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New Sedgwick Gunpowder Works, Cumbria: an archaeological and architectural survey

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NEW SEDGWICK GUNPOWDER WORKS, CUMBRIA

An archaeological and architectural survey

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1. INTRODUCTION, SITE LOCATION AND SUMMARY

Between December 2000 and March 2002, English Heritage (EH) carried out archaeological and architectural survey and investigation of the former gunpowder works at New Sedgwick in Cumbria. The survey was undertaken as part of a wider thematic project investigating gunpowder manufactories across the whole of Cumbria, initiated in June 1999 (Dunn 2000; Jecock 2003) as the logical progression to EH'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 both at the group as a whole and at individual sites (*e.g.* Wilson 1964; Marshall & 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. EH'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.

The works at New Sedgwick is one of seven powder manufactories (eight if Gatebeck is treated as two sites) which operated in the historic counties of Westmorland and the Furness area of Lancashire (present-day south Cumbria) at various times between *c*1764 and 1936 (Fig 1). All produced gunpowder chiefly for the civilian, as opposed to the military, markets. Geographically, the factories are concentrated at four locales across the region: Old Sedgwick, New Sedgwick, and Basingill lie in close proximity along the banks of the River Kent 5-6kms south of Kendal; the Gatebeck High and Low Works lie adjacent to each other on the banks of the Peasey Beck about 4km to the south east of this first group; Blackbeck and Lowwood occupy neighbouring valleys close to Haverthwaite; whilst Elterwater forms an outlier at the foot of Great Langdale. The industry became established in Cumbria mainly in response to the increased national demand for blasting powder from mines and quarries through the 18th century, but the Lake District also provided a highly suitable environment for gunpowder manufacture: its numerous rivers could supply the waterpower needed by the different processes, and the rural and wooded situations of many locations were sufficiently remote from populous areas to minimise the effects of any explosions. Later on, as more regard began to be paid to the safety of the workforce as well, several mills - including New Sedgwick - even incorporated trees, natural rock outcrops and low hills 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 overseas contacts - mostly routed through Liverpool - the Cumbrian gunpowder industry was able to build up a healthy market for its products abroad, particularly 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 new explosives, but the Cumbrian mills stuck with their traditional stock-in-trade, now rechristened blackpowder to distinguish it from the newer forms. Despite the 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 response of the Cumbrian mill owners was to merge with their competitors as part of Explosives Trades Ltd., the forerunner of Nobel Industries (from 1926, itself incorporated into Imperial Chemical Industries Ltd. (ICI)) (Crocker 1988, 2). However, by 1928, ICI had started the inevitable process of rationalisation in order to concentrate blackpowder production at a single site, namely Ardeer in Scotland. Production in Cumbria finally ceased in 1936, with Gatebeck the last site to close (Crocker 1988, 1-2; Patterson 1995, *xi* and 44).

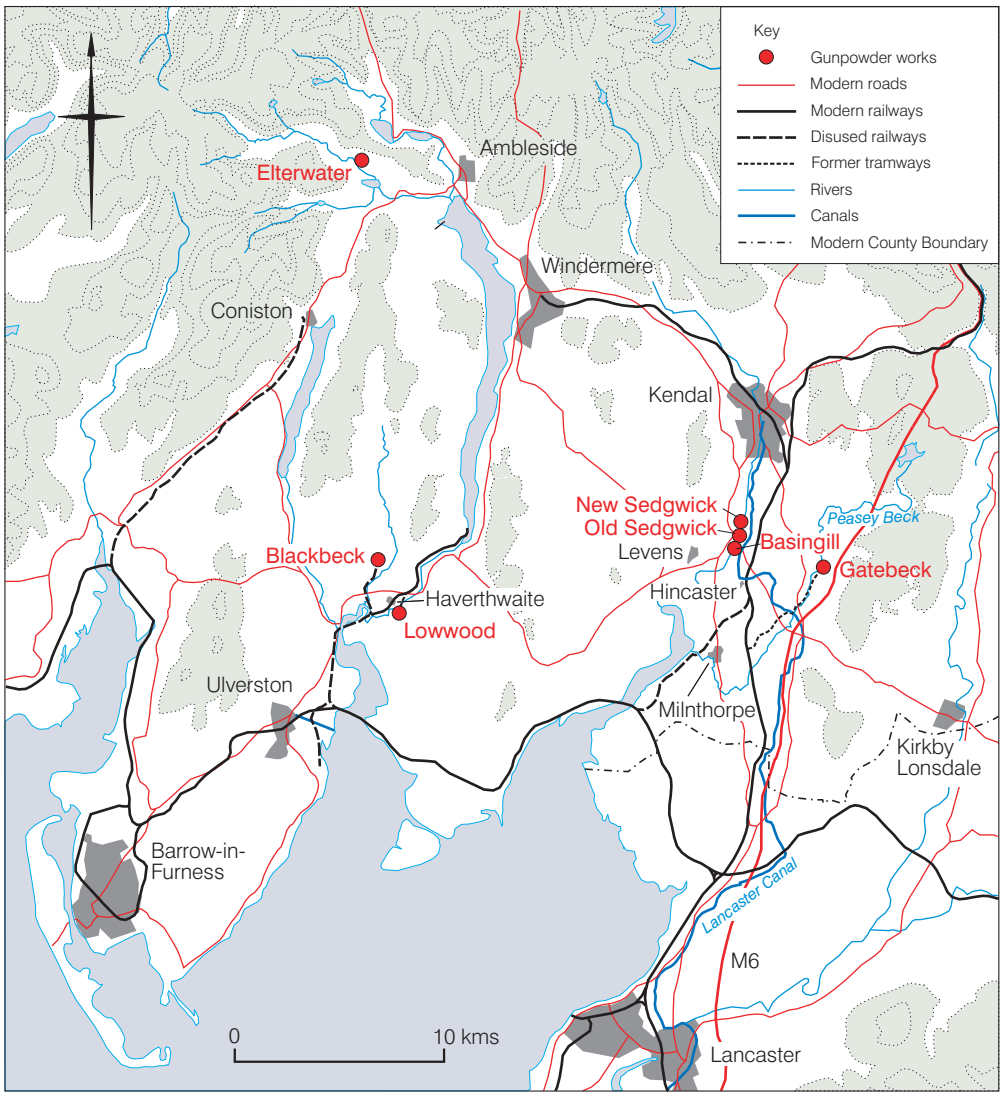

Figure 1.
General location diagram

New Sedgwick was the first of these sites to be recorded by EH. Fieldwork commenced in December 2000 but was temporarily halted in February 2001 following outbreaks of foot and mouth disease in northern England. Access restrictions to the site were not eased until late spring by which time much of the archaeology was concealed by dense, seasonal vegetation growth. Some survey was carried out at this time, but the majority of the remaining

fieldwork had to wait until leaf fall and was completed between December 2001 and March 2002. The work involved an analytical field survey of the archaeological remains at 1:1000 scale (to Level 3 standard as defined in RCHME 1999, 3-5) and an architectural survey of the incorporating mills and cooperage buildings - these were planned at 1:100 scale. The fieldwork was backed up by documentary research confined to readily available published sources and a limited search of historical archive material in the Cumbria Record Office. The research has also benefited from access to photographs, notes and plans held in a number of private archives and collections. In addition, a former employee at New Sedgwick has also been interviewed by EH and his memories about the works recorded on audio tape. A set of colour photographs of the site was also taken by EH as part of the recording process. The start of the field investigation coincided with the tidying up of some of the former buildings by a team of volunteers working for the National Trust, the current owners of the site. This work involved the removal of scrub and accumulated debris to reveal the floors of several of the incorporating mills, the southern powder press pump house and the cartridge press pump house together with the footings of the green charge house, glaze house and stove house. The floor of the saltpetre refinery has subsequently also been cleared.

The former works is located 4.5km south south west of Kendal and 1km north west of Sedgwick village, on the west bank of the River Kent, centred at National Grid Reference (NGR) SD 509 881 (Fig 2). It was not the first gunpowder works to be established on this stretch of the Kent. An earlier gunpowder works, Old Sedgwick, was situated on the east bank of the river. Its northern end was directly opposite the southern extremity of the unlicensed area of New Sedgwick (see section 2 below) and was the earliest recorded gunpowder works in Cumbria being established in *c*1764 by John Wakefield I and partners (Jecock and Dunn 2002). During its lifetime the latter was commonly known as the Sedgwick Gunpowder Mills. However, in the archaeological and historical literature it is now universally referred to as 'Old Sedgwick' in order to distinguish it from the later works (the subject of this report) which is generally known by the shorthand name of 'New Sedgwick'. In 1790, the restricted nature of the site at Old Sedgwick forced the company to construct additional incorporating mills at Basingill, some 1.2km downstream from New Sedgwick and on the east bank of the river (Hunt and Goodall 2002). Old Sedgwick closed in 1852, following the expiry of the lease of land, shortly before the New Sedgwick works were established. The factory was transferred to a more spacious site at Gatebeck, 4km to the south east. Despite the move, Basingill remained in use until 1935 with Gatebeck now supplying the green charges for the mills and receiving in return the ripe charges.

The remains of the works occupy an area of 10.9 ha (26.9 acres) with its component elements being dispersed over a distance of 1km along the riverside. It was established by Walter Charles Strickland, owner of Sizergh Castle and its estate, and construction started in 1857. However, the Stickland era was of short duration because in 1864 his company failed and the works was taken over by a syndicate from Manchester. It closed in 1935, at which date a number of the buildings were demolished to prevent any residual gunpowder in their fabric being accidentally ignited. During World War II the site was requisitioned by the

army and used as a munitions store. The area occupied by the main part of the works was extensively altered in 1977 to make way for a caravan park that is still in use today. The site as a whole is designated a Scheduled Ancient Monument (No 27807) and a number of its upstanding remains are also Listed Buildings (Grade II). The overall level of preservation of the site is good although the survival of individual archaeological features tends to be at one of two extremes - either very good or very poor - due to the policy of selective demolition when the works were abandoned.

The principal surviving features are the massively constructed leat that brought water from a weir on the River Kent to power the various processes, the remains of most of the turbine pits, two adjacent ranges of incorporating mills separated by a blast wall, a saw mill and cooperage, gate house, clocking-in house, and a variety of blast banks. Further buildings are preserved either as concrete floors or wall footings in a ruinous condition, and include the green charge house, powder and cartridge press pump houses, an accumulator housing, corning house, saltpetre refinery complex, glaze house, reel house, stove house, two packing houses and two cartridge compressing houses. A tramway system was established to transport materials around the manufacturing part of the site, and traces of this still survive in places (a short separate tramway also served the cooperage). The works was linked by road to a railhead at Hincaster Junction, situated 3.5km to the south, where a former gunpowder warehouse still stands beside the present West Coast Mainline. There are also numerous remains dating to World War II including a garage, store shed, concrete bases for temporary buildings, trenches, sites of munition dumps and concrete pathways; the military remains here have not been recorded before.

2. GEOLOGY, TOPOGRAPHY AND LAND USE

New Sedgwick lies on the periphery of the Sizergh Castle estate on the right bank of the River Kent. Below Kendal, the Kent - which drains the southern fringe of the high Lakeland fells (east of Ambleside) south into Morecambe Bay - 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 of a glacial valley; however, rejuvenation of the river in the post-glacial period has created a narrow trough-like feature in the dale floor through which the Kent now flows. The river is either flanked by intermittent narrow terraces or confined within even narrower rock-cut gorges. The principal manufacturing area of the gunpowder works is situated at 25m above OD on a terrace - maximum width 119m - of alluvial deposits flanked by a meander in the river. Although the works extend beyond this area, more hilly terrain, especially to the west and north, has tended to confine development in these areas. The length of the site - at 1km - is typical of gunpowder mills in general; safety requirements and the need to provide water power from a main leat often gave rise to the dispersal of different manufacturing processes. The leat has been largely constructed along the foot of the natural slope and thus effectively marks the division between the river terrace and the steeper ground to the west which forms part of Low Park Wood. Low Park Wood is characterised by undulating glacial deposits which form a series of small hills and troughs. The topography of this area thus provided a natural form of blast protection while being removed from the main area of powder production and it was here that at least one (and possibly as many as three) store magazine was situated. One of the glacial hillocks, west of the incorporating mills and just outside the limits of the EH survey, has been dug out, probably to provide material for some of the blast banks on the site (see section 6.2.8 below). The limestone tends not to outcrop, except towards the northern end of the site where the river flows through a gorge. In this area there is a small disused quarry which was almost certainly the source of at least some of the building stone used to construct the works.

The presence of the limestone bedrock means that much of the site is well drained and there is little surface run-off with the exception of two small streams, both unnamed. The southernmost of the streams flows into the main leat behind the incorporating mills, and the second stream, at the northern end of the site, also apparently emptied naturally into the leat until the early 20th century when it was diverted across it and into the Kent by means of a small aqueduct (Ordnance Survey 1914b). This arrangement has not been maintained with the result that the stream once more discharges into the leat. During the 1960s, to try and control the flow of water, the stream was damned to create a pond in the farmland just beyond the western limits of the site; the dam lies on the boundary separating the site from the farm. Large accretions of lime scale on the aqueduct and on the bed of the southern stream testify to the heavy mineral content of the water. A spring rises beside the site of the new stove house and is named 'Robin Hoods Well' on the Ordnance Survey first edition 25" map (Ordnance Survey 1895). The River Kent is approximately 30m wide at New Sedgwick but despite its size historical sources indicate that it may not have always delivered a

reliable flow of water into the leat (see section 6.2.1 below). Indeed river levels are heavily dependent on rainfall as was witnessed first hand by the EH survey team, firstly in 2000 when river levels were high after a very wet autumn and secondly at the end of 2001 when the river was low after a fairly dry November/early December.

Estate plans show that when construction of the works began in 1857, Low Park Wood did not extend eastwards as far as the riverbank but ended at the western edge of the river terrace. The latter was the location of a pasture field or hay meadow called Kid Holme (CRO(K) WDB/22/68.4). The narrow strip of land at the extreme northern end of the site, which is chiefly occupied by the main leat, belonged to the neighbouring Hawes estate and was presumably purchased then. Together these three areas accommodated all of the powder processing buildings, which naturally formed the greater part of the works. The rest of the plant, which comprised ancillary buildings such as the cooperage and office, was located in the eastern end of a field, called Tan Horse Park, on the south side of Low Park Wood. The site can thus be divided into two unequal parts: one for powder manufacture (the government licensed area); the other for the ancillary buildings (the unlicensed area) (CRO(K) WD/NT/40).

Within a 3km radius of the works lie a number of small hamlets and villages, including Sedgwick village, Natland, and Levens (Fig 2). Contemporary sources show that it was from these settlements, and from Kendal to the north, that most of the workforce came. The nearest road bridges are at Hawes Bridge to the north and at Force Bridge, beside Basingill to the south although vehicular access to the site was from the south only. The New Sedgwick Gunpowder Company built an elegant suspension footbridge across the River Kent close to the works entrance after its wooden predecessor was washed away in a flood during October 1874. In spite of its rural setting, New Sedgwick was well sited to take advantage of good transport links. Hincaster Junction, which lay only 3.5km to the south, linked the Furness Railway with the London and North Western Railway's mainline up the west side of the country, allowing easy access to local and national markets and a cheap way of importing the necessary raw materials. A dedicated gunpowder warehouse was built beside the mainline at Hincaster Junction: it still survives and is described below in section 6.2.10.

Almost all of New Sedgwick is now in deciduous woodland that is particularly dense at the northern end of the site and beyond the caravan park on the west. Since the 1950s both the river terrace and much of the unlicensed area have also been colonised by trees and bushes. Some of the standard trees on the site are clearly of some antiquity and may well have been planted when the works was established. The caravan park is restricted to the central area of the site and includes a large reception building with yard and store shed, a children's play area, two toilet blocks, a subterranean water pumping station, several water supply and disposal points, service roads as well as numerous caravan pitches. The majority of the pitches are located on the west side of the leat where they have been terraced into the natural slope and roughly surfaced with small stones/gravel; these continue for some distance into the woodland beyond the western limit of the survey. All pitches have been equipped

with connection points to mains electricity and satellite television. The caravan site is only used during the summer months. The caravan pitches have been represented schematically on the EH plan except where their earthworks impinge on the archaeology.

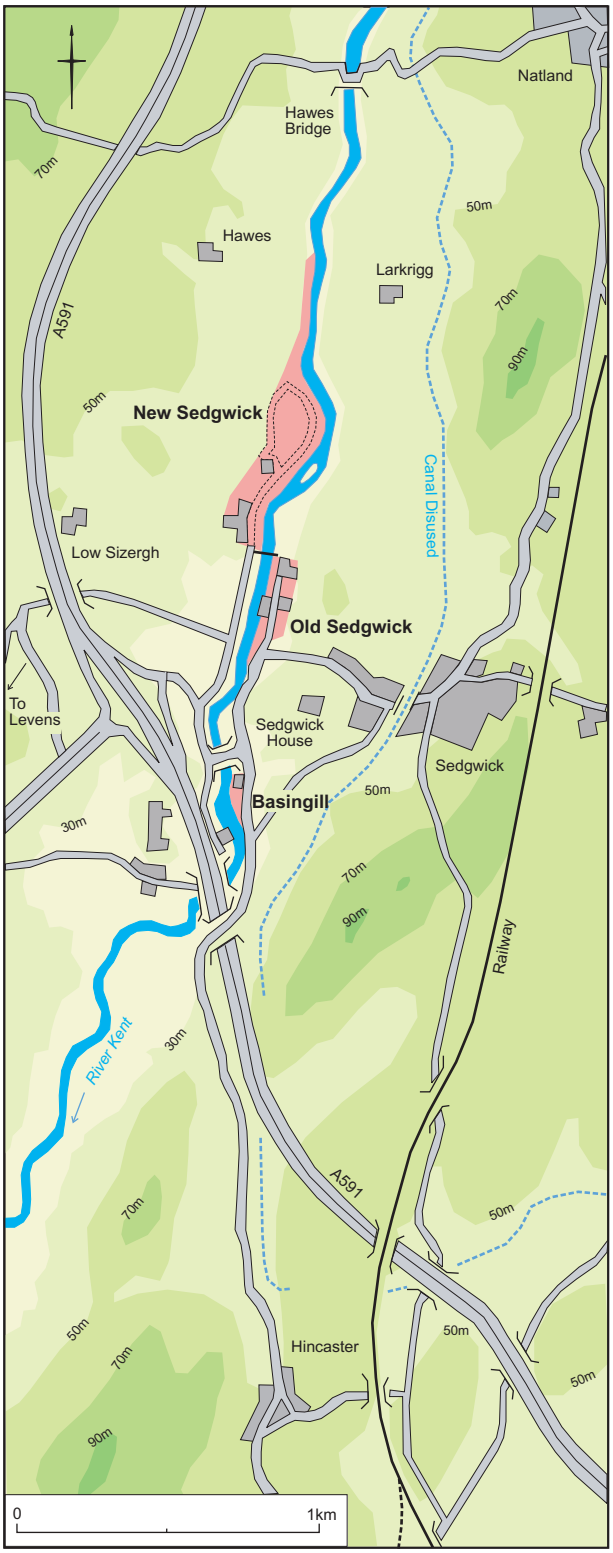

Figure 2.
Local setting diagram

The National Trust, which acquired the site in 1950, maintains a number of buildings at the southern end of the site. The gate house, which comprised the office and foreman's house, is permanently occupied as two separate cottages. To the rear of these cottages is a

garden and small grass paddock (with sheds); the latter has been sub-divided into two parts by a fence. To the north side of the cottages is a car parking area which was created from another garden while the EH survey was in progress. In addition to this, the cooperage and an adjacent open-fronted shed, which are roofed, are let to a number of tenants for use as stores for building materials. A corrugated iron and timber garage (with inspection pit) dating to World War II and a modern timber store are used for similar purposes.

