkway to give access to the western side of mill 4. However, they are in fact relatively modern additions and formed an early type of fish-holding cage (John Martin, *pers comm*). At the northern end of the tail-race, a number of concrete holding tanks have been built with steps for access and these have masked the original route and form of this water feature.

The main modern alteration to the site has been the insertion of access tracks. The principal track extends from the entrance gateway down the natural slope towards the relatively flat area of land to the west of the tail-race, where it loops back on itself. This part of the track is located to give access to the generator house, a small rectangular modern building, as shown on the schematic plan of the site (Figure 11). The generator house provides power for the fish counter, another modern addition to the site that spans the river on both sides of the large island. While the track itself has not directly affected any of the mill buildings, archaeological evidence in the form of subtle earthworks are likely to have been disturbed or perhaps even obliterated by the track and associated construction work to build-up and level the surrounding land.

To the west and south-west of the southern incorporating mill group are a number of scarps, but the majority of these are of recent origin. A semi-circular raised area on the south-western side of the modern track, immediately near mill 6, is a turning bay for vehicles and it also facilitates access to the river. To the south is a modern water channel cut at right angles to the river and possessing a concrete revetment at its eastern end.

6. DESCRIPTION AND ANALYSIS OF THE FIELD REMAINS OF THE GARDEN

The garden at Basingill occupies an area measuring some 200m north-south by about 40m east-west, covering an area almost entirely to the south of the gunpowder works. The principal surviving components consist of built elements, but there are also a number of slight earthwork features masked by woodland vegetation. The garden appears to have comprised at least three distinct elements; the formal terraced walk, overlooking the garden, river and gunpowder works; informal woodland walks; and a viewing area at the southern end of the garden (Figure 25). The wild vegetation, which has colonised much of the site, has unfortunately masked virtually all trace of the original planting pattern which might otherwise have survived. There are, however, examples of non-indigenous plants and trees, such as laurel, Portuguese laurel, periwinkle and yew, which are likely to have been introduced in the course of planting a formal garden.

6.1 The terraced walk

The main feature of the garden is a terraced path, which extends for *c* 110m, some 3m above the ground level immediately to the west, on top of a revetted quarry face. The path, *c* 1.8m wide, has been cut back into the natural slope of the land, which falls towards the River Kent. As a result, its east side is edged by a retaining wall, *c* 1.4m high, capped with coping stones, although not all of those now survive. The ground between this and the site boundary wall on the east is now rough and overgrown and slopes down to the top of the retaining wall. The west side of the path, which is defined by the vertical drop of the quarry face also has low-level coping stones, a number of which still survive *in situ*. Many of these stones show evidence of having held metal railings, although the railings have long since been cut off flush with the stone. The start of the path, close to the modern entrance, is no longer very well defined, as it has been obscured by vegetation growth and rubble spreads. However, the OS first edition map, surveyed in 1857, shows the area more clearly, with the path extending close to an L-shaped gunpowder building depicted on this map (see section 5.1.4). A short distance to the south, the rock face has been quarried back, creating a right-angled recess, over which the path is carried by a stone-built arch (Figure 24). At its southern end, the path leads to a flight of steps, the foot of which is flanked by a pair of pillars. A narrow path adjacent to the bottom of these steps leads downslope, and originally gave access to a terraced, planted area below. The northern pillar of this pair has truncated metal stumps in its northern face

Figure 24. The archway of the terraced walk (NMR: AA038841)

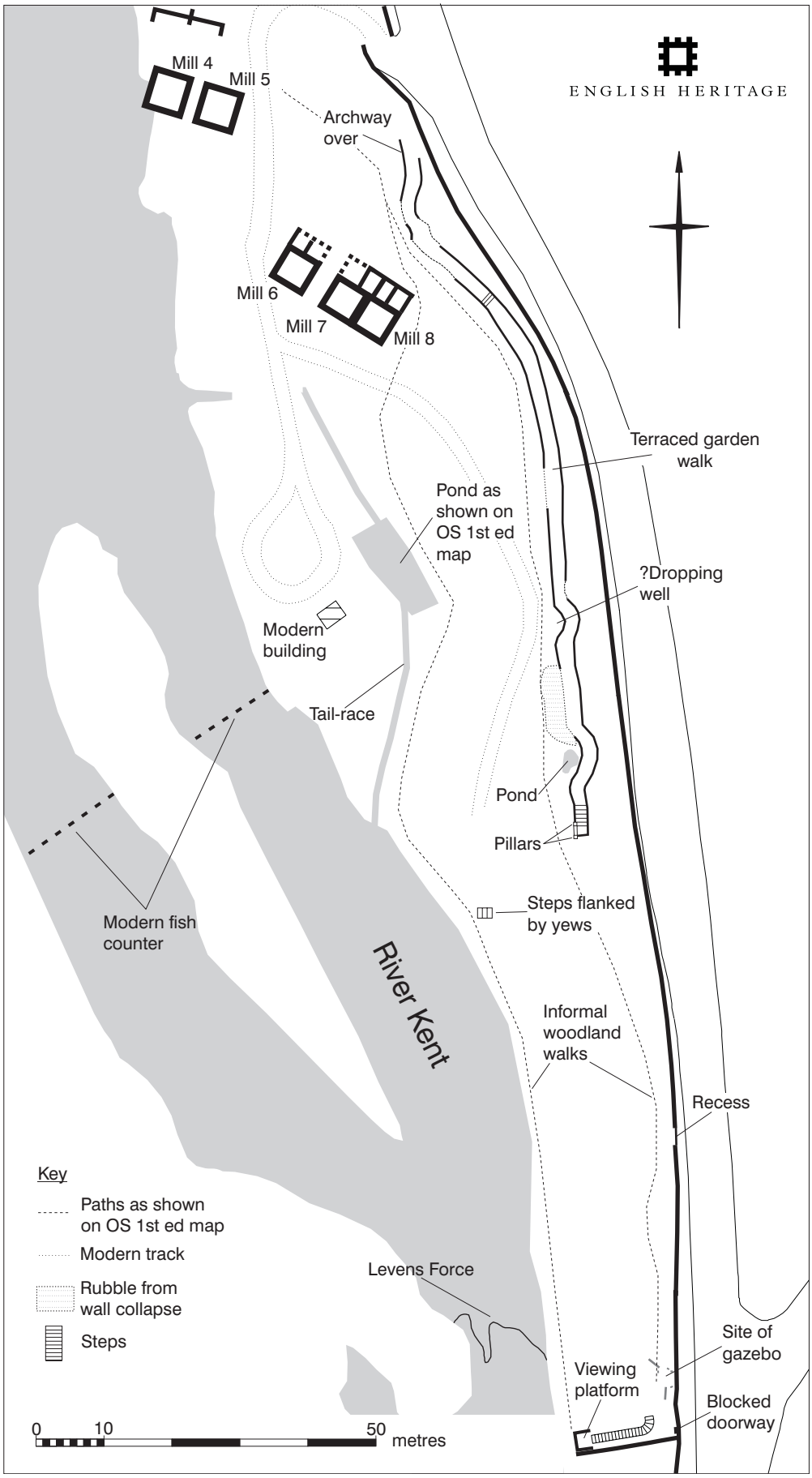


Figure 25. Schematic diagram of the garden at Basingill

where it supported the horizontal elements of the railings. This tallies with evidence from the accident report on the explosion, as outlined in section 4.1, which describes the disused garden (Cundill 1883, 5-6). The quarry has been faced, almost in its entirety, with small dressed stone blocks to give the appearance of a high wall. In places, the facing has fallen away, revealing the quarried stone behind, and in other places, the whole quarry face has collapsed, resulting in the complete destruction of the path.