3. HISTORY OF RESEARCH

In 1926 a summary of Walter Charles Strickland's application to the Justices of the Peace for a licence to erect the gunpowder works appeared in print (Curwen 1926, 111). This was followed in 1929 by the publication of a short historical account of the works in the ICI in-house magazine. The two paragraphs are contained in an article concerned with short histories of the group's constituent companies (Imperial Chemical Industries 1929, 342-43). Most of the other published accounts of New Sedgwick are similarly brief contributions, largely focussed on the company history (Somervell 1930, 70-71; Wilson 1964, 60-61; Crocker 1988, 40-41) while Ted Patterson (1995, 33-37) presents a synthesis of the manufacturing methods employed based on ICI's Manufacturing Method Book for New Sedgwick. Patterson's account is also supported by a site plan. Paul Wilson, in addition to his 1964 seminal historical overview of the Cumbrian gunpowder industry, produced a guidebook (complete with site plan) to New Sedgwick for the National Trust (Wilson nd); this again is largely concerned with historical aspects and how gunpowder was produced. Since the early 1960s a great deal of historical research and fieldwork has been undertaken on the Cumbrian Gunpowder sites, including New Sedgwick, by Mike Davies-Shiel whose overview of the industry was published in 1969 (Marshall and Davies-Shiel 1969, 75-88). In 1992 Alan and Glenys Crocker produced detailed field notes for a visit by the Wind and Watermill Section of the Society for the Protection of Ancient Buildings to some of the Cumbrian gunpowder works. An edited version of these was published in the newsletter of the Gunpowder Mills Study Group; the entry for New Sedgwick is chiefly concerned with the incorporating mills (Crocker and Crocker 1992). In the same year the National Trust carried out a structural survey of the cooperage area and the incorporating mills which resulted in ground plans and brief descriptions of the buildings being produced (National Trust, Grasmere). In 1993 the Cumbria Record Office at Kendal purchased a set of architect's drawings by Robert Shaw dated 1859 of the cooperage buildings; there are also plans of a watch house, clock tower and magazine. A note describing this material was published in the newsletter of the Gunpowder Mills Study Group by Alan Crocker (1993, 12-14). Crocker (2000, 96) also included mention of two Vortex turbines (supplied to New Sedgwick in the late 1850s) in his paper on early water turbines which was published in the Journal of the Association for Industrial Archaeology. An illustrated account of New Sedgwick is also contained in Ian Tyler's recently published history of Cumbria's gunpowder industry; in the main he outlines the history of the site, describes in some detail the explosions that occurred and includes a plan (Tyler 2002, 196-222).

4. THE DOCUMENTARY SOURCES AND HISTORY OF THE WORKS

The history of the gunpowder works and details of how the site was used after the works closed in 1935 is outlined below. A number of the documentary sources referred to in this report cannot be ascribed precise dates or require a note of explanation; a brief description of them, therefore, forms the first part of this chapter. Detailed discussion of historical sources in relation to individual archaeological features is reserved for section 6.

4.1 Documentary sources.

The three editions of the OS County Series 25" maps published between 1880 and 1914 are indispensable in tracing the evolution of the site (Figs 3-5). The area occupied by the works extends over two map sheets with the majority being on the southern sheet. The first edition of the latter was surveyed in l857 when the works were under construction, but was not published until 1895 (Ordnance Survey 1895). There is no reference on this map to any amendments being made between the initial survey and its eventual publication and a comparison with the OS County Series 6" map surveyed in 1858 (Ordnance Survey 1862) helps to confirm that this is an accurate depiction of the works in 1857. It is surprising though that the leat and all the main buildings had either been constructed or were at an advanced enough stage to be shown by the OS surveyors. The first edition northern sheet, surveyed in 1858, was published in 1880 (Ordnance Survey 1880); it shows two buildings west of the leat that do not appear on latter editions of this map or on any of the early plans of the works (the larger of the two buildings is also depicted on the OS County Series 6" map (Ordnance Survey 1863)). The second edition of the 25" map was published in 1898 and includes revisions made in 1896 (southern sheet) and 1897 (northern sheet) (Ordnance Survey 1898a; 1898b). Both sheets were revised again for the 1914 edition (1912 southern sheet and 1911 northern sheet) (Ordnance Survey 1914a; 1914b).

In addition to the OS maps a number of other plans of the works have been located while undertaking research for this report. Part of an existing footpath that extended south from Hawes Bridge passed through the area occupied by the new works and on January 7th 1860, the Justices at the Kendal Quarter Sessions agreed to it being closed and 'stopped up with earth' (CRO(K) WQ/O/15). Three sketch maps relating to this event survive in the Cumbria Record Office, Kendal, together with a printed notice (CRO(K) WQ/A/H/15), dated August 4th 1859, informing the public that an application to stop up part of the footpath was to be made. The maps almost certainly all belong to this 1859/1860 period, one is undated (CRO(K) WDB/35/779) but the other two have notes written on them referring to 1859 (CRO(K) WQ/A/H/15) (Fig 6) and 1860 (CRO(K) WDB/35/564). They will be referred to from now on in this report as the 1859/1860 sketch maps. In addition to showing footpaths and a recently built wooden footbridge across the river, the weir, leat and gunpowder buildings are also depicted; most of the latter are also named which helps with the identification of the buildings shown on the OS mapping of 1857.

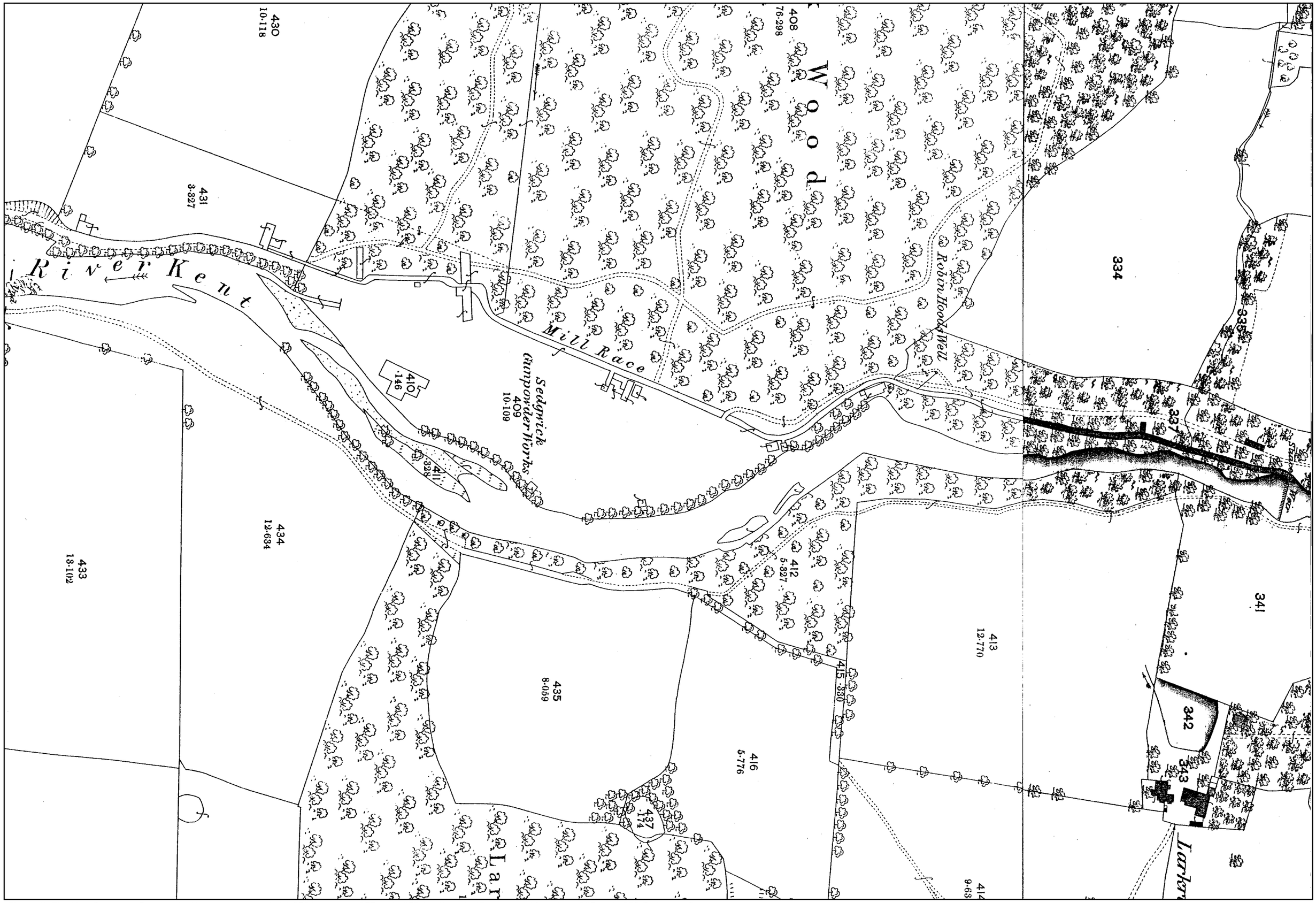

Figure 3. *The New Sedgwick Gunpowder Works as mapped at 1:2500 scale in 1857 and 1858 (north end). (Reproduced from the 1895 and 1880 Ordnance Survey maps)*

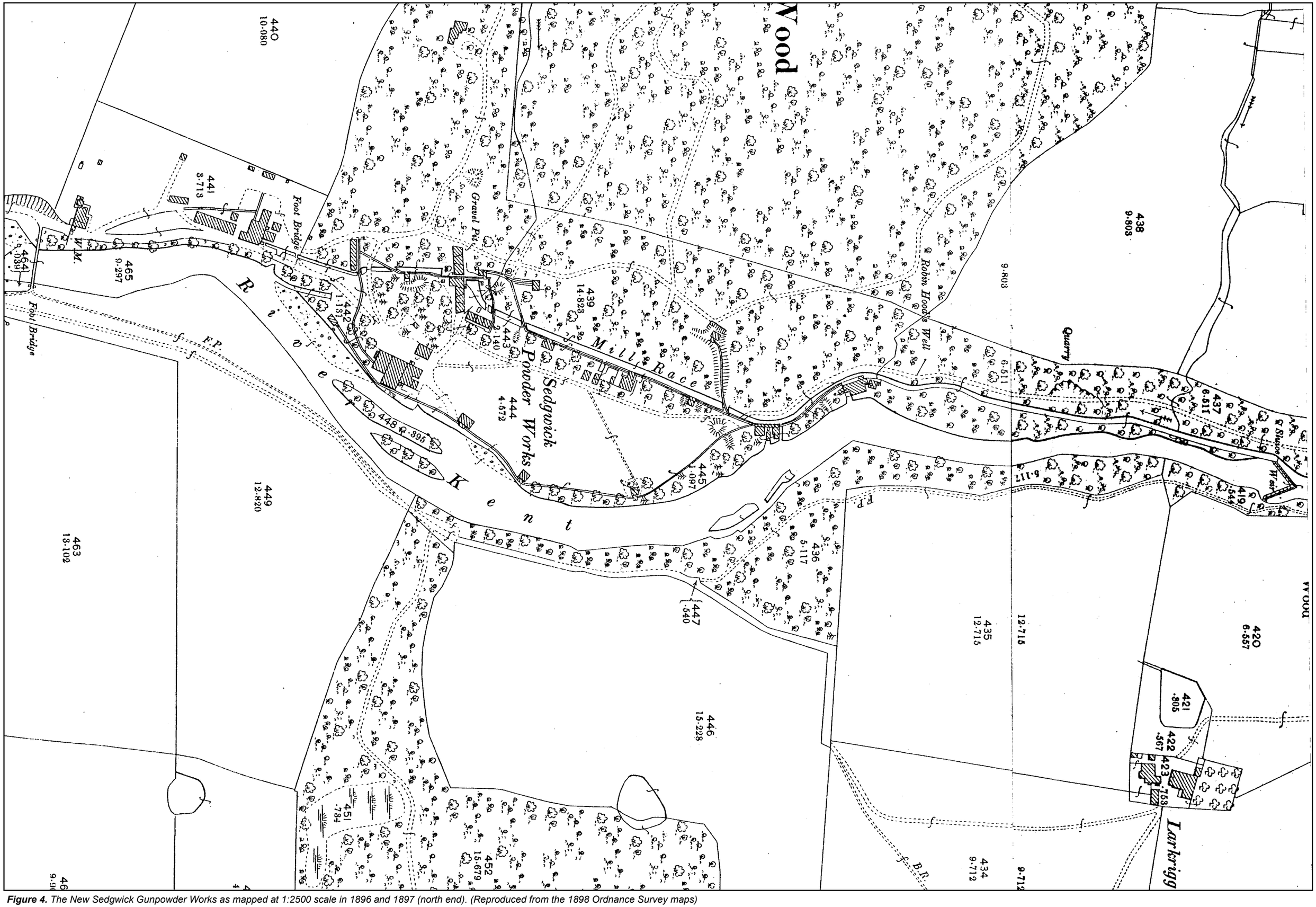

Figure 4. *The New Sedgwick Gunpowder Works as mapped at 1:2500 scale in 1896 and 1897 (north end). (Reproduced from the 1898 Ordnance Survey maps)*

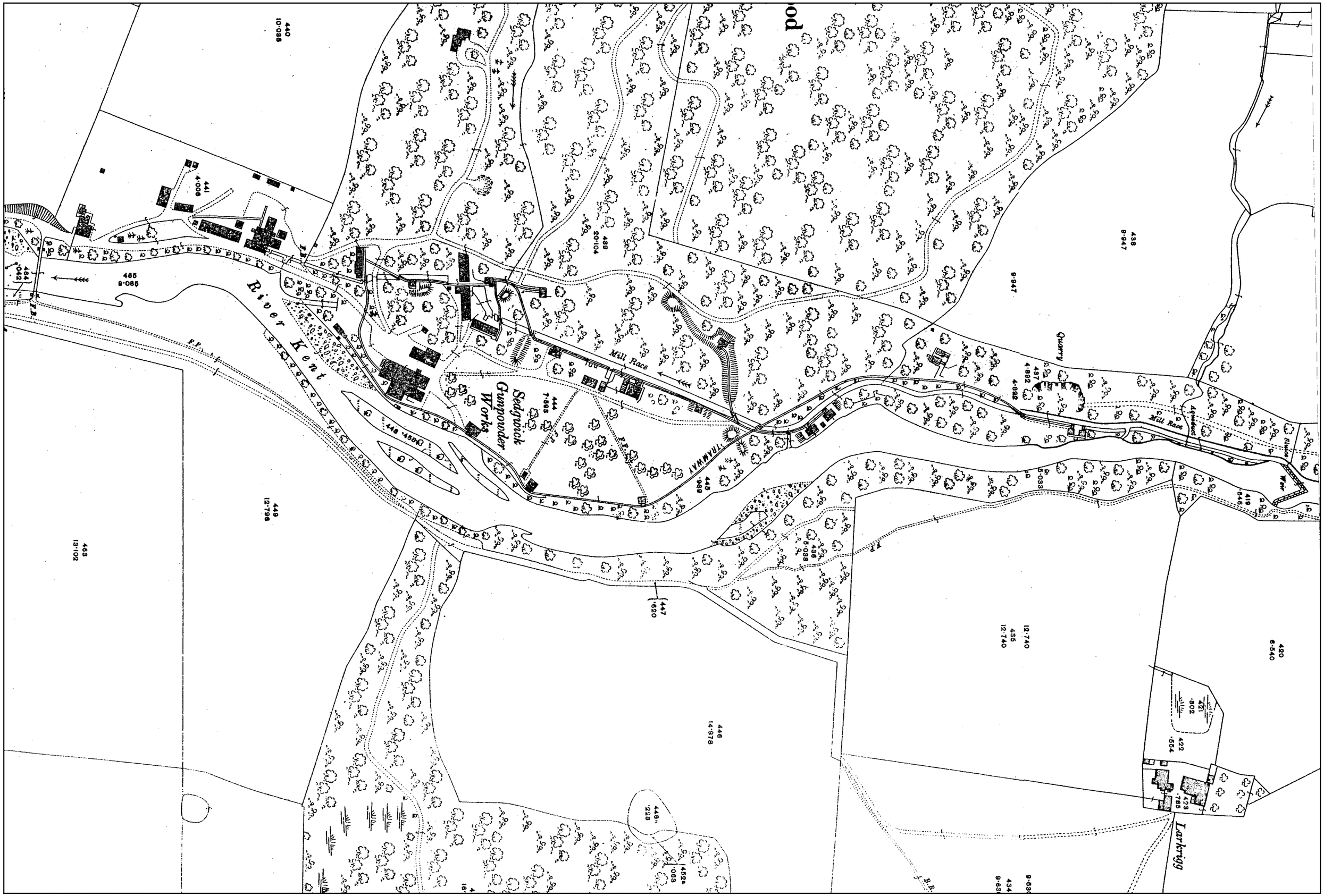

Figure 5. *The New Sedgwick Gunpowder Works as mapped at 1:2500 scale in 1912 and 1911 (north end). (Reproduced from the Ordnance Survey 1914 edition)*

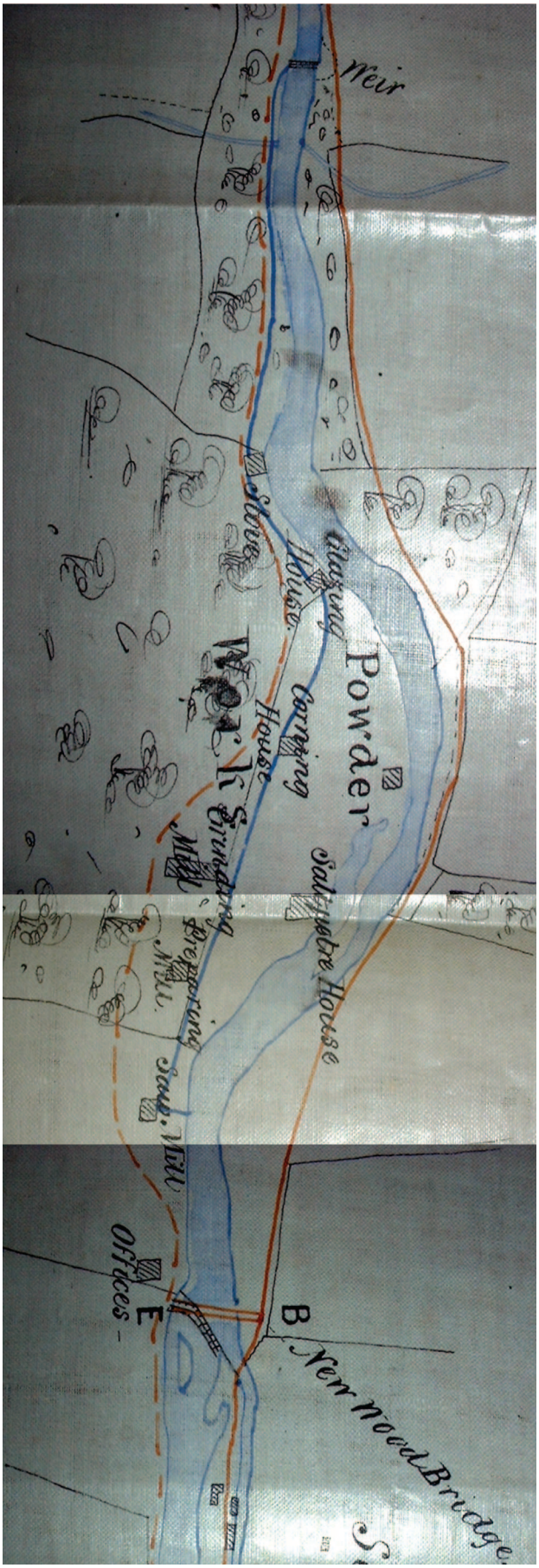

Figure 6.
Extract from sketch map related to closure of footpath at New Sedgwick, 1859 (one of 'the 1859/ 1860 sketch maps'). (Extract from CRO (K) WQ/A/H/15, reproduced by permission of Cumbria County Council Archive Service)

A very detailed and annotated plan of the works that accompanied Amending Licence No. 910 is held by Nobel Enterprises at Ardeer and will be referred to in this report as the 1900 site plan (Fig 7). It is dated October 1900 and was subsequently signed (approved) by Captain J H Thomson (HM Inspector of Explosives) on 2nd November 1900. In addition to this plan there is another - similarly detailed and annotated - but slightly later in date in the Cumbria Record Office, Kendal (CRO(K) WD/NT/40); it was made by John Banks of Kendal. Although undated, this latter plan must have been produced between 1903-12 since it shows the new glaze house, which cannot have been built before 1903 but omits some of the buildings in the unlicensed area which appear on the OS 25" map revised in 1912 (Ordnance Survey 1914a). Indeed it is possible that the construction of the new glaze house and other buildings at around this time prompted the preparation of this map; hereafter in this report it will be referred to as the 1903-12 site plan. These plans allow many buildings that might otherwise remain anonymous to be identified.

According to Mike Davies-Shiel (*pers comm*) in 1977 M W Helliwell produced a plan of the works for the National Trust which is the one that appears in Paul Wilson's guide book (see above section 3). The depiction of some of the buildings is over simplified on this plan and the functions/names ascribed to them are not always correct. The saltpetre refinery complex, for example, is labelled 'Black Pot', but earlier site plans indicate that this was the name given to a small, separate building situated to the east of the refinery. Subsequent commentators (e.g. Patterson 1995, plan by Jack Simmons facing p33) have tended to perpetuate this incorrect labelling. Internal evidence indicates that the plan in Patterson's book of 1995 is very closely based on that in the guidebook, although some additional errors have crept in. For example the guidebook plan has a building labelled 'Reception' between the northern block of incorporating mills and the saltpetre refinery complex. This appears to be the modern reception building at the entrance to the caravan park and is thus completely unrelated and much later than the gunpowder works - hence its much lighter depiction on the plan when compared to the gunpowder buildings. This building is also included on the plan in Patterson's book, but here it is interpreted as part of the gunpowder works and included in the numerical system used for identifying the various buildings; it is numbered 18 and labelled 'Reception'.

A number of photographs taken when the works was in operation have been located and reveal details of buildings and structures since demolished. One of these images is of the new glaze house (built after the earlier glaze house blew up in 1903) and is published in the ICI house magazine (Imperial Chemical Industries 1929, 343). Tyler also reproduces this photograph (which he dates to *c*1900, incorrectly implying that it is the earlier glaze house) together with one showing the remains of the earlier glaze house soon after it exploded (Tyler 2002, 218). Several unpublished photographs of the site survive in the collection of David Willacy in Sedgwick, and with his kind permission these have been copied by EH for deposition in the National Monuments Record. David thinks that the majority may have been taken in the late 1920s. The collection also contains family-type photographs which include images of Thomas Faulkner who, according to Davies-Shiel (*pers comm*), was the site manager from 1925 to 1932. One of these has, in the background, the new glaze

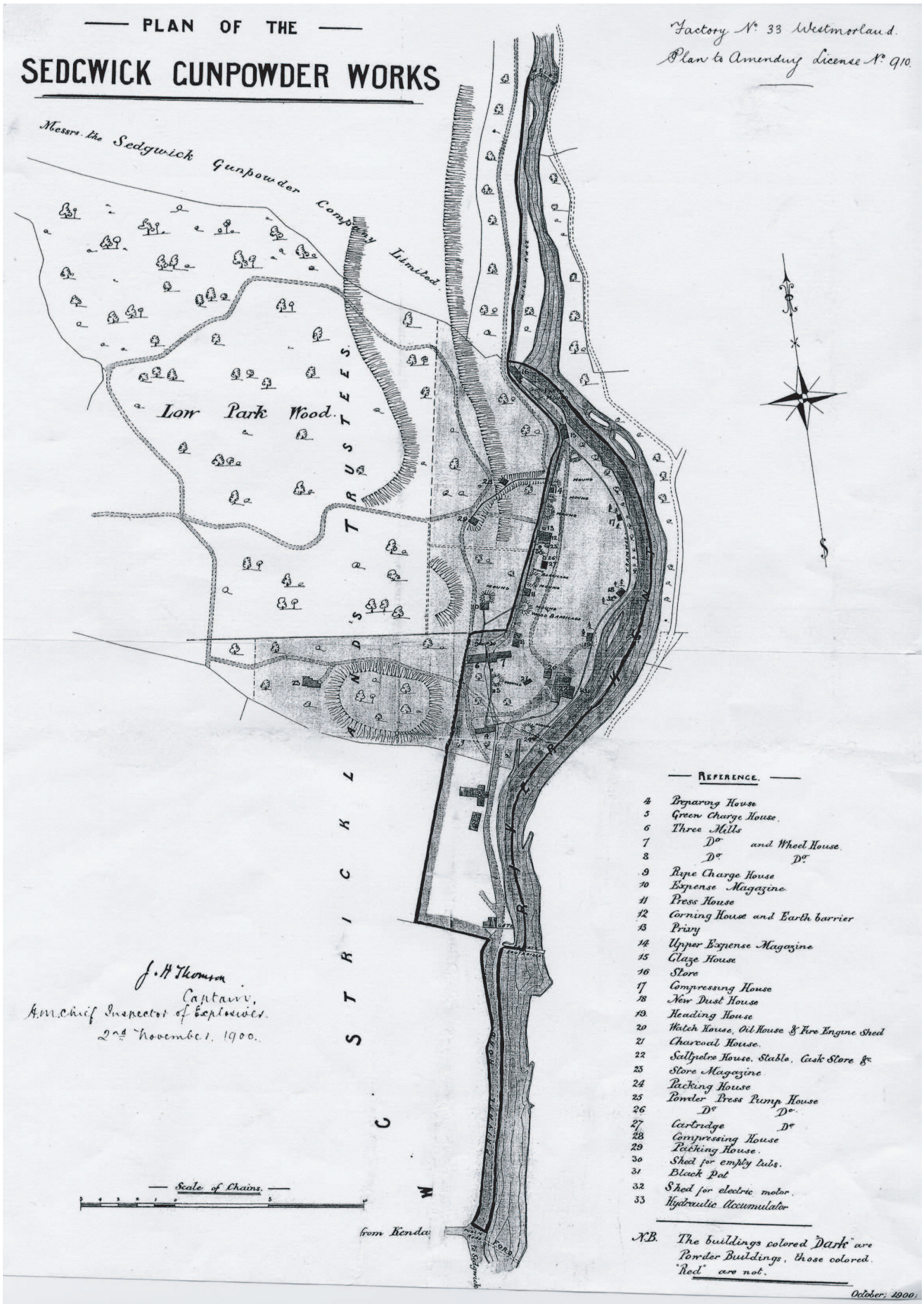

Figure 7. *The plan of the works accompanying Amending License No 910, drawn October 1900 ('the 1900 site plan').*
(ICI plc, copyright reserved)

house which was built after the first glaze house blew up in 1903. Two photographs in this collection are much earlier and were taken by J H Hogg of Kendal, probably between 1873 and 1875. One of them (Fig 8) is of particular importance because it is a view across the main part of the works from the east and shows buildings such as the saltpetre house which no longer survive. This photograph also provides its own internal dating evidence because it shows the heading house erected in 1873 and the powder press house which blew up in 1875 (the replacement press house was built at a new location). The other photograph (Fig 9) is of the unlicensed area at the southern end of the works and buildings, such as the clock tower above the turbine house, are visible. In this report these images will be referred to as the 1873-1875 photographs.

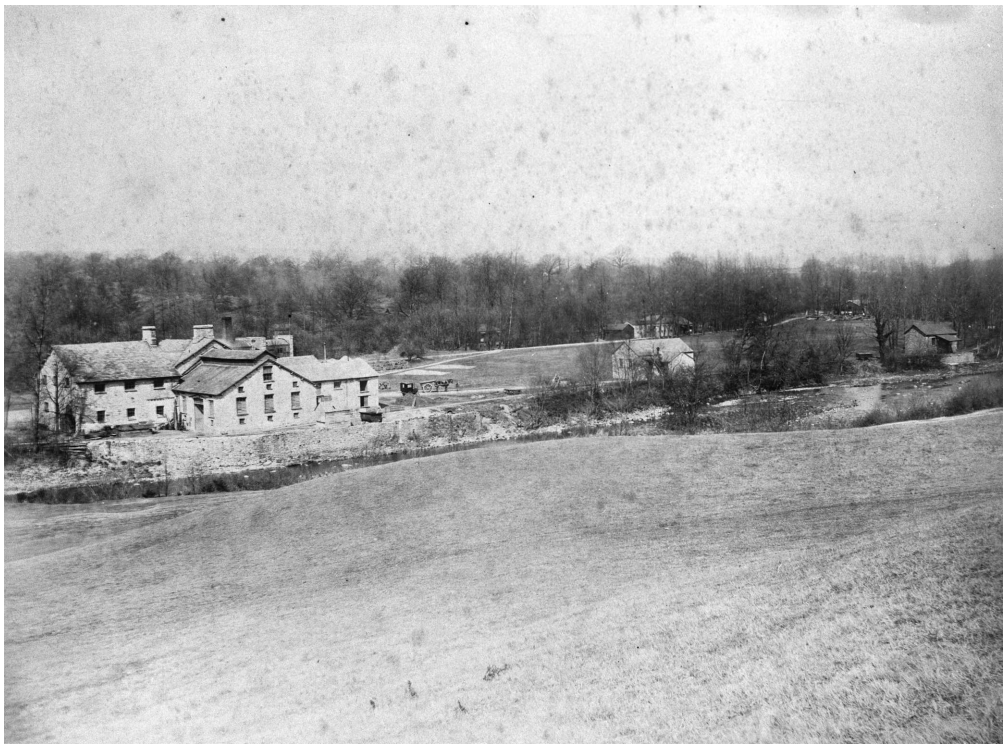

Figure 8.
View from the east showing the saltpetre refinery complex and other buildings in the main part of the works, by J H Hogg (one of 'the 1873-1875 photographs'). (NMR: AA022282, reproduced by permission of David Willacy)

Despite government safety legislation and the efforts of successive foremen, misfortune and carelessness caused a number of explosions, at least five with fatal consequences (see Appendix 1). The principal incidents at the site all were reported in the Westmorland Gazette and three also resulted in official accident reports by HM Inspectors of Explosives

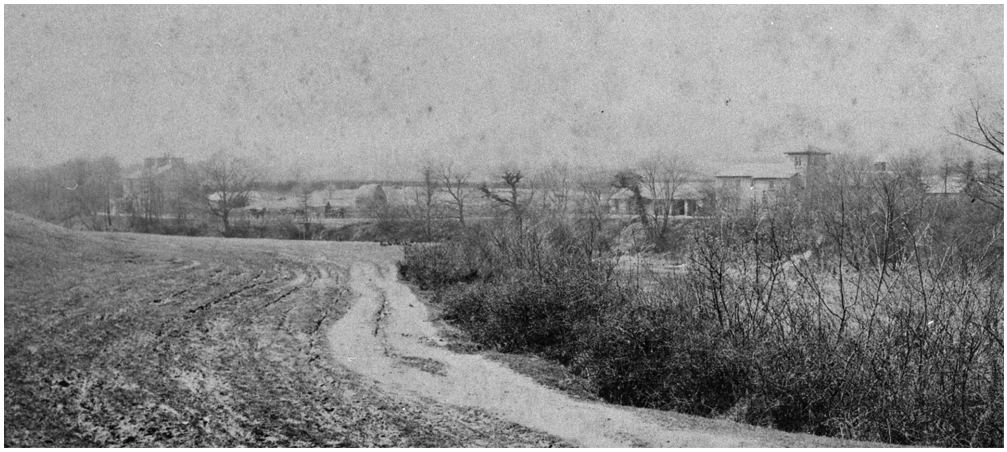

Figure 9.
View from the north east across the unlicensed area, by J H Hogg (one of 'the 1873-1875 photographs'). (NMR: AA022283, reproduced by permission of David Willacy)

(Explosives Inspectorate 1883; 1903; 1906). Both the newspaper and Inspectors reports contain detailed and incidental information about some of the buildings and the processes undertaken in them. The 1883 accident report also contains a sketch plan of the interior of the cartridge compressing house where the explosion occurred (Explosives Inspectorate 1883, 5) and the 1903 report has plans of the glazing house and some of the machinery plus a sketch plan of part of the works (Explosives Inspectorate 1903). Smaller explosions or flashes occurred regularly in the incorporating mills and were such a fact of life that they were not normally reported in detail. HM Inspectors also published annual reports listing all explosions on a nation-wide basis; these sometimes provide brief details of incidents which may not have been reported elsewhere. Following the 1875 Explosives Act, all changes to plant had to have the approval of the Explosives Inspectorate and be authorised through the issuing of an Amending Licence. It is known from the official reports into explosions at New Sedgwick that two amending licences were issued between 1875 and April 30th 1883 with a further six between then and April 1903 (Explosives Inspectorate 1883, 2; 1903, 3).

ICI produced detailed manuals called Manufacturing Method Books (MMBs) which outlined the processes and plant directly involved in manufacture at each of its sites. The MMB for New Sedgwick, although current in 1935 was probably written around 1930 (Patterson 1995, 33), and gives a detailed snapshot of the site just prior to its closure. Two of the men who worked at New Sedgwick have recently given verbal accounts of the gunpowder works, based on their memories. James Willacy, who was employed in the office at the entrance to the site from 1916 until its closure, was interviewed by EH during February 2001. A transcript of the interview is held in the National Monuments Record. James Guy, who worked on the site between 1924 and 1935, was interviewed by Cliff Brown (Sizergh Forester) in July 1995. His experiences were recorded on tape and later transcribed by Edward Hornyold-Strickland, but with limited success due to the quality of the recording. In October 2000 James Guy revisited New Sedgwick accompanied by Robert Maxwell, National Trust Archaeologist for the NW Region, and talked in detail about many parts of the site.

Mike Davies-Shiel has very kindly supplied EH with material from his archive relating to New Sedgwick. This includes copies of colour photographs taken by him during 1977 together with a plan of the site dated 1991 (Helliwell's 1977 plan forms the base document to which Davies-Shiel has added additional information). Also amongst the material supplied is a transcription of a notebook which was compiled by Thomas Faulkner in *c*1925; it contains details of what was in the principal buildings, and at the time of the transcription was in the possession of Faulkner's grand daughter. The original transcription was copied out in longhand by Davies-Shiel who has reproduced it for EH as a typescript to which he has added his own comments and observations in parenthesis.

The National Trust has a set of black and white photographs of the works that were taken in 1977 and include images of the remains of some of the process buildings. In addition there are pictures of structures which no longer survive namely the clock tower above the turbine house of the saw mill and the laboratory which was situated a short distance north of the gate house. Mr Kenneth Major also has four photographs of New Sedgwick which were

taken by a Miss E M Gardner in *c*1945, photocopies of these have contributed to EH's understanding of the works.

4.2 Company history

The application for the licence to erect the New Sedgwick Gunpowder Works was made to the Justices of the Peace at the Easter Sessions held at Kendal on April 9th 1857 and was approved by them in full. The application is recorded in the Kendal Order Book as follows: 'I, Walter Charles Strickland of Sizergh Castle in the County of Westmorland Esquire do hereby give notice, that I do intend to apply to the Justices of the Peace, assembled at the next General Quarter Sessions of the peace for the said County of Westmorland, which be holde on Thursday the ninth day of April next, at Kendal in the said County of Westmorland, for a licence to erect certain mills for making gunpowder with proper magazines and offices adjoining there to, in certain closes or enclosures of land called respectively Kid Holme and Low Park, being part of an estate called the Low Sizergh Estate situate in the Township of Helsington, in the parish of Kendal which said inclosure called Kid Holme, adjoins the River Kent on the west side thereof, and which said enclosure called Low Park on the west side thereof partly adjoins the River Kent and partly adjoins the said enclosure called Kid Holme and no part of which said mills, engines, magazines, or other offices so proposed to be licensed, is to be distant less than eight hundred yards from Sedgwick House, the present residence of John Wakefield Esq or more than two hundred yards from the west bank of the River Kent. And I do hereby give further notice that I shall apply to the Justices assembled at the same Quarter Sessions to license the erecting and having in the said inclosure called Low Park, and at a distance of not less than eight hundred yards from Sedgwick House aforesaid, a magazine or magazines remote from the said mills, for the purpose of receiving and safe keeping of all the Gunpowder made at such mills. Dated this twenty fourth day of March 1857'(CRO(K) WQ/O/15). The application makes no mention of Tan Horse Park, the field at the southern end of the site, presumably because the buildings intended for this the unlicensed area were not for powder manufacture.

The engineer of the new works was Job Bintley, later appointed Borough Surveyor of Kendal (Somervell 1930, 70; Wilson 1973, 330). John Hudson, a local businessman, was appointed chairman of the new company (Somervell 1930, 70) while the foreman of the works was John Cheeseman who was appointed in November 1859 (*Westmorland Gazette*, 7 August 1875). Cheeseman lived in the gate house and, according to the census return of 1861 came from Kent, strongly suggesting that he had previously worked at one of the gunpowder works there, and had been chosen for his experience. This is supported by Tyler (2002, 196) who states that he had been employed at the Faversham Gunpowder Mill. At the inquest into the cause of the deaths which followed the explosion that destroyed the corning and powder press houses in June 1875, Chesseman stated that he had 'been employed in powder making for 40 years' (*Westmorland Gazette*, 7 August 1875). Two members of his family were later killed in an explosion at New Sedgwick (Explosives Inspectorate 1883, 5).