Below the terraced walk is a relatively level area, the floor of the earlier quarry, defined on one side by the revetment wall and to the west by a natural fall in the ground surface. There is no definite evidence that this area was utilised as part of the garden, although it is quite possible that any planting in this area has long since died and been destroyed, especially as the modern access track cuts through the eastern part. Below, to the west, two scarps can just be discerned (Figure 10). The upper one of the pair seems to define a path, probably the one depicted on the OS first edition mapping. The lower scarp defines a second terrace that may be remnants of the garden landscape in this area, possibly the trace of a planting terrace. The southern group of gunpowder mills truncates these terraces, indicating that the latter are earlier than these mills. It is difficult to be more certain about the nature of these and any other garden features in this area, because the earthworks are heavily overgrown and fairly degraded as a result of modern activity.

6.2 Informal woodland walks

At the foot of the steps at the southern end of the terraced walk, a narrow path defined by a west-facing scarp ascends the valley side towards the site's eastern boundary wall. Near the latter it changes direction and from here to the southern end of the site, it has been laid out along a course roughly parallel with the wall. This path appears to have been the uppermost of a pair of informal walks that originally led through the wooded, southern part of the garden, which affords excellent views over Levens Force. The lower path takes a similar course, following a break in the natural slope, some 14m downslope of the upper path. The northern part of this lower path was recorded by English Heritage as an earthwork, with scarps defining each side of it, but the remainder was not surveyed on to the site plan in its entirety, as it was both inaccessible due to dense vegetation and blocked by otter holts created by the Environment Agency. However, its course is depicted on the OS first edition map, and this is the source for the route of the path shown on figure 25. After *c* 25m, the path curves upslope slightly and passes between a number of yew trees, possibly part of the original planting. In between the roots of these yews are three steps, which were presumably incorporated as part of this garden walk. Immediately to the east of the steps is a small semi-circular feature cut back into the natural slope (Figure 10). This may be a modern feature, but it is quite possible that it dates to the construction of the garden and that a bench was located here, sheltered by the natural hillside and accessed by the short flight of steps.

Approximately 50m south along the upper path from the end of the formal walkway, the path broadens out from *c* 2m wide to *c* 6m wide. This flat apron-shaped area, which measures *c* 16m in length, appears to have been intended as a viewing platform - certainly it affords impressive views over Levens Force and across to Force cottages (Figure 26). A large beech tree, probably of some antiquity, is situated towards the southern end of this platform. At the platform's northern end is a recess in the perimeter wall, some 35cm deep and 2.1m across. This may have housed a bench or seat, which would give further support to the suggestion that this was a viewing area.

Figure 26. View over Levens Force (NMR: AA038823)

A scatter of masonry was observed on the ground surface in this area, but there was nothing to suggest that it related to a former structure.

The path continues south beyond this platform in a less well-defined form than previously and, although overgrown, it is still possible to follow the route shown on the OS mapping. Some 25m south of the platform, six stone pillars are visible, four of which are still standing upright. The pillars are roughly hewn, and thus not regularly shaped, but most measure in the region of 2m by 0.4m by 0.2m. Three have metal bolts in their tops. It seems that these pillars formed some kind of gazebo or similar structure. Their position coincides with the location of a small square structure depicted on the early OS mapping. The map evidence does not give any hint as to its form, but given the height of the pillars and the metal bolts in the top of some, it is quite possible that they supported beams or even a roof.

6.3 Viewing area

At the southern end of the site, about 6m south of the possible gazebo, a flight of steps leads from the end of the upper path down to a viewing platform overlooking Levens Force. The steps start on top of the slope but after a short distance, curve around and descend the slope, parallel with the southern boundary wall. The steps are now heavily overgrown and covered with debris; however, enough were visible at the time of this survey to obtain an idea of their extent, and they match those illustrated on the various editions of the OS mapping.

A stone platform, 2.1m square, with a wall on three sides and measuring 0.6m high internally, lies at the foot of these steps. Access to this feature in now virtually impossible due to a fallen tree, which has also destroyed some of the masonry. The platform has, however, been sketch-plotted on to the English Heritage plan. This platform would once have afforded an impressive view over Levens Force, but trees and scrub currently block the vista.

A former doorway represented by a blocked opening with a lintel above is visible in the eastern perimeter wall alongside the road at the southern end of the garden. It is located 0.35m from the junction of the eastern and southern perimeter walls, and measures 1.7m in height to the base of the lintel on the west side of the wall and 1.3m in height on the road side. This difference in height is due to the build up of the ground level when the road was reconstructed and widened in the 20th century. The lintel is 1.3m wide and 0.15m high, and protrudes by 0.3m into the site on the west side of the wall. This door would have allowed access to the garden and its walks well away from the gunpowder works. In addition, if the southern section of the garden was retained as a discrete unit, as suggested by the depiction on the OS second edition map, then this doorway would have afforded entry to this area, independent of the gunpowder works. It would thus seem that this end of the garden, with its viewing platform and spectacular views of Levens Force, might well have been used up until at least the beginning of the 20th century.

6.4 Water features

Towards its southern end, the high revetment wall below the terraced garden walk curves in two places (Figure 24). Within these curves are two features, labelled as 'wells' on early maps. The first feature, *c* 30m north of the southern end of the terraced walk, has been developed around a springline in the natural rock face. Evidence for a stone arch suggests the water possibly flowed out of a fountainhead, but the mineral content of the water has caused large calcareous deposits to build up masking its exact form (Figure 27). The stretch of revetment wall and terraced garden walk to the south of this well has collapsed, probably as a result of the water coming out of the rock in this area (Figure 28). The path adjacent to this feature is still waterlogged, and water appears to flow across the path and past a yew tree on the opposite side. Another large area of calcareous concretion occurs beyond the tree and over a rock-cut slope to the west, which suggests that water originally cascaded from the spring, across the path and over the rock face. A further slope below this appears to define the edge of a depression above the east side of the tail-race from the southern mill group, possibly the remnants of a pond. There is another area of concretion by the edge of this pond-like feature, suggesting that the water from the spring originally flowed into the pond. Given the depiction of this area on the OS mapping, it seems that the mill tail-race was inserted after the garden had been abandoned, thus utilising the pre-existing pond as part of its course.