Despite this accumulated expertise, the new gunpowder works did not flourish and the Sedgwick Gunpowder Company Ltd. ran into financial difficulties and ceased trading in

June 1864. Apparently the original company had spent most of its money on constructing the works and its outlying magazines with the result that it lacked the means to carry on its overseas trade (*Westmorland Gazette and Kendal Advertiser*, 25 June 1864). However, the business was reconstructed by a syndicate from Manchester in September of that year, who traded as the New Sedgwick Gunpowder Company Ltd., the appellation 'new' signifying the change in company rather than to distinguish it from the earlier factory on the opposite bank of the river which closed *c*1852 (Jecock and Dunn 2002, 3). It was at this time that Henry Swinglehurst joined the company as manager of the works, beginning a long family association with the site. The Explosives Act of 1875 created a national licensing system for gunpowder works and, as an existing factory, New Sedgwick was granted a Continuing Licence (No 33) on 19th May 1876 (Explosives Inspectorate 1883, 1). Henry Swinglehurst bought out the other partners in 1886 to become company director and made his son, Addison Swinglehurst, both secretary and manager. The company was then known as the Sedgwick Gunpowder Company. When Henry Swinglehurst died in 1896 Addison became director and the business became a private limited company called the Sedgwick Gunpowder Company Ltd. (Patterson 1995, 6). Eventually, in 1903, his son, Henry Addison Swinglehurst became manager of the works. The family lived locally, having homes at Hincaster House in Hincaster and Helm Bank in Natland. The company continued as a family concern until the end of 1917 when, according to Tyler (2002, 220-21), Explosives Trades Ltd., which became part of the Nobel Industries Ltd. in 1920, acquired it; the Nobel Industries was later incorporated into ICI during 1926.

The gunpowder produced at New Sedgwick was principally for blasting in quarries and mines although some sporting powders were also made (Somervell 1930, 71), perhaps chiefly during its early to middle years. In 1880 the manufacture of compressed pellets or blasting cartridges began (Imperial Chemical Industries 1938, 178). The output of the works was 20 tons per week (Wilson 1964, 61).

The closure of the works was planned for some time as Henry Hornyold-Strickland noted in 1934 - 'The Imperial Chemical Industries Ltd., now tenants of our Low [Park] Wood gunpowder works site, terminated their tenancy, pursuant to a policy of concentrating their scattered powder works in a few larger areas. The company paid the estate four years rent, i.e. just over £1000, and conveyed to me personally so as to be free of all obligations in the county 14 cottages in Sedgwick and 6 in Natland as well as a small portion of a field the remainder of which belonged to Hawes farm' (Strickland Archive, Sizergh Castle).

The site shut down at the end of May 1935 when the 50 or so employees were either made redundant or transferred to the Gatebeck works or the new Ardeer works in Ayrshire (*Westmorland Gazette* 1935, 8 June 1935). According to James Guy the site was cleared between June and October 1935 when the timber buildings were either burnt or taken down and any stone buildings with wooden linings were also burnt. Wood was also stacked in the incorporating mills and the whole lot burnt. The machinery was dug out of the embers and sold for scrap. He said when interviewed that 'the heavy wheels from the incorporating mills were charged up in the bosses with gelignite, and fired. They blew up into seven

pieces, of which each weighed 18cwt. These were taken to the railway station for transport to the smelters'.

4.3 New Sedgwick after 1935

During World War II the army requisitioned the site for a munitions depot. In 1942 when Henry Hornyold-Strickland installed a Blake Ram on the west bank of the river to supply water for milk cooling at Larkrigg Farm, 250m to the east, he found that 'it was never allowed to work properly owing to interference by the military who occupied by requisition the whole of the old Powder Works as an ammunition and explosives depot' (Strickland Archive, Sizergh Castle). For a time the Women's Land Army may also have had an involvement with New Sedgwick and local tradition associates their personnel with a loading platform and associated shed near the cooperage complex (see section 6.3.1 below) (Cliff Brown, *pers comm*).

In 1950 the site of the gunpowder works passed to the National Trust with the rest of the Sizergh Castle estate. In May 1977 what was described at the time as a 'controversial' new site for 200 caravans was opened (*Westmorland Gazette*, 27 May 1977). The gunpowder works was recently designated a Scheduled Ancient Monument and in January 1999, the gate house, clocking-in shed, cooperage complex and turbine pit were all listed Grade II.

5. THE PROCESS OF GUNPOWDER MANUFACTURE

The method of gunpowder manufacture has been described in detail elsewhere (Cocroft 2000; Crocker 1999; Patterson 1995) and only a brief outline will be given here in order to provide the reader with a general background to the terminology used in section 6.2 below. Details of the precise method followed at New Sedgwick in its final years are known from the factory Manufacturing Method Book (MMB), a copy of which survives in the Patterson Collection in the NMRC at Swindon. Patterson (1995, 33) thought that this document dated to about 1930. The chief output of the New Sedgwick mills was blasting powder for mines and quarries produced both as a loose powder and, after1880, as compressed cartridges. A small amount of sporting powder (gunpowder for non-military use) and for fog signals was also produced (Somervell 1930, 70-1). 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 parenthesis.

The three ingredients of gunpowder are saltpetre, charcoal and sulphur mixed in proportions which varied but were often 75:15:10 (for firearms) and 70:15:15 (for blasting) (Crocker 1988, 3). At the time of the MMB (page 10) the ratio at New Sedgwick was 72.857:16.429:10.714. These constituents do not react together chemically but are simply blended together. The manufacturing process is, therefore, concerned with creating a thoroughly combined mixture of the correct density, in an evenly granulated form. Saltpetre has two chemical forms: potassium nitrate (nitrate of potash) and sodium nitrate (nitrate of soda). The former is stable under ordinary climatic conditions and was always the saltpetre of choice. Sodium nitrate on the other hand absorbs water from the air, but was less expensive; it was often used to make blasting explosives, but had to be kept dry or it lost its efficacy. Gunpowder made from the two forms was distinguished as N/P or N/S powders (Patterson 1995, 10-11).

The first stage of manufacture was the preparation of the three ingredients. **Saltpetre**, imported from abroad (Sodium nitrate occurs naturally in Chile while India used to be the source of much potassium nitrate) and in its ‘grough’ or raw state, needed to be refined. This was normally achieved by gentle boiling and re-crystallisation, which enabled the impurities to be skimmed off. **Sulphur** occurs naturally near volcanoes and was often imported from the Italian mainland and Sicily. It also contained impurities that were removed through distillation, but this was often done before the sulphur reached the gunpowder manufactories. **Charcoal** was often made on site in sealed retorts in order to keep out grit and stones, but could also be bought in from local suppliers provided it was of sufficient quality. At New Sedgwick it has been suggested that all charcoal was sourced from outside the works following a fire at the charcoal house in 1884 (Tyler 2002, 204). The ingredients were normally housed in separate buildings although there is no evidence that New Sedgwick ever possessed a dedicated sulphur store.

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 each rotating 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 circular drum containing arms fixed to a central spindle. The mixed ingredients, called the green charge, were transferred to the **green charge house** to await incorporation.

At 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 **wrought charge** (ripe charge). This process took 1.5 to 2 hours and was supervised from the comparative safety of the **watch house**, with the charge being periodically dampened to help it meld together. At New Sedgwick all the mills were under-driven (powered by a line shaft from below through the bedplate) by waterwheels. Once incorporated the ripe charge was removed and stored in the **ripe charge house** until the next stage of manufacture. An **expense magazine** also appears to have been used to store the ripe charge at New Sedgwick - perhaps there were occasions when the quantity of wrought charge exceeded the storage capacity of the ripe charge house.

The mill cake was then transferred to the **powder press house** (press house). First it was broken down by hand using wooden beaters and combined with dust recycled from the corning house. The powder was then spread thinly on to a series of brass plates - one on top of the other - to form a large 'sandwich' of 35 layers which was pressed for about 35 minutes in total. While one batch was under pressure another was being prepared. Hydraulic pressure was certainly being used from 1875 (if not before) operated by turbine driven pumps.

By this stage the powder had reached a satisfactory mix and density but needed to be granulated into rounded and evenly sized grains. This was carried out in the **corning house** where the press cake was broken into pieces by hand and then passed through a series of rollers that granulated it. The powder grains then landed on the sieves of the scry or separator which separated dust and over-size grains from the powder. The dust was returned to the powder press house and the over-size grains went back through the rollers. At New Sedgwick an **expense magazine** to the north of the corning house may have been used to temporarily store corned powder on its way to the glaze house.

In the **glaze house** the powder was placed in wooden drums with graphite (blacklead) and rotated. This process smoothed the powder grains and made them less hygroscopic. At New Sedgwick sporting or 'bright' powders were rotated for about 15.25 hours, the barrels were then stopped and the graphite added; the drums were then run for a further 2 or 3 hours. Black and cartridge powders were treated rather differently from the above in that graphite, of an inferior quality, was added at the start of the process with cartridge powders being rotated for 6 hours and black powder for about 15 hours. A waterwheel at New Sedgwick always supplied power for the glaze house. At New Sedgwick reeling (the removal of fine dust from sporting powders) was carried out in the glaze house until the latter exploded

in 1903 after which a separate **reel house** was constructed at the northern end of the works.

The glazed powder destined to be sold loose went straight to the **stove house** (drying house) to remove any residual moisture, whereas cartridge powder was despatched to the dust house (see below). The stove house at New Sedgwick that was built after the glaze house explosion of 1903 consisted of two separate structures: one for drying blasting cartridges and the other for loose powder. Hot water pipes, supplied by an external boiler, ran around the floor of each building and provided the heat for drying. The powder was usually left overnight to dry. The dried powder then went to the **dust house** for final sizing of the grains. The powder was put into a separator and agitated through sieves of different sized meshes (known as LCB, CB, FBB and FBBx, FO and Cartridge Powder) and anything that was too large or too small was sent to the preparing house where it was returned to the manufacturing cycle. At the **heading house** (heading-up house (this literally refers to the closing of the barrels)) the loose powder was packed into barrels, each lined with a waxed calico or rubber bag, which were then stencilled before being taken to the **store magazine** to await despatch.

The cartridge powder followed a more convoluted route through the works after leaving the glaze house. It went first to the **dust house** to be sized and then to the **heading house** where it was weighed before being sent to the **cartridge compressing houses** (cartridge press houses). If the latter were unable to take the powder then it was put into barrels and temporarily kept in the **store magazine** until the cartridge compressing houses were ready to receive it. At the latter the powder was poured into moulds and then compressed into pellets or cartridges. At the time of the MMB there were three pressing machines housed in two separate cartridge compressing houses, all hydraulically operated by turbine-driven pumps housed in a separate **cartridge press pump house**. The cartridges were then dried in the **stove house** before being sent to a **cartridge packing house** where women packed them into boxes. The boxes then went to the **heading house** for nailing and stencilling and on to the **store magazine** to await despatch.

Powder was checked for quality and reliability in the **proofing laboratory** and on the **proofing range**. Barrels and boxes were made at the **cooperage** complex situated in the **unlicensed area** of the works which at New Sedgwick lay to the south of the gunpowder manufacturing part (**licensed area**) of the works. The unlicensed area also contained the **gate house** (office and foreman's residence) and the **clocking-in shed** at the main entrance to the works.

6. DESCRIPTION OF THE REMAINS

The following description of the site is presented in three main phased parts: the first deals with a couple of features which pre-date the gunpowder works; the second with the works itself; the third with the use of the site during World War II. In order to preserve a coherent narrative the description of the remains relating to the gunpowder works are ordered by process rather than by date, although there is a chronological account of the site in section 7, Discussion. A description of the different processes involved in powder manufacture and an explanation of some of the terms used has already been given in section 5 above. To help the reader identify the gunpowder buildings they have been numbered and labelled on the phase diagrams (Figs 59-61) which accompany section 7.2 below; these numbers (in brackets) have also been included below and appear where each building is described. The hachured site plan of the earthworks and other features recorded by EH is shown in figure 10 (inside back cover). The remains were surveyed in the field at 1:1000 scale and the plan contains both archaeological and modern detail.

6.1 Phase 1. The features pre-dating the gunpowder works

With the exception of the field walls defining the edge of the site, and some of the tracks, only two features were found during the EH survey that are demonstrably earlier than the gunpowder works (Phase diagram Fig 58). One is an earthen bank and the other is an early weir crossing the River Kent.

6.1.1 The earthen bank

This is situated in the woodland about 40m to the north of the cooperage/saw mill complex and consists of a short length of curving bank, about 4m wide and 0.3m high. To the south the now ruinous wall that separated the licensed area from the unlicensed area of the gunpowder works overlies the bank. The latter is thus earlier than the wall and may be the remnants of a former field boundary.

6.1.2 The early weir

A lease of July 1857 between Walter Charles Strickland and the Sedgwick Gunpowder Company Ltd. has a plan attached which does not show the gunpowder works and must, therefore, pre-date the construction of the latter (CRO(K) WD/AG/29.6). But a line is drawn on the plan across the river in the area that was later to become the northern end on the central part of the works. A possible building, which does not survive, is also depicted on the riverbank close to the line's western end. The line almost certainly represents an early weir which at the very latest must have been abandoned when the gunpowder works was established. The weir would have been of little use to the works which built its own weir further up river. It is significant that, unlike the gunpowder buildings, the early weir is not shown on the first edition of the OS 25" map (revised 1857) although the probable bypass channel associated with it is depicted; this suggests that the weir had already gone.

Part of this weir still survives near the site of packing house 3. A single timber beam, 0.2m square containing a number of iron bolts, is visible crossing the bed of the river diagonally in

an approximate north-east to south-west direction. At least two drilled holes, set at ninety degrees to the wooden beam, are present in the exposed bedrock a few metres to the west of the southern end of the beam. The adjacent east bank of the river also appears to have been cut back to create a bypass channel (there is a hint of this channel on the plan accompanying the 1857 lease). On the very edge of the western riverbank are at least two linear hollows. They lie to the south between the weir and the 'island' in the river opposite the saltpetre refinery complex. It is just possible that they are the remnants of a leat channel leading away from the weir to provide an early industrial site in the vicinity, such as a water mill, with power. There are references to a mill in Helsington parish in 16th and 17th-century inquests, perhaps these remains are connected with it (Jecock and Dunn 2002, 38).

6.2 Phase 2. The gunpowder works

A weir was built across the River Kent in order to supply a massively constructed headrace (main leat) that brought water to the waterwheels and turbines at the works. This leat traversed the whole of the licensed area and entered the unlicensed area to the south in order to provide power for a cooperage complex. The licensed area, where powder production took place, was laid out in a logical manner with the arrangement of process buildings progressing in an approximately clockwise direction from the south where the buildings used for storing the basic ingredients were located.

6.2.1 The water power system

The machinery at New Sedgwick was powered by water, either by means of waterwheels, turbines or hydraulics. Hydro-electric power was being generated on site by at least 1900 but it was mostly used for lighting, exceptions being the dust house and latterly the saw mill and machine shop within the cooperage. Water for the works came from a weir on the River Kent, at the northern end of the site, and was delivered by a massively constructed leat.

The length and complexity of the water system at New Sedgwick owes much to the experiences of other mill owners on the River Kent in the fifty years before the works was built. Unreliable flow rates at certain times of year caused manufacturers in the area to propose the building of a number of reservoirs in the fells above Kendal to regulate water flow, powers being granted to them in an Act of Parliament of 1845. Kentmere Head reservoir was completed three years later but it proved so expensive that the others were never built (Wilson 1973, 328-30). Although New Sedgwick would have benefited from the new reservoir, the engineer, Job Bintley (who was in fact also responsible for the Kentmere dam), must have also realised that the other reservoirs would never come into being and had to take into account possible shortages. Thus, the leat was long - 845m - giving a fall of 21ft (6.4m), twice the fall of that at Old Sedgwick and Basingill (Wilson 1973, 341).

When first built the leat took water, in sequence, to the glaze house, the turbine house (which provided power for the corning house), the incorporating mills, preparing house and the cooperage. The glaze house and incorporating mills were powered by conventional waterwheels, the others by turbines housed in vertical pits. The turbines were built by

Williamsons, a local firm; the company order book reveals that these were the No 3 turbine (6-horse power, 17ft 6in (5.33m) head) and No 8 and 9 turbines (8-horse power, 20ft (6.09m) head). Turbines 8 and 9 were replaced by ones supplied by Gilbert Gilkes & Company in the early 1920s (Williamsons sold their business to Gilbert Gilkes in 1881 (Crocker, 2000, 96)); a 15-horse power turbine with a 20ft (6.09m) head replaced No 8 (K Major, *pers comm*). An additional range of two incorporating mills (to which a third was later added) had been erected by 1869 and was provided with yet another wheel pit and tailrace - these were also linked into the main system. It is uncertain how the first powder press house was powered but the new powder press house of 1875 certainly relied on hydraulic pressure. The introduction of blasting cartridge production at New Sedgwick in 1880 led to the construction of a purpose-built pump house complete with turbines and pumps in order to provide power for the hydraulic cartridge presses. Once again water was taken off the main leat to drive the turbines. By the end of 1900 this pump house also housed a dynamo which produced electricity. Soon after the glaze house explosion in 1903 a reel house was built at the northern end of the works; a small turbine using water from the main leat powered it.

The weir and leat

The leat took water from a point where the river starts to narrow and is constricted by the valley which becomes a gorge in this area. Map evidence indicates that during the life of the works the form of the weir that was built here changed. The original weir, marked on the OS 25" map surveyed in 1858, was constructed across the riverbed on a straight course which was later replaced by a more ergonomic 'V'-shaped structure that was certainly in existence by the time of the OS second edition 25" map, revised in 1897. It may well have been built immediately after October 1874 when according to a newspaper account the weir was washed away in a flood; apparently 'it was sometime in November before the weir was put right' (*Westmorland Gazette*, 7 August 1875). According to David Willacy (*pers comm*) the 'V'-shaped weir survived until about 1990 and photographs showing it in a dilapidated state were taken by Miss Gardner in *c*1945 and Davies-Shiel in the 1970s. They indicate that the weir consisted of long, horizontal timber beams supported on short vertical posts and iron rods sunk into the bedrock. The base of the 'V' faced upriver, an arrangement that would have helped deflect water into the leat. When river levels are low, vestiges of the weir are still discernible, especially near the east side of the river. In this area the riverbank was cut back into solid bedrock in order to create a bypass channel. This survives together with the remnants of a sluice gate situated almost half way along its length. Winding gear, presumably once associated with this gate, lies in the bottom of the channel at its southern end. The bypass channel may have been constructed at the same time as the original straight weir because the indentation in the riverbank that marks its course is also shown on the OS 25" map surveyed in 1858.

A rocky shelf with an uneven surface separates the bypass channel from the river and was probably created when the riverbank was cut back. The shelf was used to provide a seating for the eastern end of the 'V'- shaped weir, timbers from which still survive both on top of the shelf and also protruding north west from it into the river. They are held in place by the remains of iron rods (large bolts) - some with nuts - set into the underlying rock. The

remains of a fish pass also survive and consist of a concrete wall, 'L'-shaped in plan, extending from the rocky shelf into the river on the south side of the weir (Fig 11). Below and coming off the southern side of the main wall is a second but much smaller concrete wall, also angled towards one end. According to Davies-Shiel (*pers comm*) there was fierce litigation concerning the weir because the riparian owner on the east bank of the Kent did not want the weir to abut his land and hence the eastern side was designed as a fish ladder. The weir at the nearby Basingill Works also had a fish pass (Hunt and Goodall 2002, 14). On the edge of the riverbank, near the entrance to the leat, are traces of the western side of the 'V'-shaped weir consisting of iron bolts, some with nuts still attached, set in bedrock together with remains of timbers, one of which protrudes from a concrete housing. Iron rods are also visible north of the leat entrance but it is not clear how these related to the weir. No doubt the 'V'-shaped weir was repaired or refurbished from time to time, so all the surviving features may not be contemporary. A short distance south of the remains of this weir at least two iron rods protrude from the riverbed, but it was not possible to record their positions due to the depth of the water. They appear to be associated with a line across the river where the water seems to break - perhaps these features are related to the original straight weir.

Figure 11.
The weir and fish pass from the south west. (NMR: AA012908)

The sides of the leat are rendered for their entire length, but where the render has fallen away a coursed stone revetment wall is visible behind it. The depth of the leat varies slightly but is about 1.3m on average and its bottom is of concrete. Where the course of the leat is close to the riverbank, at its northern end, its exterior has also been strengthened by very solid revetment walling, which, together with the revetted eastern side of the leat channel, forms a broad wall-like feature. In this area low beam-like barriers are visible across the

width of the leat channel north of the reel house. They are situated in the basal part of the channel and their ends are held in concrete housings standing proud of the side walls of the latter. Apparently they were traps to collect silt washed into the leat (Tyler 2002, 196). Between the reel house and first stove house the soil dug out to make the leat channel forms a marked bank on the latter's eastern side. In places it appears to consist of a series of interlocking mounds of dumped material that were largely left in an unspread state. Information contained in a newspaper article indicates that the leat was damaged on at least two occasions (*Westmorland Gazette*, 7 August 1875). The first was in 1872 when the leat burst causing gunpowder production to stop and the whole workforce was put on to its repair. Two years later the leat was damaged in the flood that also destroyed the weir. A comparison of the first and second editions of the OS 25" mapping (surveyed in 1857 and revised in 1896) indicates that at least one of these incidents probably took place near the site of the first stove house. An approximately 80m long section of the leat in this area had been rebuilt on a slightly different alignment by 1896. Field evidence also indicates that this area is potentially unstable; it lies above a bend in the river and the area, particularly to the west, is prone to waterlogging due to the outflow from the spring known as Robins Hood's Well.

The leat was designed to make maximum use of the head of water by means of a series of enlargements and constrictions in its width at a number of places along it its course, thereby ensuring a sufficient flow of water at key points. The leat is 3.5m wide until just before it reaches incorporating mills 1 to 6 where it broadens, in effect forming a small mill pond to feed the wheel. It narrows to 2.5m beyond the incorporating mills (Fig 12) and then swells slightly beside the entrance to the turbine pit of the preparing house, again forming a

Figure 12.
The main leat looking south from near the incorporating mills (blast walls of green charge house visible above on left). (NMR: AA012871)

slight reservoir. It then narrows once more, to 1.4m, before feeding into the turbine pit beneath the clock tower.

Waste water

The return of spent water to the River Kent from the various process houses was also carefully managed. The first glaze house and later the new glaze house and reel house were situated close enough to the riverbank for the used water to be discharged straight into the Kent via a very short tailrace from each building. However, the corning house was located some distance from the river and spent water from its turbine house entered a culverted tailrace that was constructed east of and probably parallel to the main leat. Further to the south, tributary tailraces from both the incorporating mills and the preparing house joined this underground channel. The preparing house was situated on the western side of the leat, which meant that in order to gain access to the main tailrace, spent water from the turbine pit of the preparing house must have been routed in a culvert underneath the leat. The main tailrace emerges from underground in the face of the river terrace on which the works is built, some 30m to the south east of the former preparing house, and extends as an open channel for 30m to the river. It exits the terrace through a monumental arched entrance, 3.9m wide and 2.5m high, which is flush with a coursed revetment wall above (Fig 13). The interior of the culvert was not investigated for safety reasons, and to prevent access iron railings have in recent years been erected across the entrance. However, it is still possible to look into the southern part of the culvert through the arched entrance, and this reveals a tunnel-like channel curving gently to the east, while on its western side the opening of the tailrace from the preparing mill is also visible. A photograph from this location and showing these underground features is reproduced in Tyler (2002, 217). The sides of

Figure 13.
The arched exit of the main tailrace from the south east. (NMR: AA012903)

the outflow channel leading from the arched entrance to the river are strongly revetted in stone at the river's edge to a maximum height of 2m.

The cooperage was situated too far south to link up with the main tailrace, and instead a stone-arched culvert took waste water from the turbine pit east to the river. The architect's drawings of 1859 of the clock tower reveal that the tailrace was about 10ft (3m) beneath the ground surface, and a note adds that it was 'to be made sufficient to bear the watch house corner and Buttress'. The culvert discharged into the river, its course angled to prevent debris from the river being washed back inside it, and its eastern end is still visible as an opening in the face of the steep riverbank.

Flow management

A succession of sluice gates and overflow channels allowed the volume of water in the leat to be carefully controlled. All of the process houses could be isolated by means of sluice gates at their individual take-off points. In addition, water from the river could also be prevented from entering the leat by means of a pair of sluice gates located at its entrance beside the weir. The housings for these survive in the side walls of the leat channel indicating that the sluices were spaced about 1.5m apart. Remains of winding gear no longer in situ lies on the floor of the leat. A modern timber footbridge now crosses the top of the leat between the sluices. Below this bridge on the south west, and beyond the southernmost sluice gate, are two timber beams, one above the other, crossing the leat channel. They are probably the remains of traps designed to catch any debris washed into the leat. Iron safety railings once stood above the entrance to the former on the north, but these are no longer in position and have fallen into the leat.

An overflow, 14m north of the cooperage turbine house, takes the form of a lowering on the eastern side of the leat, 0.3m deep, which leads to a funnel-shaped channel with a sloping bed, draining into a small culvert under the road. The lip of the overflow has evidently been repaired at different times and is made of concrete. The mouth of this outflow is still visible in the face of the steep riverbank. It is set 1.2m above the edge of the river, the channel is 0.75m wide and externally has a stone lintel across its top, although its interior appears to be roofed or lined with wooden boards. The bank beneath the outflow is revetted with stone; the wall displays a slight batter and is strengthened by two buttresses, one on either side. The overflow would have allowed the water to be more effectively shut off for maintenance of the turbine and to prevent a build up of water at the terminus of the leat. It was probably installed when the clock tower over the turbine was erected in *c*1859.

An overflow channel was inserted along the northern side of the glaze house probably when the second compartment (north of the waterwheel house) was added. The channel lies immediately beyond this structure and both were in existence when the OS 25" map was revised in 1896 (Ordnance Survey 1898a). This channel remained in use after the explosion of 1903 which destroyed the glaze house and led to the construction of a replacement building slightly further to the north (see section 6.2.3 below). The overflow survives as a short stone-built channel, 0.8m deep, leading from the eastern side of the leat and draining

directly on to the riverbank which drops away sharply at this point. Similarly, when the stove house was rebuilt on a different site, the drain from its predecessor was left in place. This channel is about 0.8m deep and 0.6m wide with stone flags at its base and timber to its top. Water enters the channel through an opening in the base of the leat and exits 3.2m above the riverbed through another opening, this time in the face of the revetment wall associated with the second stove house to be built at the first stove house location (see section 6.2.3 below).

There is another overflow channel north of the reel house which was probably put in when this building was constructed. This channel, 0.6m deep, tapers before dropping into a trench roughly cut in the exposed bedrock on the edge of the river; the trench is angled southwards to prevent water from the river backing up into it and is currently filled with domestic rubbish (old cartons etc.) brought down by the river. The leat is now blocked immediately south of this point, and the water that collects behind this barrier (including water from the northernmost stream) flows back along the channel and into the river.

The aqueduct

By 1912 (Ordnance Survey 1914b) the stream at the northern end of the site was prevented from draining into the main leat as a result of the construction of a small aqueduct which carried the water across the leat to the riverbank (Fig 14). The aqueduct still survives and appears to be made of timbers held together with iron bolts; it measures about 1.1m wide overall. The sides and base of the water channel that it carried are thickly encrusted with limescale - any structural details are thus masked. The reason for the aqueduct is uncertain. It may have been simply to stop stream water undermining the revetment wall of the leat and to formalise the drainage path of the steam here. It could also have been an attempt to stop lime-rich water entering the leat and furring up the workings of turbines or other machinery. In this respect it may be relevant that its construction seems to coincide with that of the

Figure 14.
The aqueduct and main leat from the north. (NMR: AA012923)

nearby reel house which was powered by a small turbine. If lime-rich water was a general problem on this site, it is surprising that no similar effort appears to have been made to divert the southern stream situated near the incorporating mills.

The supply of water for other purposes

Water was not needed in the manufacture of powder, except for a small amount during incorporation. It was, however, required for the refining of saltpetre and to a lesser degree in the smithy and cooperage. There is some evidence to suggest that water for these purposes was also taken from the leat. Set into the base of the leat, opposite the site of the preparing house, is a square timber lined duct leading, via an inspection pit, to two iron pipes, 0.2m and 0.1m in diameter. These appear to be set under the trackway which led to the saltpetre house and may be the remnants of a gravity fed system that supplied the saltpetre refinery with water.

The smithy and cooperage could have been adequately supplied by simply taking water manually out of the leat, but latterly water may have been pumped from the bottom of the turbine pit of the cooperage. Outside the east wall of the turbine house is a small pump connected to an iron pipe leading to the turbine pit through the base of the wooden pentrough. Another pipe from the pump apparently lies buried underground beside the leat. It is visible north east of the cooperage where it surfaces to cross the leat in the direction of the smithy, and is controlled at this point by means of a stopcock, before disappearing underground once more. The date of the pump is uncertain.

6.2.2 The preparation and storage of the raw ingredients

In this section the saltpetre refinery complex, the charcoal house, the sulphur store and the 'Black Pot' building are described.

The saltpetre refinery (1)

The saltpetre refinery was part of a much larger building that also housed other operations. It was recorded by the OS in 1857 (Ordnance Survey 1895) and is also depicted (rather schematically) on the 1859/1860 sketch maps. The refinery complex is briefly mentioned in newspaper accounts of the explosions at the incorporating mills in 1859 and 1869 which also broke windows at the refinery (*Westmorland Gazette and Kendal Advertiser*, 24 September 1859; 22 May 1869). In 1896 a man had his hands and ears slightly burnt while renewing some bolts in a pan that had been used to extract saltpetre from waste gunpowder; he had removed the candle from a lantern which he was using in order to see when the gunpowder ignited (Explosives Inspectorate 1903, 11). The building complex is numbered 21 and described as 'Saltpetre House, Stable, Cask Store etc.' on the site plans of 1900 and 1903-12 and was situated close to the riverbank. In order to prevent the latter collapsing under the weight of what was a substantial stone building or being eroded by the river, a 60m length of the riverbank was revetted by a stone wall, 0.6m wide and up to 3.2m high (east face). The western face of the wall is 0.8m high above ground level beside the remains of the 'Black Pot' building (see below). Only the footings of part of the saltpetre house survive today; much of its western half now lies under or has been destroyed by the parking area

outside the caravan club reception block. Dumped material - possibly from the construction of the parking area - also obscures part of the site. The building was probably taken down when the works were closed because air photographs (RAF 106G/UK 653//3158// 13-AUG-1945) taken in 1945 show that it had gone by this date; since it did not contain mixed powder the reason may have been to re-use its stone. Water for the various processes carried out in this building may have been piped from the main leat (see section 6.2.1 above). One of the 1873-1875 photographs (Fig 8) shows a view of the building taken from the south-east, on the opposite riverbank, from which the easternmost wing - conspicuous by the provision of numerous ventilators to aid evaporation of the saltpetre solution - may be confidently identified as the saltpetre refinery. According to Faulkner's notebook (see section 4.1 above) the contents of the refinery included two pans (7ft (2.1m) in diameter and 5ft (1.5m) deep), two wash bins (capacity 4 tons each), four cooling tanks, five vats (ranging in capacity from 900 to 1200 gallons) and a well under the floor. By about 1925 New Sedgwick was also supplying the Elterwater Gunpowder Works with pre-refined sodium nitrate saltpetre for the manufacture of blasting cartridges (Jecock *et al* 2003, 38).

The photograph shows that this wing was a tall, single-storey stone structure, its roof gabled south-east to north-west and with a louvered vent running almost its entire length. Three louvered windows were also present in the south-east gable wall, which also had small vents above and below each window, and a further louvered window in the gable apex. There was a wide, central doorway, flanked on each side by a louvered window with a small vent below, in the south-west wall. At the time of the EH survey the outline of much of the refinery block was visible as an almost square, flat-bottomed hollow (floor) measuring about 12.3m by 10.9m, with edges defined either by scarps or the ruined walls of the building. The walls, clearly of coursed rubble with traces of rendering on their inner faces, survive to a maximum height of 0.8m. The course of the collapsed south-west wall of the building is interrupted by the flagstone threshold, about 2.7m wide, of the central doorway. A square tank sunk into the floor of the building (with a pair of concrete edges leading away from it to the north west), was also visible in the centre of the refinery at the time of the EH survey; it is built of stone slabs and is 0.9m deep. A recess around the inner lip of the tank must have been the seating for a former cover or grille, while shallow grooves, about 0.15m deep, may have brought liquid to or from the tank. One is centrally placed on the upper edge of the north-west side of the tank while the other is similarly positioned on top of the south-east side. Soon after leaving the edge of the tank this last groove bifurcates with one arm pointing to the north east and the other to the south west.

Towards the end of 2002, by which time the EH survey had been completed in the field, the National Trust cleared the leaf mould and felled the saplings growing over the site of the refinery block. This revealed the floor to be surfaced with either large flagstones or areas of concrete. Immediately north west of the central tank clearance exposed a slightly lowered area in the floor (the north-east and south-west concrete edges were recorded by the EH survey) in which are sunk two large cast-iron basins that form a line with the tank (Fig 15). The furthest (upper) basin from the tank is at a slightly higher level than its companion (as is the rest of the floor in the north-west part of the refinery) and measures 1.9m across

Figure 15.
The tank and cast - iron basins in the floor of the saltpetre refinery, from the south east. (NMR: DP001578, reproduced by permission of Christopher Dunn)

although, like the other (lower) basin, its upper part may have been truncated when the refinery was demolished; the lower basin is 1.7m in diameter. EH revisited this part of the site in January 2003, but on this occasion the basins were full of frozen water so it was not possible to record their depths, but they may be fairly shallow. They were still visible as surface features as late as 1977 when Davies-Shiel photographed this part of the site. Perhaps they are the basal elements of the two large pans in the refinery mentioned in Faulkner's notebook (see section 4.1 above). The clearance also exposed a number of channels, about 0.15 in width and depth, in the floor that may have transported liquid to or from the tank and basins (or have collected spills). There is one on either side of these latter features set some 2.2m in from the south-west and north-east walls of the building to which they are parallel. Arms extend at right angles from both channels towards the bifurcated groove on the south-east lip of the tank and also towards the lower basin; near the latter one has the remnants of a cast-iron trough in it. The floor at the north-west end of the building contains eight square post sockets, each about 0.2m across and 0.05m deep, arranged in two groups and separated by the upper basin. They must relate to former structures and each group contains four sockets spaced about 1.9m apart and forming a square. A vertical cast-iron pipe, 0.11m in diameter, protrudes through the floor near the northernmost group. A short channel is also visible in the floor beyond the south-west group of sockets and near the north-west wall of the refinery to which it is parallel; it seems to link up with a series of other channels exposed immediately outside (north west) this part of the building where clearance has also revealed fragmentary walls and a concrete floor. None of these recently exposed features have been added to the EH plan.

The photograph of 1873-1875 shows that at its north-western end the refinery abutted the south-east gable of another element of the building that had an inset chimney stack. Just north of this element, the upper part of a tall, industrial-looking chimney stack is also visible in the photograph, but it is not clear now how, if at all, this relates to the building as a whole.

But the most likely explanation is that was related to the boilers which were apparently housed in the westernmost range at the north-east end of the building (see below).

The other parts of the building, which are visible in the photograph of 1873-1875, do not display such diagnostic features. The south-western wing was gabled north-east to south-west and was two storeys high and, on the south-eastern side, there were six windows arranged three to each floor; the ones that lit the first floor were wider than those on the ground floor. There were further windows and a doorway (near the southernmost corner) in the gable wall at the south-west end. The apex of the roof was interrupted towards its north-east end by a chimney stack. According to James Guy, there was a joiners shop on the first floor which could be entered by an external staircase beside the south-west gable end; the staircase is not shown on the old photograph, but it is depicted by the OS on both the second and 1914 editions of the 25"map. This is presumably the same joiners shop as that mentioned in a report of the explosion which destroyed the corning and powder press house in 1875; the joiners shop was described as being close to these buildings (*Westmorland Gazette*, 3 July 1875). All that now survives on the surface are the concrete edges of two, long step-like features, 0.2m high. Map evidence shows that a tramway left this building from the south to take the processed ingredients to the preparing house (Ordnance Survey 1898a; 1914a). A curving scarp, 0.4m high, 30m south west of the refinery may mark the edge of the track bed.

The north-east end of the building comprised two parallel gabled ranges orientated approximately north-east to south-west. The easternmost range was extended by a bay sometime between 1857 (Ordnance Survey 1895) and the 1873-1875 photograph which clearly shows the join; the two openings visible in the south-east wall of the extension look like ground and first floor taking-in doors rather than windows. There were two small windows at first-floor level in the south-east wall of the original part of the range. The outline of this range and part of its later extension survive as stony banks up to 0.9m high with the original north-east end of the range (built in 1857) surviving as a scarp; the extreme north-east end of the later extension has been concealed by dumping. James Guy has a recollection that the ground floor was used as stables, a function supported by the labelling on the site plans of 1900 and 1903-12. A number of carts (one with a horse between its shafts) are visible just outside the north-east end of this building on the 1873-1875 photograph. The cask store may also have been sited on this side of the building (a line of about six barrels are visible outside it on the 1873-1875 photograph), as this would be a convenient location for the transfer of empty casks to the heading house. It was observed during the survey that the ground in this area is thick with charcoal; it is not clear whether this is as a result of its storage here or whether its occurrence is due to the deliberate burning of the wooden parts of the building after its demolition. In the angle between the refinery and this range stood a small, roofed structure (Ordnance Survey 1898a) which had been removed by 1912 (Ordnance Survey 1914a). A slight swelling where the ruined walls of the refinery and eastern range join may mark its position. Beside it stood an 'L'-shaped wall or fence (Ordnance Survey 1898a; 1914a), possibly the edge of a storage bay, now visible as a low but well-defined linear scarp. A rectangular pit, 0.4m deep and 2.0m long, is situated a short distance

beyond the northern end of this scarp; there is no evidence of stone within but its well-defined edges suggest that it may have had a timber lining.