Figure 27. The 'dropping well' (NMR: AA038827)

The second well, south of the one described above, *c* 10m from the southern end of the terraced walk, also located in a curve in the revetment wall, survives as a small pond, *c* 3.8m long and

Figure 28. Wall collapse below the terraced walk (NMR: AA038825)

roughly teardrop-shaped (Figure 29). Its western edge is defined by a course of dressed stone, while an artificial slope runs down to its southern end. A small area of calcareous concretion, which begins some 0.5m up the revetment wall, suggests that this pond was also fed by a natural spring at some point, although there was no evidence of flowing water at the time of the survey. It is possible that the water flowed from under a small stone arch, as it did in the feature described previously, but moss and accretion have made it very difficult to be sure.

In his account of the garden, Conybeare refers to a 'dropping well' (1925, 33), the definition of which is a well formed by the dropping of water from above (OED 1971, 808). In view of the form of the two wells, the likelihood is that the 'dropping well' is the more northerly feature, as the fountainhead is higher, creating a significant drop. Additionally, a contemporary account of the gardens at nearby Levens Hall refers to a spring, known as the 'Dropping Well', the petrifying quality of which, turns natural matter 'into stone' (Mannex and Co 1851, 273). This connection seems to further suggest that the more northerly feature, with its natural concretions, would have been known as a dropping well.

Figure 29. Small pond (NMR: AA038828)

7. DISCUSSION AND CONCLUSIONS

In comparison with most of the other gunpowder works in Cumbria, Basingill is not well served by documentary records. Little survives in readily accessible repositories to shed light on the history of the works. However, when combined with the results of English Heritage fieldwork, a more complete picture of the site begins to emerge. The summary of documentary evidence in section 4 shows that little is known about the early years of the production at Basingill beyond the date of application for the licence to build the works in 1790. It seems almost certain that the initial stages of construction began soon after this date, but further expansion took place in stages as the site expanded in response to the increasing demands of production, with the works reaching its full extent in the mid-19th century. Incorporating mills 1 and 2 were the first to be constructed. The build quality of these structures is somewhat different from that of the other mills, with much smaller and coarser masonry blocks being used. Also, their position is the most logical one for the first set of mills, since they are in the best position to utilise the water power of the river, needing minimal extra construction. The middle mill group (mills 4 and 5) was probably not constructed during this initial phase, as evidence suggests that it was more likely to have been contemporary with the garden, which was created between 1814 and 1820. It was definitely in existence by 1826, as it appears on the lithograph published that year, and is more likely to have been built around 1820, on the basis of evidence discussed later in this section. During this early period, the site may have been relatively compact, part of the perimeter wall possibly following a different course, and enclosing a much smaller area, suggested by the butt joint discussed above (Section 5.1.5).

The suggestion that the southern mill group (mills 6-8) was constructed after the 1820s is given further credence by the documentary references to the production figures for the Old Sedgwick Gunpowder Works. County histories and directories indicate that Old Sedgwick was producing 80 barrels of powder per week in 1829 (Parson and White 1829, 627), a figure that had increased to 250 barrels per week by 1849 (Mannex 1849, 275). This increase is a substantial jump in the level of production, and must reflect an increase in the amount of ripe-charge coming from the incorporating mills (at Basingill), possibly due to the installation of additional mills. From this evidence, albeit slight, it is possible to postulate a date of between 1829 and 1849 for the construction of the southern mill group. This would also fit in with the field evidence which suggests that the latter post-dates the garden, or at least the heyday of the garden when it was at its full extent. Map evidence demonstrates that by 1857 the gunpowder works had more or less reached its maximum extent, with the exception of mill 3, which appears to be absent at this date.

The Explosives Act of 1875 is bound to have had an effect on the site at Basingill, impacting as it did upon the manufacturing and keeping of gunpowder and other explosives. While there is no documentary evidence to explicitly outline any alterations, other evidence points to some changes at the site. For example, it was probably at this time that the gateway in the perimeter wall (see section 5.1.4), which would previously have allowed carts access to the site, was blocked up, leaving the smaller doorway as access to the site, restricting it to people and barrows. This would explain why the ‘main’ gateway and access routes leading up to it are no longer shown on the OS second edition map of 1896. It has been suggested by Tyler (2002, 42) that an external magazine depicted on the OS first edition map, surveyed in 1857, near the site entrance, negated the need to enter the works; this is discussed above in section 5.1.5. This structure, however, is not shown on later maps, which post-date

the 1875 Act, a clear indication that it was not built as a result of the Act and the stringent new restrictions on access to gunpowder works. Its form and function remain a mystery in the absence of any surviving field evidence, but a possible explanation for the structure could be that it was a store, shed or shelter related to the gardens within the works or even a small estate cottage with garden. Alternatively, the structure and associated enclosure may have acted as a resting and watering place for the horses that brought the gunpowder wagons to and from Basingill.

During the course of the fieldwork at Basingill, English Heritage architectural investigators took detailed measurements of the gunpowder mills. As a result, it has been possible to produce reconstruction drawings of the mills, with suggested configurations of the machinery. The construction and form of the mill buildings has already been discussed elsewhere in this report and here only some of the more significant features will be mentioned. The massive stone-built basements would have supported a wooden floor and a timber superstructure, with a roof of metal sheets. Although small sheets of galvanized iron from the roof of one of the mills have been found at Basingill, two of which are now in the possession of David Willacy, it is clear that roofs were not always made of metal. A report of the explosion which occurred in October 1875 reports that 2 or 3 planks 'from the wooden roof' were removed (*Westmorland Gazette*, 16 October 1875). The timber superstructure housed the edge-runner mills, in which the green-charge mixture was incorporated. Evidence from Basingill and from other gunpowder mills in Cumbria and the south of England has allowed the production of a putative picture of the workings of the mill machinery. The situation and dimensions of all three wheel-pits at Basingill indicate that the waterwheels were breastshot, that is to say, fed by a flow of water approaching on a level with the centre of the wheel. A central axle powered by the turning of the waterwheel would have been fixed to the bedstones in the floor of each mill basement. A series of gearing wheels would then have transferred this horizontal power on to the vertical axis, turning a vertical shaft that extended into the upper, working floor of the mills. Another axle with a gearing wheel arrangement would then have transferred this power back to a horizontal axle, turning the edge-runners. This suggested arrangement can be seen in pictorial form below (Figures 30a-c). As no machinery survives at Basingill, we can only postulate that this was the mechanical arrangement, but it does seem to fit with the other available evidence.