In the area occupied by the western range, all that survives above ground now is a single machine bed (some of the features exposed by the National Trust near the north-western limits of their recent clearance may also relate to this range); its present location suggests that the machine which it supported was situated in the south-east corner of the building. It consists of a concrete block with a chamfered upper edge, 2.1m long, 0.9m wide and 0.2m high. The remains of sawn-off iron bolts/rods are visible part of the way along the south-west side of the block and near all the corners apart from the north-eastern one where a rod still survives. It has been bent-over, measures 0.7m long, and its end has been fashioned into an 'eye'. According to James Guy, there were a number of boilers inside the building which heated a hot water tank housed in a small extension to its west - the latter is first shown on the second edition of the OS 25" map, surveyed in 1986 (there is also a reference in Faulkner's notebook to a Lancashire Boiler in the section dealing with the refinery). This may be the same 'boiler-house near to the stables' where tar was being melted when the corning and powder press houses blew up in October 1871 (*Westmorland Gazette and Kendal Advertiser*, 28 October 1871). It is described in the newspaper account as being 150 yards (137m) from the old powder press house, which would be the correct distance for the building under discussion.

A large rectangular hollow, measuring 9m by at least 5m, and up to 0.5m deep, is situated on the northern edge of the saltpetre house. It does not appear on any of the maps of the works nor is the feature identifiable on the 1873-1875 photograph. There are no banks or stonework associated with the hollow, but its orientation suggests that it was laid out with reference to the refinery complex. It may mark the site of a later timber building but it is also worth noting that there are other features in the vicinity that may date to World War II so it could, perhaps, belong to this later phase of activity.

The course of the tramway, which lay between the saltpetre refinery and the riverbank, survives as a narrow embankment, 0.4m high; where disturbed, coal-derived clinker and ash are visible. Although the sleepers have been removed, they have left shallow indentations on its surface indicating that they were about 0.2m wide and spaced 0.9m apart. To the north east of the saltpetre building the bed of the tramway has been cut into by a scarp defining a rectangular feature that must, therefore, be later than the tramway and its removal. There is rectangular hollow adjacent to it and a small flat-topped mound of stone, brick and tile (0.4m high) a little to the north. The origin of these features is uncertain but they may be no more than the result of demolition or later dumping but it is always possible that they were created during the World War II activity on the site.

The charcoal house (2)

Charcoal was being made in retorts, presumably on site, when the charcoal store burnt down in October 1884 (Explosives Inspectorate 1885,115). It is likely that, as at Elterwater (Jecock *et al* 2003, 41), the retorts were located away from the powder manufacturing area

and were associated with a coppice barn. Tyler (2002, 204) states, but does not give his authority, that charcoal production ceased at New Sedgwick following the 1884 fire and that charcoal was subsequently obtained from Wilson Bros. of Garston near Liverpool. According to James Willacy by the early 20th century lump charcoal was being supplied locally, but the MMB still lists Wilson's Flake charcoal (and Glen's Stick charcoal) among the ingredients. James Guy remembers charcoal for the site being brought by rail to the siding at Hincaster Junction.

The first charcoal house burnt down in October 1884 when unground charcoal (there was also a small amount of ground charcoal) being stored in it appears to have caught fire by spontaneous combustion (Explosives Inspectorate 1885, 115). Its exact location is uncertain but its replacement was set apart from the other buildings to the north west of the saltpetre house. This second store is depicted by the OS on both the second (revised 1896) and 1914 editions of the 25" mapping. On the site plans of 1900 and 1903-12 it is numbered 21 and labelled 'Charcoal House'. From the map evidence it appears to have been a small rectangular building measuring no more than 5m by 4m. It stood on a raised area of ground which now forms part of an enclosed yard on the south side of the caravan park reception block; no traces survive on the surface. Latterly charcoal appears to have been stored elsewhere on site and according to James Guy this took place in charcoal houses between the sawmill and the offices. This may account for one or more of the buildings in this area whose functions have not been identified by EH. His claim receives further support from the MMB where reference to 'the Charcoal Stores' is made, implying that more than one building on the site was being used for storage.

The sulphur store

There is no evidence that New Sedgwick ever had an independent sulphur house. At the time when the MMB was produced, the sulphur store was located in a compartment of the preparing house(4); the latter, apart from its turbine pit, no longer survives (see section 6.2.3 below). If sulphur was ever refined on site, it seems likely that this was another of the activities undertaken in the saltpetre building complex (see above); sulphur may even have been stored there during the early life of the works.

The 'Black Pot' building (3)

To the east of the saltpetre house, on the edge of the riverbank, are the remains of a small rectangular building which was first shown by the OS on the second edition of their 25" map (revised 1896); it was also included on the edition of 1914. It is numbered 31 and labelled 'Black Pot' on the site plans of 1900 and 1903-12. This name was incorrectly transferred to the saltpetre house on the plans in Wilson (nd), Patterson (1995) and Tyler (2002, 202). It is visible on one of the photographs of 1873-1875 (Fig 8), which shows it to have been a single-storey building with a gabled roof and weather boarded walls. A rectangular hollow, 5m by 3.5m and 0.3m deep, with a slight bank along its northern side, marks the site of this building. The OS maps also depict a rectangular structure adjoining its southern end. The former survives and consists of a large stone tank of coursed rubble, 1m high, with a rendered interior. Dribbles of pitch adhering to its northern end suggest that the adjoining

building had a felt and pitch roof. The name 'Black Pot' is known from at least one other gunpowder works, namely Melfort in Argyll (RCAHMS 1986, 162), but what the name signifies in terms of building usage is not known. Map evidence suggests that the plan of the New Sedgwick building, with its adjoining structure (tank), is not dissimilar to that of the blacklead store at Elterwater. The site plans consulted for this report do not ascribe this function to any of the buildings at New Sedgwick. Blacklead was certainly used in the glazing processes at New Sedgwick and the MMB states that it brought by tramway to the glaze house from the blacklead store; perhaps the 'Black Pot' was this store. Against this identification is the considerable distance between the glaze house(s) and the 'Black Pot', whereas at Elterwater, for example, the glaze house and blacklead store were in very close proximity to one another (Jecock *et al* 2003).

6.2.3 The manufacture of gunpowder

Buildings described in this section include the preparing house, the green and ripe charge houses, the incorporating mills, the press and corning houses (plus their power sources), the glaze and stove houses, the reel house, the dust house and associated electric motor house, and finally the heading house. The processes that were carried out inside them have been briefly described in section 5 above.

The preparing house (mixing house or black mill) (4)

The preparing house was situated on the west side of the leat near the southern end of the licensed area and is shown on the OS 25" map surveyed in 1857 as a narrow rectangular building measuring about 24m by 5m. It is also marked on all but one (CRO(K) WDB/35/564) of the 1859/1860 sketch maps. Its doors were forced open during the explosion at the incorporating mills in May 1869; according to the newspaper account of this event the side of the building which faced the mills lacked windows (*Westmorland Gazette and Kendal Advertiser*, 22 May 1869). The building was numbered 4 and labelled 'Preparing House' on the 1900 and 1903-12 site plans. Later editions of the OS map (Ordnance Survey 1898a; 1914a) depict the turbine housing as a subdivision of the main structure. A narrow extension to part of the south wall is also shown on the edition of 1914. All that survives on the surface is the turbine pit that was situated at its eastern end. The turbine drove an edge-runner mill that ground the charcoal and sulphur. The mill, which is described in the MMB, was overhead driven and comprised two cast-iron runners each resting on a cast iron bed plate. An open-ended sloping reel sieve and a circular mixing drum were also belt driven from the main line shaft. The preparing house would have been demolished when the works closed but any traces of foundations or of a building platform have been covered by upcast from the landscaping for the caravan park to a depth of about 1.2m.

The turbine pit is a stone-lined circular shaft, 2.3m in diameter. The walls of the leat some 2.4m south of the pit contain a pair of opposing grooves, one in each wall. They are the housing of a former sluice gate which when closed would have raised the water sufficiently to have entered the turbine pit via a short pentrough whose entrance is visible in the western side of the leat. The partial remains of a timber sluice gate, together with the iron rods that fixed the framework in position, are still *in situ* at the mouth of the pentrough. The latter, now

infilled with rubble, measures 1.85m across. The pit is divided into two parts by a vertical wall of timbers (possibly old railway sleepers) held in place by galvanised nuts and bolts to which the turbine fittings would have been attached. On the south side of the timbers the pit is filled with rubble, but the northern half is clear allowing an unobstructed view to the present base, which is 2m deep and where there appears to be a central metal fixing. Spent water from the turbine must have been taken in a culvert under the leat and into the main underground tailrace of the works (see section 6.2.1 above). Faulkner referred to the turbine in his notebook describing it as an 8-horse power 'bottom spiral turbine'.

The preparing house was linked to the saltpetre refinery by the tramway that ran along the entire northern front of the building; at the west end of the latter the tramway terminated at a short blast wall (Ordnance Survey 1898a; 1914a). The mixing house was one of the few buildings at the works that does not appear to have had a porch to provide shelter from the weather when loading and unloading goods. As it approached the preparing house, the tramway was taken across the leat on a pair of beams laid longitudinally. These were held in rectangular slots spaced 0.6m apart, which are still visible in the side walls of the leat, just below their tops. The tramway from the preparing house to the green charge house also crossed the leat, but a little further to the north and at an acute angle. The upper parts of the of the leat have been eroded in this area with the result that the slots which supported the beams may not survive; however, part of the cutting for the tramway can be seen on the west side of the leat.

The green charge house (5)

The green charge house was erected on the eastern side of the main leat some 40m to the north north east of the preparing house, midway between the latter and the incorporating mills. The OS surveyed it in 1857 as a small rectangular building measuring 4m (north to south) by about 3.75m, but it was not shown on the 1859/1860 sketch maps. A building here of similar size is also depicted on the second edition of the OS map (revised 1896) but its plan position does not quite correspond to that of the 1857 building (it is more to the south), strongly suggesting that it had been rebuilt by 1896. Perhaps this rebuilding was in response to the requirements of the tramway; the latter was probably installed after 1864 and in this part of the works it lay between this charge house and the leat. The second edition map also depicts a long porch extending across the tramway from the western side of the green charge house. In addition, a narrow rectangular feature abutting the building on the east is also shown (it is also on the 1914 edition of the map), perhaps it was a loading or access area. The building is labelled 'Green Charge House' and numbered 5 on the site plans of 1900 and 1903-12.

The charge house proper no longer survives but the three blast walls and blast bank revetment that surrounded it are well preserved (Fig 16). The building was presumably of timber and was cut into (or partly enclosed by) the south-western end of an earthen blast bank, a maximum of 4.8m high but which gradually tapers away to the south. Immediately adjacent to the charge house, the cutting into the blast bank is revetted with stone to a height of 1.1m. At its west end the revetment butts against a short blast wall (the northern blast wall)

Figure 16.
The site of the green charge house from the south east. (NMR: AA012875)

of coursed rubble, orientated east to west and measuring 3.6m long, 1.9m high and 0.6m wide. Another blast wall (the western blast wall) lies to the south of the west end of the northern blast wall and is separated from the latter by a 1.2m wide gap. It seems quite likely that the inner face of the western blast wall formed one side of the charge house, which must have butted up against it. This blast wall is 2.6m high and 0.6m wide and has the remains of a doorway in its centre that presumably allowed entry to the building from the tramway. The lintel and stonework above the doorway has recently collapsed. The northern end of the wall exhibits a curious form of construction because its upper part has been built on top of a crudely formed buttress. The latter, together with the curving course of the revetment of the blast bank, has the effect of reducing the width of the gap between the ends of the western and northern blast walls - a surprising feature if this gap also served as an entrance. An iron hook fixed into the end of the wall above the buttress also survives. At the southern end of this blast wall there is a butt joint where another wall (the southern blast wall), orientated east to west, joins it on the east. This third blast wall is also 0.6m wide and now tapers (west to east) from 1.3m to 0.5m in height. At the east it terminates before reaching the revetment wall of the blast bank providing a 1.9m wide entrance into the area occupied by the east end of the charge house.

The actual site of the charge house between the blast walls and revetment had been cleared of leaf mould and accumulated debris by the National Trust just prior to the EH survey. This revealed a central rectangular depression, 2.4m by about 3m, divided into two, almost equal parts by a dwarf wall, height and width both 0.4m, and orientated east to west. These features probably helped to support the floor of the building and provide an air space underneath for ventilation. On the east, between the central depression and revetment wall of the blast

bank, clearance has also revealed footings of a possible wall, aligned north to south; it may have supported the end wall of the charge house. Dribbles of pitch are visible in places on the stonework of the northern and western blast walls indicating that the charge house probably had a felt and pitch roof. Material cleared form the interior of the building by the National Trust volunteers has been dumped about 12m to the east where it forms a small mound.

The incorporating mills (6 and 7)

The nine incorporating mills, in two ranges set at an angle to each other and separated by a blast wall (Fig 17), were built in three stages. The original range of six mills, 1-6, were built in 1857, and are shown on the OS 25" map surveyed that year. They were also depicted and labelled 'Grinding Mill(s)' on the 1859/1860 sketch maps. Mills 7 and 8 (and the blast wall) were constructed sometime after the change in the ownership of the gunpowder works in 1864 (Imperial Chemical Industries 1929, 342). They were referred to as 'two recently erected mills' in a newspaper article of 1869 (*Westmorland Gazette and Kendal Advertiser*, 22 May 1869). Mill 9 was added later; it is not visible on the 1873-1875 photograph of the main part of the works, but must have been in existence by 1889 because it blew up in that year (see below). All nine mills are shown on the OS second edition 25" map revised in 1896, and again on the 1900 and 1903-12 site plans, on which they are labelled and numbered 6 (mills 1-3), 7 (mills 4-6 and waterwheel house) and 8 (mills 7-9 and waterwheel house). Each mill contained an edge-runner mill, comprising a circular iron bed plate around which rotated a pair of heavy iron wheels or grinders. The mills were powered from below via a line shaft from a waterwheel. The machinery of mill 3 was dismantled at some time between 1906 and the production of the MMB thereby reducing the number of available mills to eight. All the mills had electricity by the time the MMB was prepared; this was used to provide lighting just outside the windows. It is not clear when the original mills commenced production, Tyler (2002, 197) says that there was limited production in 1858 but does not give the authority for this information. However, it is stated in the *Westmorland Gazette and Kendal Advertiser* (25 June 1864) that the incorporating mills have 'only been in operation five years', suggesting that actual production may not have really got underway until 1859.

The incorporating mills were involved in a large number of explosions. One of the mills of the original group was damaged in an explosion in 1859 (*Westmorland Gazette and Kendal Advertiser*, 24 September 1859) but a much more serious ignition occurred in 1869. It started in either mill 7 or 8 (where very strong 'sporting' powder was being produced) and spread to all the other mills causing serious damage (although it was expected that most of the mills would 'be at work again in a fortnight or so') and fatally wounding one of the workers (*Westmorland Gazette and Kendal Advertiser*; 22 May 1869; 5 June 1869). In contrast an explosion in one of the mills in 1872 caused only 'some damage to the mill itself' (*Westmorland Gazette*, 31 August 1872). Four explosions occurred between 1877 and 1879 and two in 1882 (Patterson 1986, 29); one of the 1878 explosions affected all the mills in the early range (Explosives Inspectorate 1879). In the Patterson Collection, held by the National Monuments Record at the NMRC, Swindon, there is a handwritten note (referring to the Explosives Inspectorate) that in 1889 all nine mills blew up but there were no injuries.

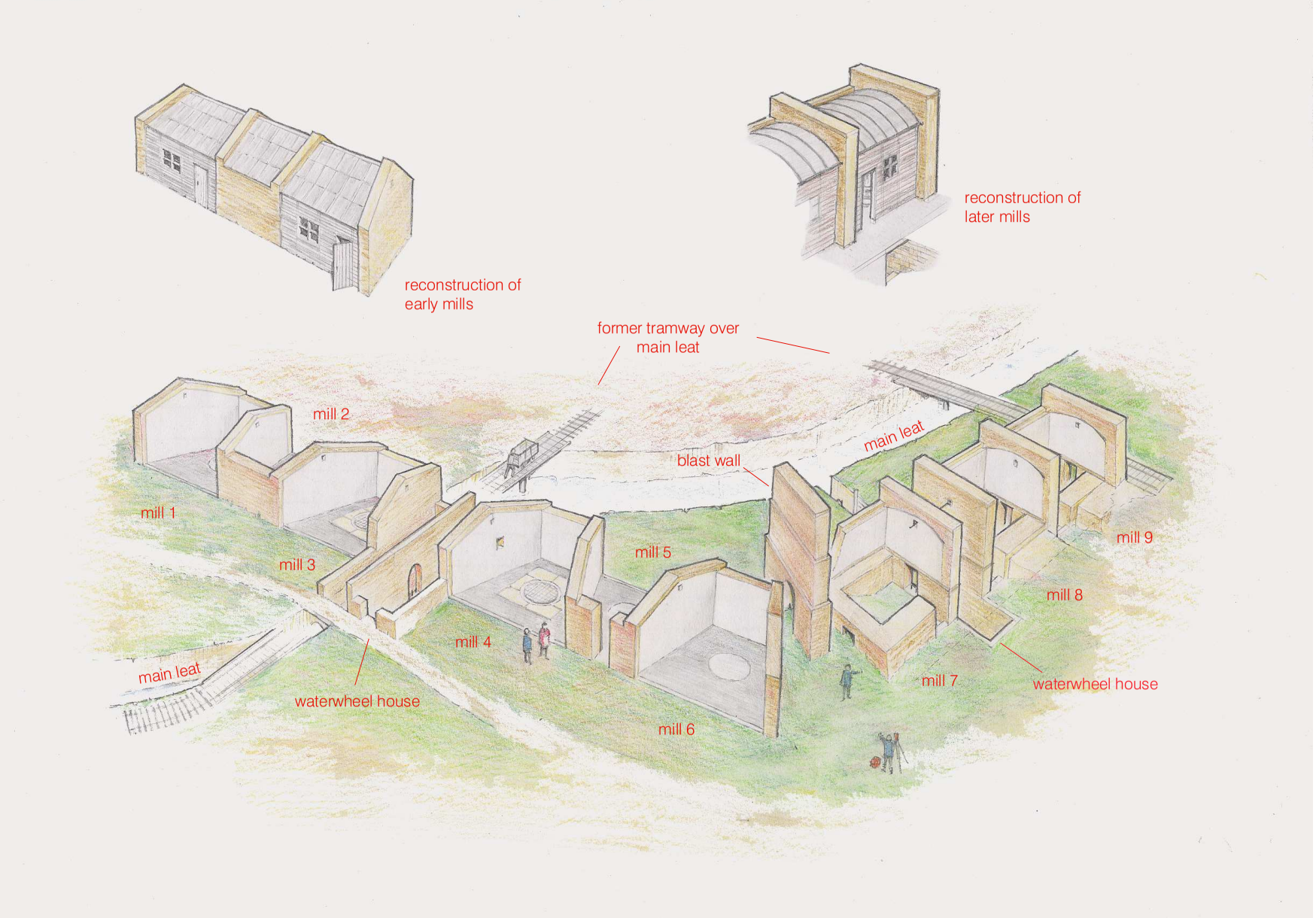

Figure 17. *Partial reconstuction sketch by English Heritage of the incorporating mills*

There were single explosions in 1894, 1898, 1900 and 1904 while four of the mills (1, 4, 8 and 9) blew up following lightning strikes in June 1906 (Patterson 1986, 29; Explosives Inspectorate 1906, 3-4). There were two explosions in both 1912 and 1915 followed by one in 1917 and two in 1918. No further explosions are listed by Patterson (1986, 29) at the incorporating mills until 1928 (but a handwritten note in his collection refers to an explosion in 1919 while 'removing clinker (hard compacted powder) from mill bed') when there was an explosion followed by another in the next year; there were also two further explosions in each of the following two years (1930 and 1931).

Incorporating mills 1-6 (6) (Fig 18)

Incorporating mills 1-6, erected in 1857, are built in a single row with two sets of mills, 1-3 and 4-6, either side of a central waterwheel house (Fig 19). The area occupied by mills 1-3 has been dug out of the lower part of the natural slope that rises above the terrace on which the main part of the works is situated. The cut edge of the slope is revetted by stone walling north of mills 1-3 and also to the south of mill 3. The mills are substantially built of coursed stone rubble but survive in varying states of disrepair, all roofs having gone, some walls obscured, some demolished and others reduced in height. Mill 1 is almost entirely covered by dumping and landscaping for the road above it, but the position of its buried western wall is just discernible as a slight break in the face of a scarp extending down from the road. The interiors of three chambers (3, 4 and 5) are clear, but rubble overlies those of the others. The two sets of mills are identical in plan, each having three trapezium-shaped chambers with alternate chambers facing in opposite directions. Mills 2 and 5 face north, their splayed side walls shared with the south-facing mills which flank them. The stone walls of the chambers, thicker at the rear than at the sides, were intended to contain the force of accidental explosions, the splayed sides serving to spread the force of any such

Figure 18.
Incorporating mills 1-3 from the west with waterwheel house and other mills in background (chamber of mill 1 in left foreground almost completely obscured by dumping). (NMR: AA012884)

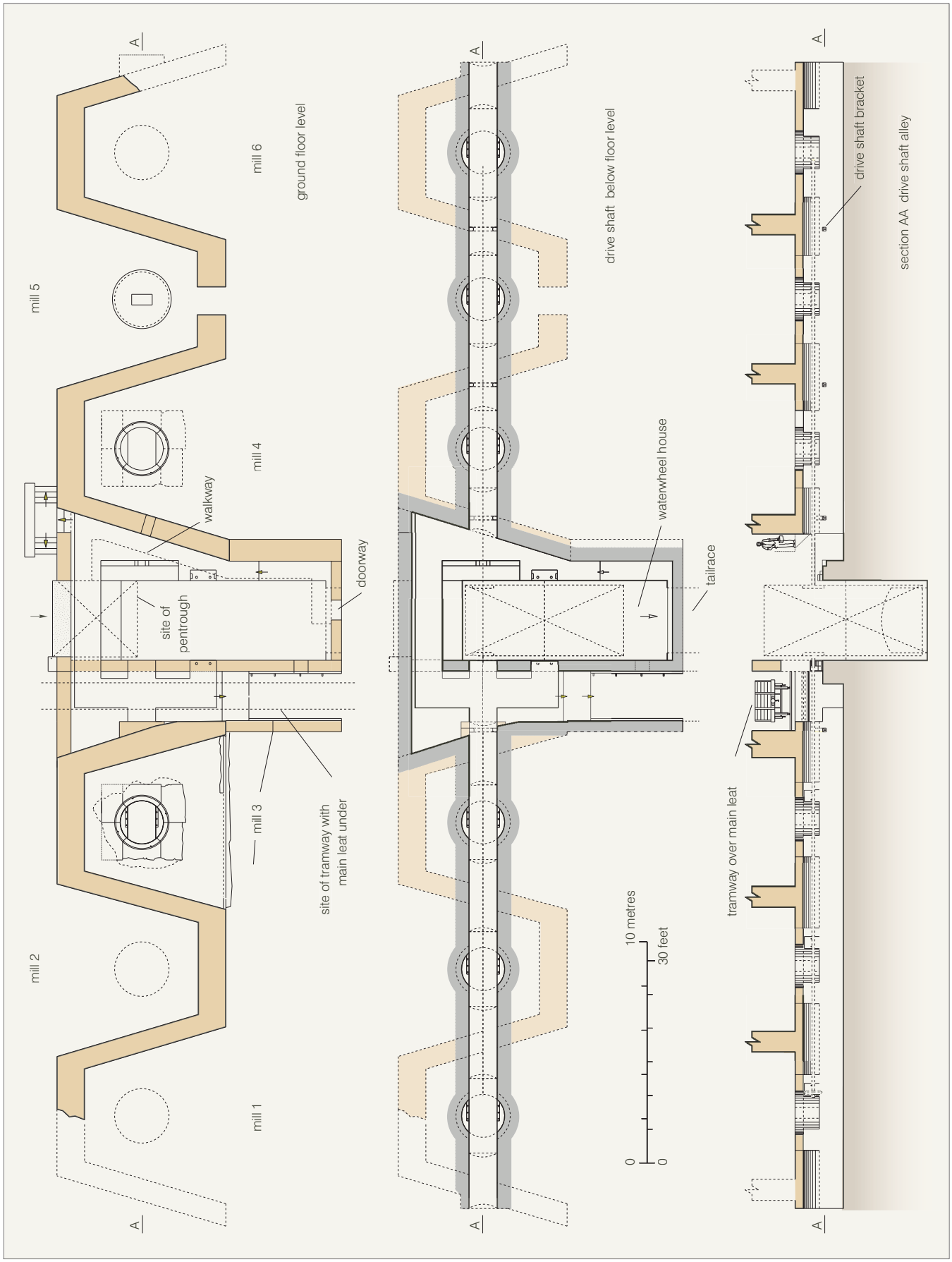

Figure 19. *English Heritage plan of incorporating mills 1-6 and waterwheel house*

occurrence. The masonry within each chamber was rendered to provide the smooth surface that was vital in order to exclude ledges or irregularities where gunpowder might settle and pose a threat to safety. The render survives incompletely, but in several mills it can be seen to stop in a vertical line close to the front, in a position where there was a post forming part of the front of the chamber. The fronts of these chambers were constructed of the flimsiest material possible in order to offer minimal resistance in the event of an explosion; it was reported in 1895 that the fronts of some incorporating mills at the Royal Gunpowder Works at Waltham Abbey, Essex, were of canvas buttoned to a slight iron framework (Fitzgerald 1895, 310). At New Sedgwick the framework may have been of wood; plugs in some wall faces would have allowed posts to be secured, and a slot in concrete across the front of mill 3 retains part of a timber beam at its eastern end. The roofs of incorporating mills were also flimsily built, for the same reason as the fronts - at Waltham Abbey they were of wood (Fitzgerald 1895, 310). The detailed form of the roofs at New Sedgwick is not known, but it is clear from the surviving structure that each chamber had a pitched roof, and that the side walls rose above this. The evidence for this is best preserved in the east side wall of mill 3, which retains parts of an iron-framed roof as well as a short length of masonry above the roof, immediately north of the gable apex. This wall, which flanked the main leat (that here ran between mill 3 and the waterwheel house), appears to have had a flat top. However one of the National Trust photographs taken in 1977 shows that this is merely the result of later consolidation and that originally mill 3 had sloping gable walls on both sides; the side walls of the other mill chambers were probably of similar form. None of the walls of these mills retains any coping, although it is known that there was once some, since an explosion in mill 1 in 1906 split the substantial flagstone copings on its side walls from end to end (Explosives Inspectorate 1906, 4).

Figure 20.
Incorporating mill 3, general view from south. (NMR: AA012870)

The chamber of mill 3 is the only one to retain significant evidence of the former roof (Fig 20). Embedded in the inner face of the east wall are the sawn-off ends of two purlins of 'L'-shaped angle iron, one at the apex of the roof, the other supporting the north slope, and two purlins of 'T'-section angle iron, one mid-way down the south slope, the other close to its base. The opposite end of the last of these purlins survives in the opposing side wall of mill 3. Sitting on the purlins in the east wall is a wrought-iron rafter in two lengths, one per slope, which overlap at the apex. The rafters are iron rods with expanded and pierced terminals at both ends and double-pierced expansions over the mid-span ridge purlins. The pierced holes were for wrought iron hook-ended bolts which secured them to the purlins. The iron purlins must have spanned the chamber, but how many iron rafters there were is uncertain, but the combined purpose of this ironwork was to support the roof covering. Fragments of iron sheeting projecting from the north slope of the east wall, above the iron purlins, may be weathering to prevent rainwater seeping in at the junction between the roof and the wall. At the rear of the chambers, the wall top continues the slope of the former roof.

The disrepair of the masonry of the incorporating mills has revealed that a combination of cast-iron and wrought iron fittings and timber beams was used to bind the stone rubble structure together in order to give it strength and make it more able to resist the potentially destructive effects of any accidental explosions. The side walls of mill 3 retain timber beams set close to their wall tops and following the incline of the slopes. Close to their base they are held down by substantial cast-iron shoes which sit over them, each one held in place by a spiked bolt driven through the centre. The upper ends of the beams cannot be seen. Flanges on the top of the bottom sets of shoes enabled iron tie rods that spanned the full width of the rear of each chamber to have their outer ends secured. There is no evidence that equivalent rods spanned the front of the chambers, but the remains of rods survive at the rear of mills 2, 3 and 5. The upright tie rods with pierced expansions for wedges, and 'T'-shaped feet, which acted as anchors, survive at the junction of one or both side walls and the rear walls of mills 1, 2, 3, 5 and 6. They were also set at the apex of the side walls in a 'V'-shaped arrangement, as indicated by both *in situ* and *ex situ* ironwork. The 'V' shape served to link both slopes and to reinforce the structure of the whole.

The six incorporating mills each housed an edge-runner mill which was set in a cast-iron housing bolted to a substantial stone base and powered from below (Fig 21). A large fragment of one of the iron edge-runners lies to the south of the waterwheel house (Fig 22); when complete this edge-runner must have measured about 2.24m in diameter. The interiors of the chambers of mills 3, 4 and 5 have been cleared, and in both 3 and 4 the massive limestone flags which form the base can be seen. Six flags form each base and around the central hole there is a groove for the base of the edge-runner mill which was secured by being screwed down to four iron bolts set in the flags. The flags are overlain in both chambers by black ash floors which must once have run up to the machinery. In mill 4 this floor overlies an original concrete floor. It is possible, however, that the ash floors are simply deposits from the wood which was stacked in the mills and burnt when the licensed area was made safe following closure of the works in 1935 (see James Guy's recollections at the end of section 4.2 above). The interior of mill 5 (and possibly also mill 6) has a concrete

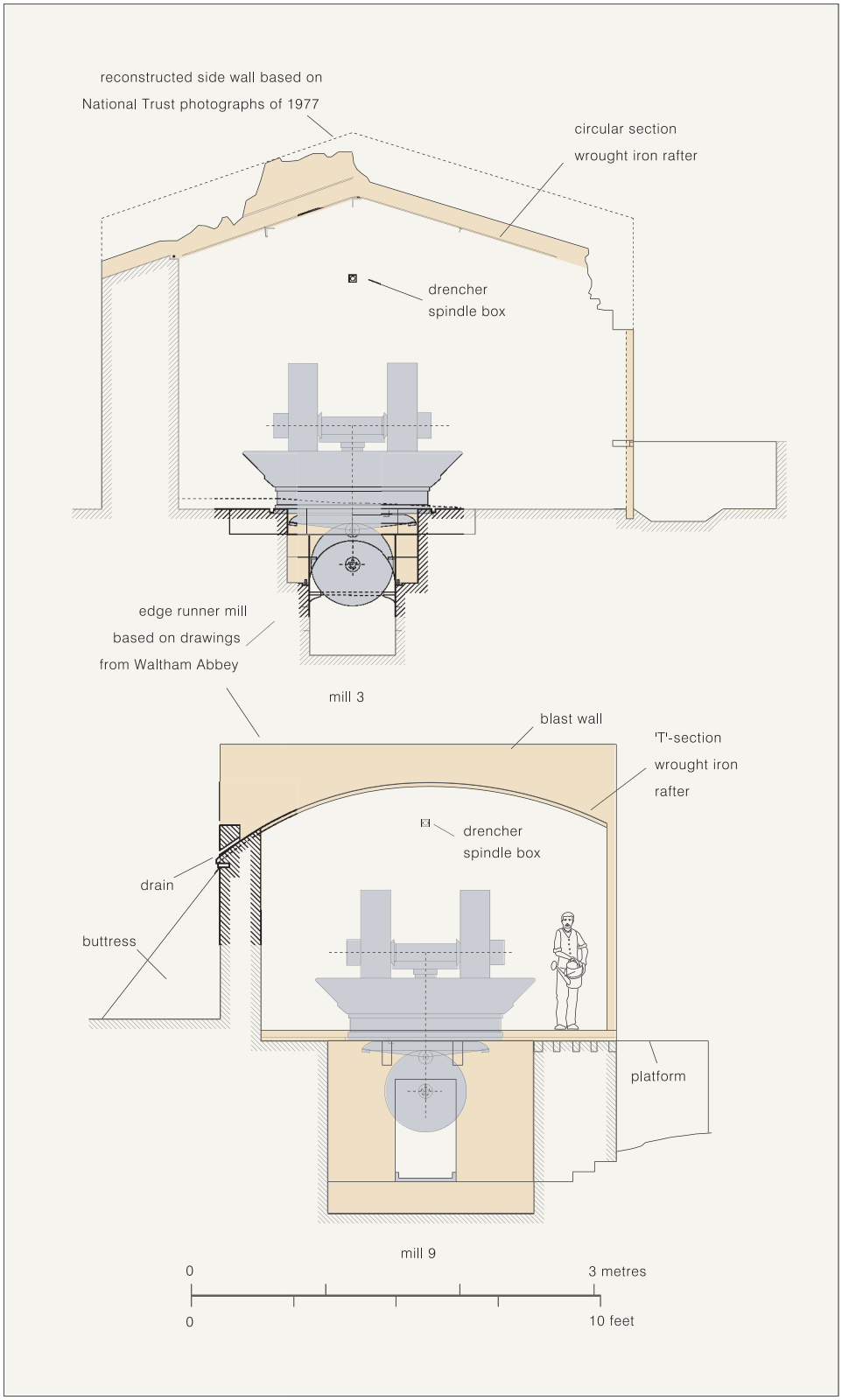

Figure 21. *Cross sections through incorporating mills 3 and 9 by English Heritage (partial reconstruction to show edge- runners and drive shafts)*

Figure 22.
Detail of iron edge-runner fragment outside waterwheel house of early range of incorporating mills. (NMR: AA 012876)

plug over the central hole: this may, like the shuttered concrete-lined gap cut through the rear wall of mill 5, date from the military occupation of the site during World War II. The south-east corner of the chamber of mill 3, and the south-west corner of mill 4, in other words the outer chambers of the casing flanking the waterwheel house, have cast iron fittings which might have held the wheels which started and stopped the power in the two sets of mills, as at Waltham Abbey (Fitzgerald 1895, illustration no. 8)

The six incorporating mills were all underdriven, separate line shafts set in tunnels under each set of three mills driving the machinery in them. The tunnels, which are built of stone rubble, are vaulted except in the chambers below each incorporating mill where the stone flags double as their covering. The line shafts have been removed, as has the gearing associated with each mill. However, cast iron beams which spanned the alley and supported the line shaft survive in incomplete form in both tunnels, and cut-outs in the masonry, and associated iron bolts, must have supported the horizontal bevel wheel and the associated friction clutch which once existed under each mill (cf Cocroft 2000, figs 3.15,16).

The risk of an explosion was ever present in incorporating mills, and to counteract this flashboards or drenchers were placed over each incorporating mill. In the event of an explosion, the flashboard was violently thrown up on hinges and in its descent backwards it automatically overturned tanks of water not only over its own bed but also over that of neighbouring mills (Fitzgerald 1895). At New Sedgwick the two sets of mills each had their own separate sets of drenchers, the evidence for which survives in the side walls of several chambers. In these, rectangular-sectioned cast-iron boxes pass through the walls, on the line of the centre of the mills below, their purpose being to support the spindle of the drencher which revolved in a timber housing. A box, *ex situ*, is 1.04m long and 0.13m square externally. The spindle fitted a void in the wood, 0.06m in diameter.

The waterwheel house (Fig 23) was located between the two sets of incorporating mills and projected south of them while the main leat ran along the outside of its west wall. The roof no longer survives, but its line on the outer face of the side wall of mill 4 is clearly visible on one of the National Trust photographs taken in 1977. It shows that it must have been a sloping roof falling from north to south. The wheel pit is rectangular in shape and has vertical walls of stone rubble except at its north end where a curved ashlar wall reflects the curve of the waterwheel. Steps are visible just outside the waterwheel house near the north-west corner of mill 4. They probably gave access to walkways, needed for maintenance, along the northern and eastern sides of the wheel pit; they are level with the base of the two line shaft tunnels. The northern walkway also provided access to that part of the western line shaft that lay below the leat. Water was led on to the waterwheel through an inlet, now blocked, at the north end of the wheel pit. Spent water went through an archway at the base of its south wall into the underground tailrace which in turn discharged into the main culverted tailrace of the works (see section 6.2.1 above). The waterwheel must have been fed with water through a pentrough, and it was probably breastshot. The waterwheel itself has been lost, but ashlar blocks with pairs of bolts to secure the bearings that supported the axle still survive. The eastern block is set in the floor of the eastern walkway, the western one in a round-headed opening in the wall of the waterwheel house. The largest waterwheel that the wheel pit could have accommodated would have been about 7.6m (25ft) in diameter and 3.2m (10ft 6in) across. Wilson (1964, 61), however, claimed that it was 36ft (10.97m) in diameter; perhaps he mistakenly gave the overall length of the wheel pit rather than the maximum diameter of a wheel which could be operated in it. Further blocks are present towards the north end of the wheel pit: that to the west is of stone and set in another round-headed opening; that to the east, a later concrete renewal with a cast iron mount in its top, rising from the floor of the walkway. The blocks supported the housings for the line shafts, power was taken from a ring wheel fitted to each side of the waterwheel to drive the line shafts under each set of incorporating mills. The western block still retains a short length of the line shaft, sawn off and set in its iron housing. Beam sockets, possibly supports for an upper walkway, are visible in the east wall of the waterwheel house.