It has been suggested in some articles that in the later years of production at Basingill, one large waterwheel drove six incorporating mills (Wilson 1964, 54; Crocker 1988, 36). Wilson's source for this information was verbal communication, and doubt must be cast upon its accuracy. The assertion that two waterwheels were dismantled to be replaced by a much larger is repeated by Tyler (2002, 40), but he assigns a much earlier date, 1829, to the alterations. The source for this information is unclear. There is no evidence on the ground to suggest that such an arrangement ever existed; in fact it is impossible to see (given the topography of the site and the distribution of the incorporating mills) how it could have functioned at the site. In the absence of any positive evidence, the idea should probably be discounted as misinformation and a virtual impossibility.

The construction of the garden at Basingill occurred some time before 1820, the date of Isabella Wakefield's marriage and subsequent move to Dingle Bank, on Merseyside. It seems reasonable to assume that she would not have set out her garden much before the age of 14 which, and as she was 20 years old at the time of her marriage, gives a date range of 1814-1820 for the completion of the garden. Given

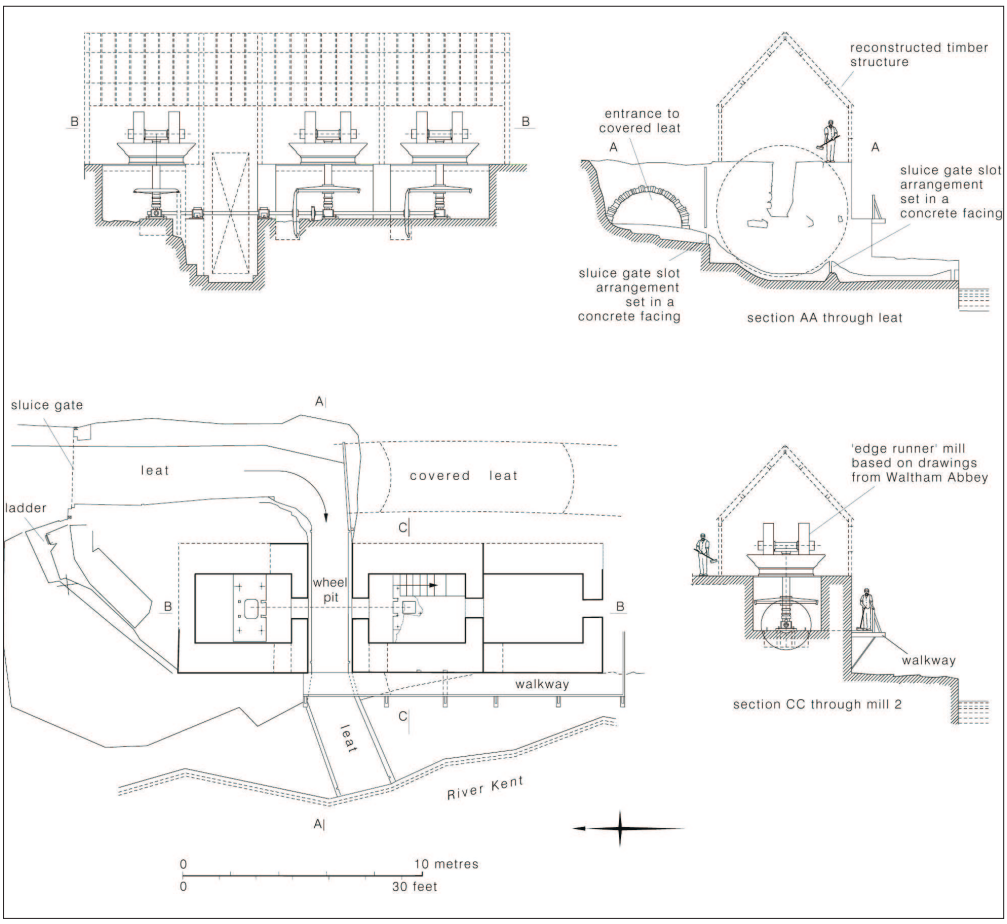


Figure 30a. Reconstruction drawings and plan of the northern incorporating mill group

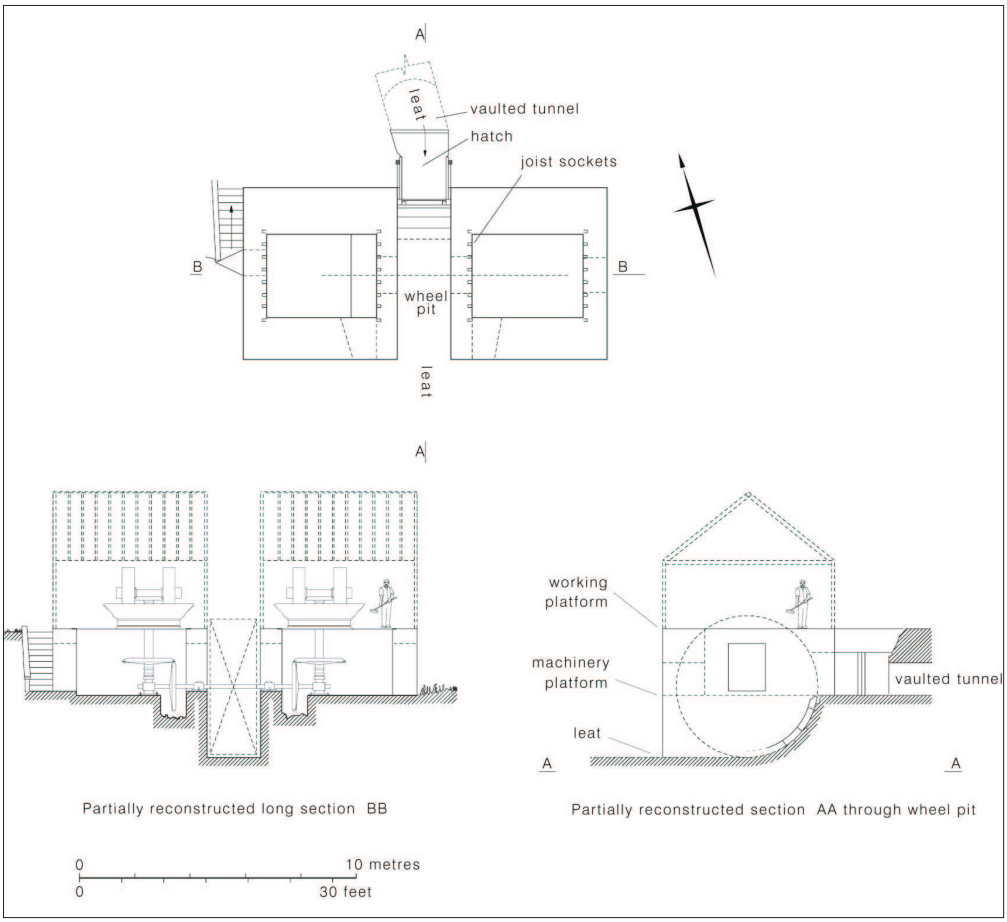


Figure 30b. Reconstruction drawings and plan of the middle incorporating mill group

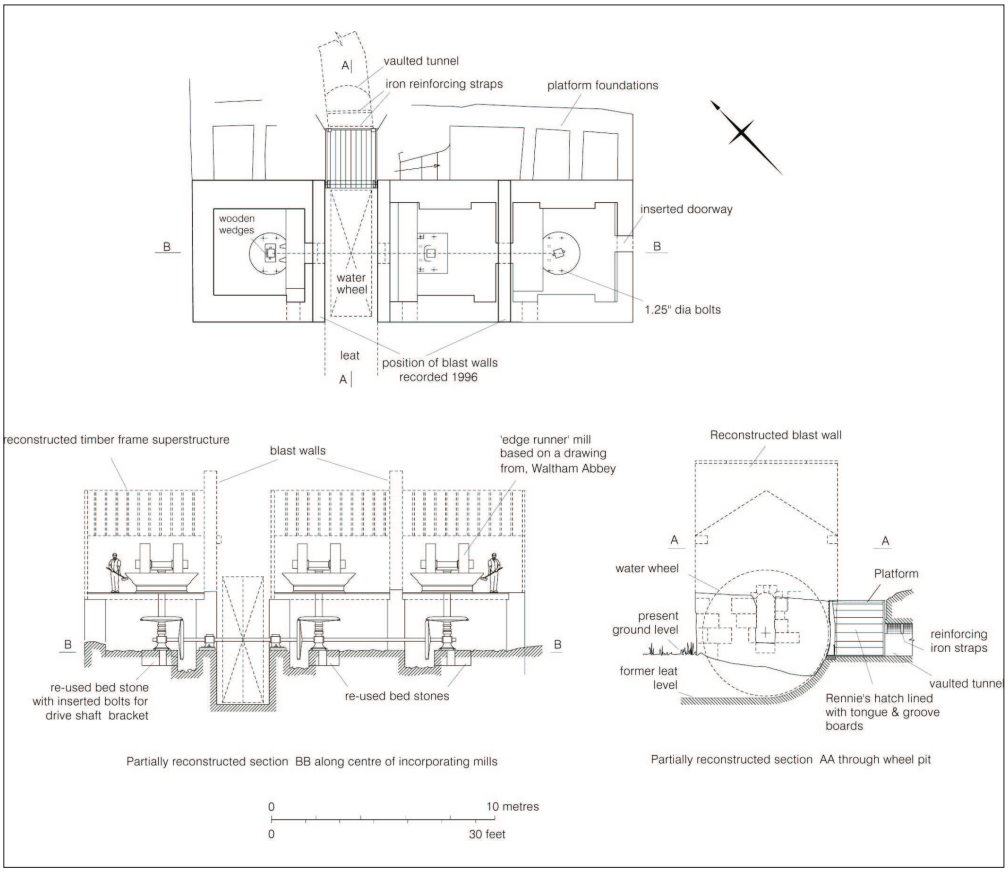


Figure 30c. Reconstruction drawings and plan of the southern incorporating mill group

the layout of the latter and its relationship to the gunpowder works, the southern incorporating mill group cannot have been in existence at this time. The northern end of the main terraced garden walk passes very close to this mill group, and when the mills were functioning, it was unlikely to have offered a particularly pleasant, or indeed safe, aspect to a garden walk. The earthwork survey has also provided evidence that the southern mills truncate two possible planting terraces, further demonstrating that these two parts of the site were not contemporary. It seems fairly certain that the middle mill group was in existence at this point, and in fact may have been incorporated into the garden, as an eye-catcher. The 1826 lithograph, discussed in section 4.1, depicts the middle mill group, with detail such as latticework in the window opening. It seems highly unlikely that this latticework would have been necessary in an incorporating mill. The middle mill group is situated in a position clearly visible when approaching the gunpowder works from the south along the terraced garden walk. As mentioned previously, the materials used in the construction of the middle mill group were rusticated stone blocks of a significant size, a modification which could not have been undertaken after the construction of the mills. It is quite plausible, therefore, that the position of the mills as an eye-catcher within the garden would have influenced the style of masonry chosen for their construction, to provide a more picturesque and rustic vista from the terraced walk. This evidence points to the middle mill group being constructed contemporaneously with the garden, or possibly even shortly after the garden had been laid out.

It is interesting to note that a description of the garden that Isabella Wakefield created at Dingle Bank bears more than a passing resemblance to that at Basingill. Conybeare, in his 1925 account of the Dingle Bank garden, talks of a walk with steps, a bridge of wood, arbours with seats and a continuous walk, called ‘The Wall’, around the private garden (Conybeare 1925, 34-35). The image conjured up is one of

a garden which worked with the natural features of the site and was designed to fully exploit the surrounding landscape, as is the case at Basingill. The surroundings of the garden at the latter, however, include man-made features, in the form of the gunpowder works and quarry, as well as natural splendour. It was apparently a conscious decision to include the gunpowder mills as a part of the garden, as the planting and walks could easily have been arranged to screen out what, to our generation, would be seen as noisy and dirty industrial activity. The backdrop to the terraced walk and the planted area was the middle mill group, possibly cosmetically enhanced, a reminder of one of the sources of the Wakefield family's wealth. A certain amount of pride in of the family's achievement in the gunpowder industry is evident in the layout of the garden. Such a celebration of industrial success within a garden design is not entirely unheard of. A garden was created in the mid-18th century at Warmley House, near Bristol, for William Champion, a Quaker industrialist. The gardens surrounded Champion's brass and copper works and were closely linked to the industrial activity, incorporating a lake which also provided power for the works. Garden features included grottoes constructed of clinker and a summerhouse built of copper slag-blocks (English Heritage 1984-7, GD1304). As well as celebrating their industrial achievement, the garden at Basingill may have been a demonstration of the Wakefields' growing social status. Some 1km to the south-west of the site lie the extensive formal parkland gardens of Levens Hall. These gardens, originally laid out in the late 17th century, include a long tree-lined avenue aligned with a bend in the River Kent, giving views to the north-east along a straight stretch of river as far as Levens Force. Although not directly intervisible, it is possible that the positioning of the gardens at Basingill was a response to the older more established gardens at Levens Hall. It may have been a case of the Wakefields asserting their new-found industrial wealth in a traditional manner, signifying their 'arrival' in society.

Evidence suggests that the garden was not totally abandoned once Isabella Wakefield left Sedgwick House. In fact, many of the main features are depicted on all three early editions of the OS maps. On the OS first edition map, surveyed in 1857, the garden is shown as a single entity co-existing to some degree with the gunpowder works. Also on this map, the woodland walks are depicted skirting around the edge of the large pond and the eastern edge of the southern mill group, indicating that they were still used, or were at least in a recognisable form at this date. The OS second edition map, produced more than 30 years later, depicts differential vegetation within the garden, with an area of orchard shown between the end of the terraced walkway and the southern portion of the garden. The steps and viewing platform are still depicted in their original form, which suggests that although the garden was no longer in use as a complete entity, an area of it may have been retained, as independent access could be gained via the doorway in the southern end of the eastern boundary wall. This arrangement seems to have carried on into the early years of the 20th century, and it is quite possible that the garden existed, albeit in a somewhat reduced form, up until the closure of the gunpowder works. While knowledge of the gunpowder works has been maintained as a result of the solid, visible structures which have survived, the garden has been forgotten in local memory.

Since the gunpowder works was abandoned in 1935, little attention has been paid to its structures. As mentioned previously, ivy has colonised the walls of some of the chambers, putting down substantial roots, some of which have found their way into joints and cracks in the masonry (Figure 31). This is causing damage to the structures, for example, the walls of incorporating mills 4 and 5, are starting to bow outwards at the top and significant cracks can be seen in the masonry, making their

Figure 31. General view of the site showing vegetation cover (NMR: AA038826)

long-term stability questionable. Trees of varying sizes grow on some of the mills. The dismantling of the blast walls in the southern mill group is demonstrative of the unsafe state into which some of the structures have fallen. Parts of the garden have similarly suffered from neglect and erosion over time. Sections of the revetment wall below the terraced garden walk have collapsed (Figure 28), and in places complete chunks of the walk itself have fallen away. Again, vegetation has taken hold in this area of the site, with many of the coping stones along the walk now shrouded in a dense blanket of ivy. At the southern end of the garden a fallen tree has demolished part of the viewing platform and made it inaccessible and the steps leading down to it, although still intact, are hidden under a thick layer of debris and slipped soil. It is clear that some of the archaeological remains of the gunpowder works and garden have already been damaged, and in some cases lost, through natural action and neglect. If left unchecked, the deterioration will eventually lead, for example, to the collapse of the mill chambers; the national importance of this site has been demonstrated through its designation as a Scheduled Ancient Monument. Although most parts of the garden are now overgrown, the trees in the area below the terraced walk and around the leat are managed to good effect by Environment Agency staff. Similarly, wildlife, including bats, birds and otters, is encouraged on the site.

In conclusion, the synthesis of earthwork survey, architectural investigation and documentary research has thrown light on to aspects of the site at Basingill which have previously received little attention. A basic understanding of the phased construction of the gunpowder works has been reached, although without corroborating documentary evidence, exact dates are still difficult to ascertain. The nature of the incorporating mills at Basingill has been investigated and possible reconstructions of their original form and mechanical arrangement have been put together. However, perhaps the most exciting result of the English Heritage survey has been the discovery of the long forgotten 19th- century garden. The juxtaposition of the two elements, the elegant garden and the functional, potentially dangerous gunpowder works, gives a fascinating glimpse of the interests and attitudes of a successful family who were making their mark in the area and on the landscape during the early 19th century. It is this added facet at Basingill that sets it apart from the other such sites in Cumbria.

8. SURVEY METHODOLOGY

The archaeological measured survey was carried out using a Leica T1000 electronic theodolite with Electromagnetic Distance Measurement (total station) to establish a ring traverse. These data were processed using MathShop software and plotted using Key Terra-Firma software. Observations were then taken from each station using a Leica TC805 total station to directly record 'hard detail', such as buildings and walls, with a handful of temporary control points marked with surveying chalk. These data were processed and plotted using Key Terra-Firma software. The archaeological detail was then plotted by hand using conventional graphical methods of tapeline and offset. This method was also used to pick up detail on buildings and walls not otherwise visible from the survey stations. Given the relatively compact nature of the site, the survey was undertaken at a scale of 1:500 with windows around the standing structures surveyed at 1:100 to pick up detailed information.

The buildings on site were subject to a detailed measured survey by members of the architectural investigation teams from English Heritage's York and Swindon offices. The data was handled by using a Leica TCR Series REDM total station in conjunction with the Fujitsu pen datalogger and Microstation 3D software. Smaller details were recorded using a hand tape and offset method.

Archive photographs were taken by Keith Buck, an English Heritage photographer. Working photographs of the site were taken by Abby Hunt using a digital camera (1.3 mega pixels) and are retained at English Heritage York.

9. ACKNOWLEDGEMENTS

Archaeological field survey was carried out by Abby Hunt and Marcus Jecock. The architectural survey of the standing buildings was carried out by Tony Berry, Nigel Fradgley and Ian Goodall. The report was researched by Abby Hunt, aided by Marcus Jecock and Christopher Dunn, and written by Abby Hunt and Ian Goodall; Christopher Dunn and Marcus Jecock commented on the text.

English Heritage gratefully acknowledges the assistance of the Environment Agency for permitting access to their property, and their members of staff who provided vital background information about, and photographs of, the site, in particular John Foster and John Martin. Mrs Janet Thompson kindly shared her knowledge of, and research into, the Wakefield family, and Mr David Willacy his knowledge of the history of Sedgwick. Mr Mike Davies-Shiel helpfully explained the principles of the Rennie's Hatch and gave his permission to reproduce a postcard of Basingill *c*1900 from his private collection. Mr Gordon Powell kindly lent an early photograph of the site. EH would like to thank the Cumbria Record Office (Kendal), for permission to reproduce maps in their collections and Dove Cottage, The Wordsworth Trust for permission to reproduce the 1826 lithograph of mill 4. Thanks also go to the Newcomen Society for allowing the reproduction of Paul Wilson's photograph of the northern mill group and Oxford Archaeology North for permission to reproduce the photographs of the blast walls of the southern mill group.

10. BIBLIOGRAPHY

Anon 1929 'Short histories of ICI companies: the North of England Gunpowder Group'. *ICI Magazine*, October 1929, 337-48

Chitty, G 1996 *Monuments Protection Programme. The Gunpowder Industry: recommendations for protection (Step 4 report)*. Unpublished English Heritage confidential internal document

Cocroft, W 2000 *Dangerous Energy*. Swindon: English Heritage

Conybeare, F A 1925 *Dingle Bank: The Home of the Croppers*. Cambridge: W Heffer and Sons Ltd

Crocker, G 1988 *Gunpowder Mills Gazetteer*. London: Soc Protection Ancient Buildings, Wind and Watermill Section, Occasional Publication 2

Crocker, A and Crocker, G 1992 'Gunpowder mills of south Cumbria'. *Gunpowder Mills Study Group Newsletter* **11**, September 1992, 8-14

Crocker, G 1999 *The Gunpowder Industry*, 2 edn. Princes Risborough: Shire

Cundill, J P 1883 *Report to the Right Honourable the Secretary of State for the Home Department on the Circumstances Attending an Explosion at the Basinghyll Gunpowder Mills, June 15th, 1883* **Report 53**. (London: HMSO)

Dunn, C J 2000 *English Heritage Archaeology and Survey Projects Division Step 4 Industrials Recording Programme Project Design. Project: The gunpowder industry module. Area: The Lake District*. Unpublished English Heritage internal document

Dunn, C *et al* in prep *New Sedgwick Gunpowder Works, Cumbria: an archaeological and architectural survey*. York: English Heritage Archaeological Investigation Report Series

English Heritage 1984-1987 *Register of parks and gardens of special historic interest in England*. London: English Heritage

Gould, S 1993 *Monuments Protection Programme: The Gunpowder Industry. Combined Steps 1-3 Report*. Unpublished report for English Heritage by The Cranstone Consultancy

Hullmandel, C 1826 *Ten Lithographic Drawings, of Scenery in the Vicinity of the Lakes, taken from Nature*. London: Charles Hullmandel

Institute of Geological Sciences 1980 *IGS 1:250000 series, Lake District sheet 54N 04W, solid edition*. Southampton: Ordnance Survey for IGS

Jecock, M and Dunn, C 2002 *Old Sedgwick Gunpowder Works, Cumbria: an archaeological and historical survey*. York: English Heritage Archaeological Investigation Report Series AI/11/2002

Mannex, P J 1849 *History of Westmorland with Furness and Cartmel in Lancashire*. London: Simpkin Marshall and Co

Mannex and Co 1851 *History, Topography and Directory of Westmorland*. Beverley: W B Johnson

Marshall, J D and Davies-Shiel, M 1969 *The Industrial Archaeology of the Lake Counties*. Newton Abbot: David and Charles

OED 1971 *The Compact Edition of the Oxford English Dictionary* **Vol 1**. Oxford: Oxford University Press

Ordnance Survey *c* 1860a County Series 25-inch map, Westmorland sheet XLII.4 (A) (surveyed 1857). Southampton: Ordnance Survey

Ordnance Survey *c* 1860b County Series 25-inch map, Westmorland sheet XLII.8 (A) (surveyed 1857). Southampton: Ordnance Survey

Ordnance Survey 1898a County Series Second Edition 25-inch map, Westmorland sheet XLII.4 (revised 1896). Southampton: Ordnance Survey

Ordnance Survey 1898b County Series Second Edition 25-inch map, Westmorland sheet XLII.8 (revised 1897). Southampton: Ordnance Survey

Ordnance Survey 1914a County Series 1914 Edition 25-inch map, Westmorland sheet XLII.4 (revised 1912). Southampton: Ordnance Survey

Ordnance Survey 1914b County Series 1914 Edition 25-inch map, Westmorland sheet XLII.8 (revised 1912). Southampton: Ordnance Survey

Palmer, A 1998 *The Low Wood Gunpowder Company: its inception and early growth 1798-1808*. London: Gunpowder Mills Study Group/Soc Protection Ancient Buildings

Parson, W and White, W 1829 *History, Directory and Gazetteer of Cumberland and Westmorland with Furness and Cartmel*. Republished by Michael Moon at Beckermet, Cumbria, nd

Patterson, E M 1995 *Blackpowder Manufacture in Cumbria*. Faversham: Faversham Soc Paper **43**

Quartermaine, J 1996, *Basingill Gun Powder Works, Cumbria: Fabric Survey*. Lancaster University Archaeological Unit

RCHME 1999 *Recording archaeological field monuments: a descriptive specification*. Swindon: RCHME

Tyler, I 2002 *The Gunpowder Mills of Cumbria*. Keswick: Blue Rock Publications

Wilson, P N 1964 'The gunpowder mills of Westmorland and Furness'. *Trans Newcomen Soc* **36**, 47-65

Archival sources and newspapers

Cumbria Record Office, Kendal (CRO(K))

WQ/O/11 Kendal Order Book 1786-1798

WQ/SR/493/14 Notice of intention by J Wakefield to apply for licence to build gunpowder works, Sedgwick, 1790

WDY 448 Elterwater Gunpowder Works: Letter Book of D Huddlestone and Co 1826-1829

Kendal Reference Library

Westmorland Gazette, Saturday 1 August 1874

Westmorland Gazette, Saturday 16 October 1875

Westmorland Gazette, Saturday 23 October 1875

Westmorland Gazette, Saturday 23 June 1883

Westmorland Gazette, Saturday 9 May 1891

NMRC Swindon

The Patterson Collection - Boxes 1 and 3

Aerial Photography Library: NMR 17667/35, 12 December 2001

Appendix 1: The process of gunpowder manufacture

The method of gunpowder manufacture has been described in detail elsewhere (see Cocroft 2000; Crocker 1999; Patterson 1995) and only a brief outline of those manufacturing methods, particularly those employed at Basingill, are given here. The later stages of manufacture could vary according to the intended use of the powder. Basingill consisted almost exclusively of incorporating mills, with only a few ancillary buildings. However, it provided powder which underwent further processing at Old Sedgwick until 1852, and at Gatebeck thereafter. Some of the terminology for the process houses appears to be Lake District vernacular; where this is the case other commonly used terms are given in brackets.

The three ingredients of gunpowder are saltpetre, charcoal and sulphur in the appropriate ratio 75:15:10. These constituents do not react together chemically but are simply blended together; the manufacturing process is therefore concerned with creating a thoroughly combined mixture but in an evenly granulated form. The finished powder was sent loose in barrels or kegs, or may have been pressed into cartridges.

The first stage of manufacture was the preparation of the ingredients. Saltpetre, imported from Chile in its 'grough' or raw state, needed to be refined. This was achieved by gently crystallising the saltpetre which enabled the impurities to be skimmed off. Sulphur, often imported from Italy or Sicily, also contained impurities but was sometimes refined before reaching the works. Charcoal was often made on site in sealed retorts but could also be bought in from local suppliers provided it was of sufficient quality. In the **preparing house** (mixing house) the charcoal and sulphur were ground separately to a fine powder in an **edge-runner mill**, a pair of vertical cast-iron runners which rotated on a cast-iron bed plate. All the ingredients were then sieved to remove lumps or grit before being weighed out in the correct proportions and mixed in a rotating barrel. The mixed ingredients, called green charge, were transferred to the **green-charge house** to await incorporation.

It was the incorporation stage of this process with which Basingill was wholly concerned. The green charge was brought to Basingill from Old Sedgwick, and latterly from Gatebeck. In the **incorporating mills** the green charge was fed into a series of edge-runner mills that mixed and compacted the gunpowder into a denser mass known as **mill cake** or **ripe charge** (wrought charge). The process took 1½ - 2 hours during which time the charge was periodically dampened to help it meld together. Sometimes lumps of powder would accumulate and adhere to the edge runners or the mill-bed and would have to be removed using wooden mallets or similar tools. These accretions are referred to as **trod** in contemporary reports. During incorporation, the mill workers would retreat to the **watch house**, where they could wait for the process to finish in relative safety. At the end of the incorporation process, the ripe charge was removed and stored in the **ripe-charge house** until the next stage of manufacture. At Basingill this was initially taken by road to Old Sedgwick, and latterly to Gatebeck, at least once a day, for the next stages in the manufacturing process (see Jecock and Dunn 2002).

Appendix 2: List of recorded explosions at Basingill

Following the implementation of the 1875 Explosives Act, any fatal accident at licensed premises involving fire or explosions had to be investigated by a government official. As a result accidents which occurred after 1875 are recorded, often in great detail, in official reports by an HM Inspector of Explosives. Prior to 1875, it is necessary to rely on the local newspaper reports for details of explosions. However, the local newspaper for this area, the Westmorland Gazette, is not indexed in a way that facilitates such a search, and while systematic scrutiny of the newspaper archive may provide a fuller list of explosions at Basingill, it is beyond the remit of the present report. It would appear, as the record shown below stands at present, that Basingill suffered no explosions between its inception in 1790 and 1874. Given the regularity of explosions at this and other gunpowder works in the later period of their operation, this seems highly unlikely. This kind of anomaly might indeed be corrected with a much more detailed combing of the documentary record. Following the explosion in 1891, the record is again seemingly devoid of explosion reports until 1923. These post-1923 records of explosions come from a transcription of a notebook of Alfred Bush, an employee of ICI at Gatebeck and Sedgwick. The transcription is contained within the Patterson Collection, but provides no more details than the date of the explosion, the affected mills, the duration of milling prior to the explosion and the type of blackpowder.

Date	Location	Cause	Damage	Casualties	References
25 Jul 1874	Incorporating mill	Unknown	Roof & sides of mill blown off	1 killed	*Westmorland Gazette,* 1 August 1874
12 Oct 1875	Incorporating mill	Spark created by a stone?	Damage to roof	2 killed	*Westmorland Gazette*, 16 Oct 1875, 23 Oct 1875
15 Jun 1883	Northern & middle incorporating mill groups	Lightning strike	Wooden superstructure	1 died later of injuries	Cundill 1883; *Westmorland Gazette*, 23 Jun 1883
7 May 1891	Incorporating mill	Unknown	Wooden superstructure destroyed	1 critically injured	*Westmorland Gazette*, 9 May 1891
17 Apr 1924	Mill 7	Unknown	Unknown	Unknown	Patterson Collection
10 Feb 1925	Mill 7	Unknown	Unknown	Unknown	Patterson Collection
10 Sep 1925	Mill 6	Unknown	Unknown	Unknown	Patterson Collection
16 Apr 1926	Mill 7	Unknown	Unknown	Unknown	Patterson Collection
30 Aug 1927	Mills 2&3	Unknown	Unknown	Unknown	Patterson Collection

Date	Location	Cause	Damage	Casualties	References
4 Oct 1927	Mill 7	Unknown	Unknown	Unknown	Patterson Collection
25 Apr 1928	Mill 6	Unknown	Unknown	Unknown	Patterson Collection
26 Apr 1928	Mills 2&3	Unknown	Unknown	Unknown	Patterson Collection
30 Aug 1928	Mill 5	Unknown	Unknown	Unknown	Patterson Collection
18 Oct 1929	Mills 2&3	Unknown	£117 of damage	Unknown	ICI engineers report 13 Nov 1929; Patterson 1995, 14

Appendix 3: The archive and photographic record

A survey archive consisting of the field plan, hard-copy print-out of the final electronic drawing, plus supporting background information such as the Project Design and correspondence has been deposited in the NMRC, Swindon, under Collections reference AF 00071, where it is available for public consultation upon request. The digital plan is currently retained at the English Heritage York office and is publicly available on request.

Archive photographs, taken by Keith Buck, are held at the NMRC, Swindon and are publicly available on request. These photographs are listed below with their NMR numbers.

NMR number	Subject
AA038820	View of steps within yew tree close to lower garden walk
AA038821	Recess, possibly for a seat, in site boundary wall
AA038822	Standing pillars at south end of garden
AA038823	View west over Levens Force from upper garden viewing platform
AA038824	View south-west over southern mill group
AA038825	Collapse of wall facing below terraced garden walk
AA038826	View north along modern access track
AA038827	Accretion and collapse around northern water feature below terraced garden walk
AA038828	Pond close to southern end of terraced garden walk
AA038829	Steps and pillars at southern end of terraced garden walk
AA038830	View of mill 1 from the south
AA038831	Interior of wheel-pit of northern mill group
AA038832	Entrance to tunnel at north end of the site, viewed from the head-race
AA038833	Flight of steps inside mill 2
AA038834	View over northern mill group from south
AA038835	Blocked gateway amd doorway in exterior of site boundary wall
AA038836	View south along the River Kent, taken from Force Bridge
AA038837	Gates and gateposts of former entrance to Sedgwick House
AA038838	Wheel-pit of northern mill group, from western river bank
AA038839	View north to Force Bridge along head-race
AA038840	Wall detail at northern end of modern boatshed
AA038841	Archway carrying path over quarry face at northern end of terraced garden walk

NMR number	Subject
AA038842	Joist sockets on top of walls of mill 4
AA038843	View into wheel-pit of middle mill group
AA038844	View of middle mill group from the south
AA038845	Platform footings adjacent to the north-east face of the southern mill group
AA038846	Fish counter on the River Kent
AA038847	Southern mill group from the south
AA038848	Island in the River Kent, viewed from the north
AA038849	Rennie's hatch above wheel-pit of southern mill group
AA038850	Interior view through doorways of southern mill group
AA038851	Bedstone in mill 8
AA038852	Detail of floor level and masonry in mill 8

Appendix 4: List of NMR numbers linked to the survey

SITE NAME	COUNTY	DISTRICT	PARISH
Basingill Gunpowder Works	Cumbria	South Lakeland	Sedgwick

SITE NAME	NGR	NMR No.
Basingill Gunpowder Works	SD 507 867	SD 58 NW 35
Basingill Gunpowder Works - northern mill group	SD 5074 8677	SD 58 NW 53
Basingill Gunpowder Works - middle mill group	SD 5075 8674	SD 58 NW 54
Basingill Gunpowder Works - southern mill group	SD 5077 8672	SD 58 NW 55
Basingill Gunpowder Works - leat	SD 5078 8668	SD 58 NW 56
Basingill - terraced garden walk	SD 5080 8669	SD 58 NW 57
Basingill - viewing platform and steps	SD 5081 8655	SD 58 NW 58
Basingill - formal garden	SD 5080 8662	SD 58 NW 59
Old Sedgwick Gunpowder Works (site of)	SD 509 873	SD 58 NW 41
Sedgwick House (site of)	SD 5092 8710	SD 58 NW 42

ENGLISH HERITAGE

NATIONAL
MONUMENTS
RECORD

The National Monuments Record
is the public archive of English Heritage.
It contains all the information in this report - and more:
original photographs, plans old and new,
the results of all field surveys, indexes
of archaeological sites and historical buildings,
and complete coverage of England in
air photography.

World Wide Web: http://www.english-heritage.org.uk

National Monuments Record enquires: telephone 01793 414600

National Monuments Record Centre, Great Western Village, Kemble Drive,
Swindon SN2 2GZ