The main leat passes between mill 3 and the western side of the waterwheel house, and leads south to various buildings lower down the site. Its northern section crossed both the line shaft to mills 1-3 and also the end of the waterwheel axle, presumably by means of a short timber trough. The depiction of the leat on the OS 25” maps suggest that in 1857 it was an open channel but that it had been covered over, perhaps with timbers, by the time of the revision for the second edition in 1896. The later editions also show the tramway from the green charge house passing between the mills, and running along the top of the covered leat on its eastern side, on its way to the ripe charge house. Four ‘U’-shaped iron brackets, which clearly supported a timber beam that was possibly connected with the tramway, survive in the outer face of the west wall of the waterwheel house. According to the MMB, bogies were brought along the tramway to a point between mills 3 and 4 where the ripe charges were loaded and the green charges unloaded.

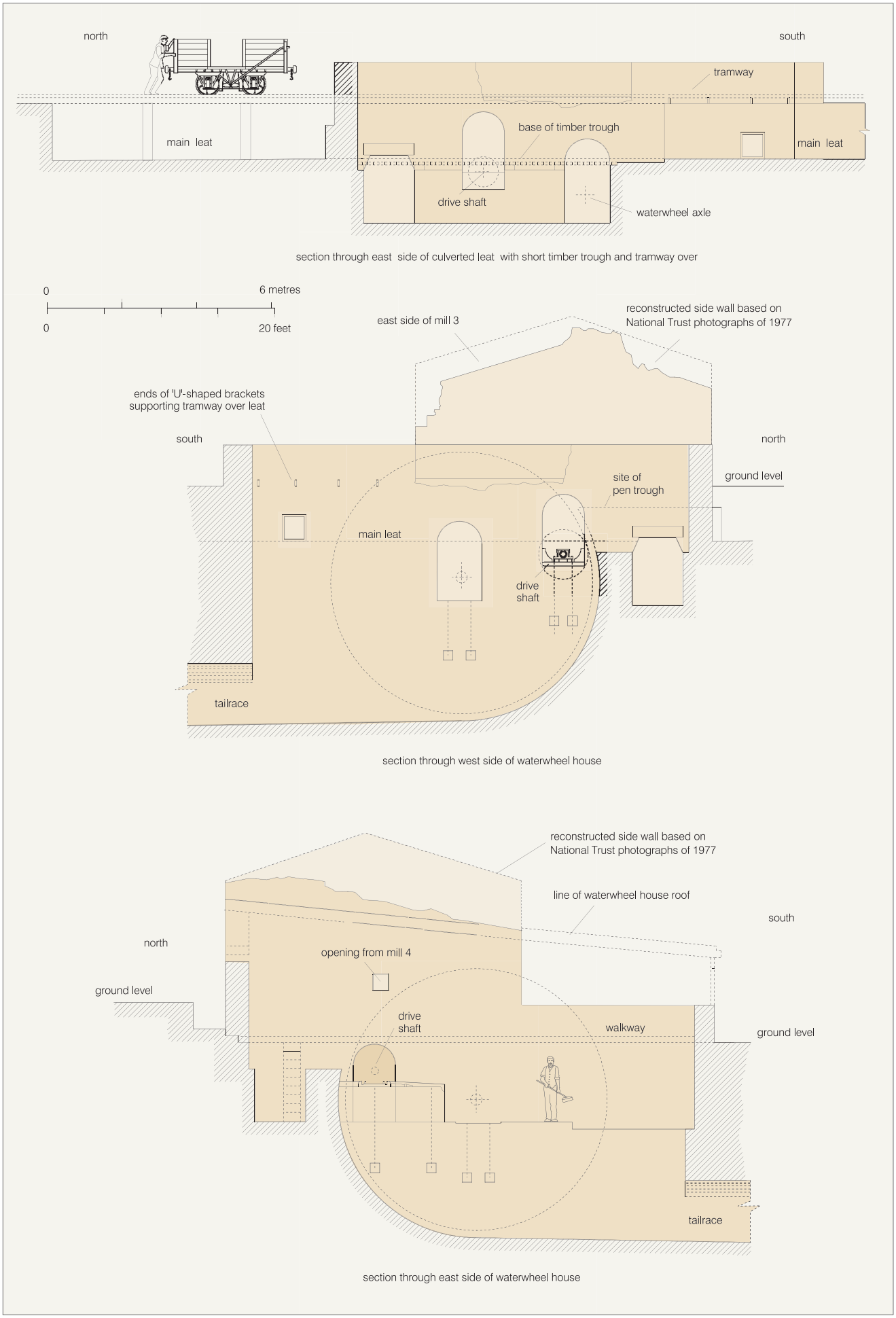

Figure 23. *Cross sections by English Heritage through the waterwheel house and along the main leat between incorporating mills 3 and 4 (some features partially reconstructed)*

Incorporating mills 7-9 (7) (Figs 24 and 25)

Incorporating mills 7 and 8, and the waterwheel house between them, were built in the late 1860s, shortly after the change of ownership of the gunpowder works in 1864. The explosion of 1869 destroyed part of one of the side walls of the mills and smashed the machinery (*Westmorland Gazette and Kendal Advertiser*, 22 May 1869). The newspaper account also refers to some of the felt roofing being lodged in the tops of trees and to the iron sheeting (front walls) of the mills being blown a considerable distance. These two mills were obviously repaired and a third incorporating mill, 9, was subsequently added to the north east; it must have been erected by 1889 because all nine mills at New Sedgwick exploded in that year (note in Patterson Collection).

Figure 24.
Blast wall (left) and incorporating mills 7,8 and 9 from the south east. (NMR: AA 012873)

Separating the original and later mill groups is a stone blast wall, rising above the height of the mills. It is shown on both the 1898 and 1914 editions of the OS 25" map, and also on the site plan of 1903-12. Constructed in three tiers for stability, access between mills was maintained via a skewed archway through it which was aligned with the north wall of incorporating mills 1-6.

Incorporating mills 7 and 8 (Fig 26) are built of rock-faced rubble, the stones at the corners with distinctive dressed-back edges, but as with the earlier incorporating mills they survive in a state of disrepair with some of their walls lost although they retain a little more evidence of their roofs. The chambers of the mills are rectangular in plan and face to the south east. The side and rear walls are of differing thickness, the walls also stepping back at the level of the now largely lost internal floors. The masonry within each chamber was plastered up to a vertical edge close to the front, which will have had a flimsy covering. The side walls of the two mills rose to flat tops; stone coping with chamfered edges survives on the north-east

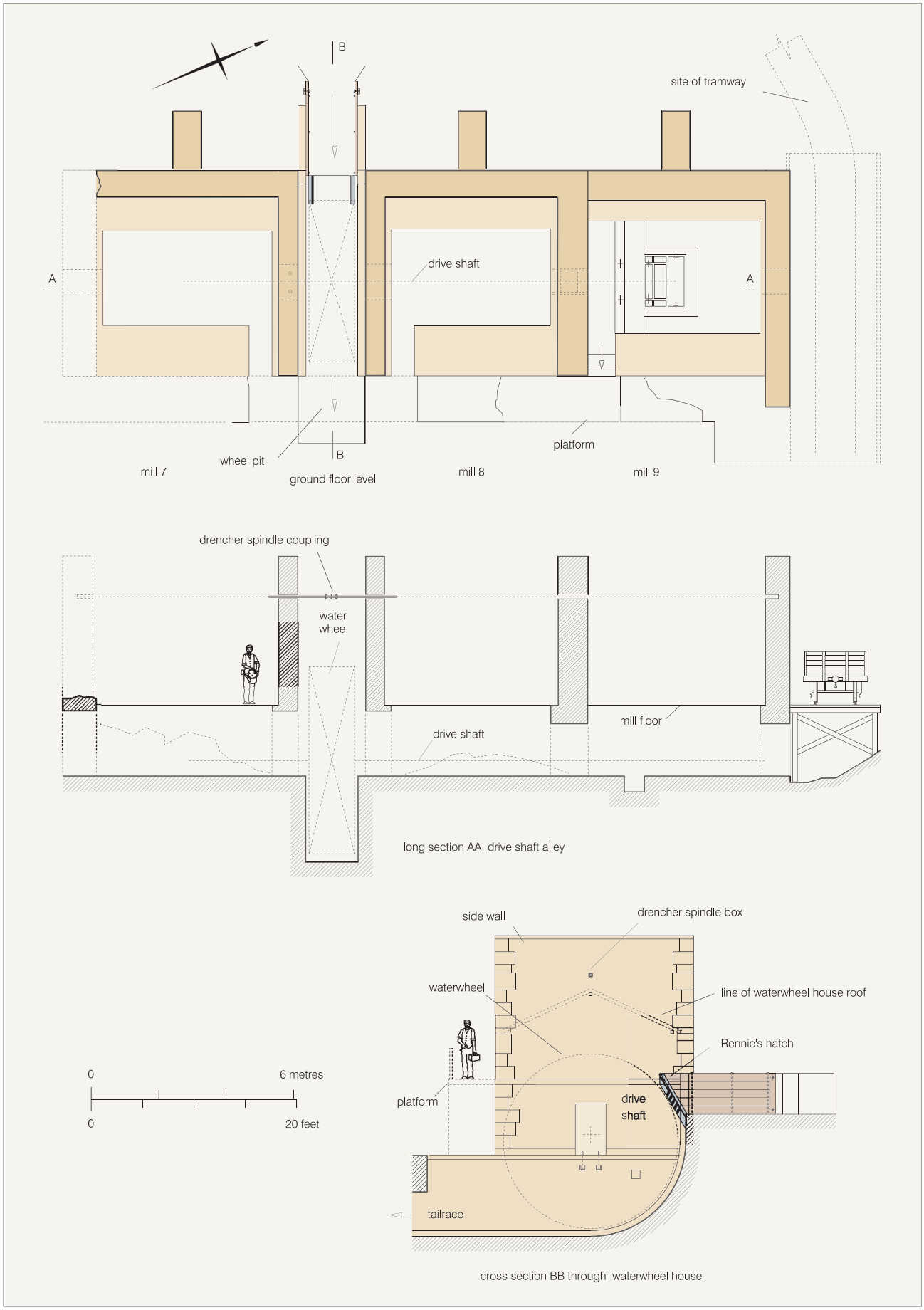

Figure 25. *English Heritage plan and sections of incorporating mills 7-9 and waterwheel house (partial reconstruction to show tramway and platform)*

Figure 26.
Incorporating mill 8 from the east. (NMR: AA012895)

side wall of mill 8. The exterior of this mill is visible in one of the 1873-1875 photographs which shows what appears to be a timber front with at least one window in the upper part of the structure. The roofs of the chambers were iron-framed and were gently curved. Mill 7 retains the most complete evidence. Set against the north-east wall is a 'T'-sectioned iron rafter in a segmental curve made in two lengths joined at the centre. The rear end of this strap projects through the rear wall where its curved end sits on the top of a further horizontal 'T'-sectioned iron strap which is faced against a length of timber set in the wall. The ends of four further 'T'-sectioned iron rafters survive in the rear wall but they do not project far into the chamber. A small tie rod set mid-way round the rear curve projects into the chamber from the rafter against the side wall, and was part of the roof structure, no doubt giving rigidity to it. The iron roof of mill 8 has largely been lost - the side walls have curved marks in the plaster, a second, lower curve on the south-west side wall having nine evenly-spaced iron eyes above a curved 'T'-section strap. The north-west wall has no matching lower curve, just the equivalent upper curve in the plaster.

The edge-runner mills that were used in the mills were underdriven, but there was no shaft tunnel. Instead the side walls of both chambers have square-headed openings, larger beside the waterwheel house than at either end, which supported the drive shafts. The chambers had floors, the original ones replaced by reinforced concrete floors that now only survive around the edges. The upper course of masonry was removed when the new floors were created. The chambers had drenchers: the side walls have holes for the spindles, a length of cast-iron spindle set in a copper sheath projecting into mill 7.

The rectangular waterwheel house set between the two mill chambers has opposed flat-headed openings in the side walls to support the axle of the wheel, the opening to the south

west with two screw-threaded bolts which held the axle bearing box in place. The wheel pit has the remains of an adjustable sluice gate which according to Tyler (2002, 198), was a Rennie's Hatch opening off the headrace with water draining out of the wheel pit through a square-headed opening. The wheel pit could have accommodated a waterwheel measuring up to 4.57m (15ft) in diameter and 1.37m (4ft 6in wide.

Incorporating mill 9 was added to the north-east end of mill 8. It is similar in form to mills 7 and 8 in having a rectangular chamber, curved roof and a flat-topped side wall with edge-chamfered stone coping. The interior of the chamber has plastered walls and boxes for a drencher. It has been cleared of debris by the National Trust down to the bottom floor level where there are sandstone flags with four bolts next to a rectangular slot for an upright wheel driven by a line shaft. This arrangement may be secondary, since this mill exploded in 1906. A square-headed opening in the north-east wall suggests that the line shaft may originally have run this far to an end support. A fragment of the iron-framed roof with parallel straps linked by cross rails and saltire bracing survives loose on the ground behind the mill. The north-east side wall of the latter projects beyond its front face to screen a platform (see below) in front of the chamber, which passed round the front of it to reach the tramway which maps (Ordnance Survey 1898a; 1914a) and the site plan of 1903-12 show served it. Around the northern end of mill 9 is a deep cutting to allow access to the underground gearing; the tramway must have been carried over this by means of a small viaduct, although no traces survive.

In front of the mills there was an access platform, level with the main working floor of the chambers. It is shown on the OS 25" maps of 1898 and 1914 with a slightly wider area at the north-east corner of mill 9 in order to facilitate loading and unloading from the tramway. Remains of the platform consist of wall fragments that either butt against the external structure of the chambers or edge a raised area, about 1.4m wide, in front of them. It is uncertain if the building of that part of platform which fronts mills 7 and 8 was contemporary with them or whether the whole of the structure was constructed when mill 9 was added. There was a similar platform associated with the southern incorporating mill group at the Basingill Works (Hunt and Goodall 2002, 27).

The ripe charge house (8)

The ripe charge house lay a short distance north of incorporating mills 1-6 and to the south of the unnamed southern stream which crosses this part of the site; the building was surrounded by a series of five separate blast banks. It was not shown on the first edition of the OS 25" map or on the 1859/1860 sketch maps but is depicted on the later editions of the OS map (Ordnance Survey 1898a; 1914a). It must have been in existence by 1874 when a tramway was laid from the 'the charge house' to the lower expense magazine which was being constructed at the time (*Westmorland Gazette*, 7 August 1875). On the site plans of 1900 and 1903-12 it is numbered 9 and labelled 'Ripe Charge House'. It was only about 12m away from the nearest incorporating mill which is perhaps surprising given that an Act passed in 1772 stipulated that gunpowder magazines or storehouses had to be at least 50ft (45.7m) from mill buildings (Cocroft 2000, 28). The building no longer survives, but

map evidence indicates that it consisted of a main store, measuring about 4.5m by 4m, with a rectangular structure, probably a porch, butting against its north side and projecting beyond it to the east where it covered part of the tramway leading from the early range of incorporating mills. Immediately beyond the north-east corner of the porch the OS maps also show a short tramway that ran east across the main leat and along the side of mill 9 thereby linking the later range of incorporating mills with the ripe charge house. Between the ripe charge house and the main leat this tramway survives partly as a broad cutting edged by blast banks and partly as a slight terrace bounded to the north by a south-facing scarp, 0.5m high. The main tramway is shown on the maps leaving the north-west end of the porch to continue its route in a northerly direction towards the powder press house. About 15m beyond the ripe charge house a short spur left the tramway to serve the lower expense magazine.

A large blast bank, 3.7m high, to the south west shielded the ripe charge house from any explosion at incorporating mill 2; in order to maximise the protection afforded by the blast bank, the ripe charge house was built or cut into its side, in a similar fashion to the green charge house. The lower part of the cut scarp into the blast bank is stone revetted to a maximum height of 0.7m. The western arm of this scarp continues northwards in more reduced form and away from the site of the ripe charge house to define the western edge of the tramway heading north; in places revetment walling is visible. Occasionally the southern stream overflows along the route of the former tramway and across the site of the green charge house (where it has created a curving hollow) to discharge into main leat. There are four other blast banks, the high number made necessary by the presence of the southern stream which bisects the area. They vary in height, measuring between 1.4m to the south and 1.9m to the north. Only one of these blast banks, on the north side of the stream, is shown on the OS 25”maps revised in 1896 and 1912. Traces of stonewalling indicate that the inner face of the south-east blast bank was also revetted. A line of set stones, 2m long, 0.3m wide and 0.1m high, are visible about 3.5m north of the western end of this bank; there purpose is uncertain but they might be wall footings.

The powder press houses (9 and 10)

The powder press house was initially situated adjacent to the corning house. Field evidence indicates that the overall area occupied by these buildings had been excavated to form a broad depression in which to site them, presumably to help contain the effects of any explosions. In places this lowered area, especially where the natural slope of the valley side has been cut into, is over 2m deep; it is revetted principally to the south, west and north where the excavation is deepest. A massive blast bank crosses the central part of the lowered area west-north-west to east-south-east and rises above the other revetment walls (Fig 27). The feature is original, appearing on the first edition OS 25” map but has undergone modification. The structure is trapezoidal in section and comprises a huge earthen bank contained by a series of revetment walls. The eastern and western ends of the bank are revetted with a gabled wall; the eastern one has been strengthened by a secondary stone wall, itself supported by later stone buttresses. The northern side of the bank was originally contained by a stone wall with a batter, the top of the wall protruding above the summit of

Figure 27.
Blast bank between first powder press house and corning house , from the south east. (NMR: AA012916)

the bank and thus forming a slight parapet. Against this wall is a second revetment wall, this one vertical, which is slightly lower than the original leaving a narrow terrace along the upper edge of the blast bank. On the southern side, the earth bank slopes down more gradually until it meets a less substantial revetment wall, 1.1m high. This represents a later broadening of the blast bank that up to 1912 (Ordnance Survey 1914a) appears not to have extended beyond the line of the revetment walls at either end. There was a 'truckman's shelter' built against the blast bank at the time of the 1903 glaze house explosion (Explosives Inspectorate 1903, 5).

The siting of the press and corning houses so close together was a very dangerous arrangement which meant that if one exploded it was likely that the other would follow suit; this happened in 1871 and was fortunately avoided in 1874 when the corning house ignited. After the 1871 explosion it was decided to separate the powder press and corning houses by moving to a new location for the powder press house. This was not without its problems and the site initially chosen was converted into an expense magazine (the lower expense magazine). This resulted in an old expense magazine being demolished to provide the site for the new powder press house (*Westmorland Gazette*, 7 August 1875). The new powder press house was situated approximately 70m south of the old powder press house and was under construction in 1875 when the old powder press and corning houses blew up once again (*Westmorland Gazette*, 3 July 1875). For the purposes of this report the two powder press house locations will be referenced as the first powder press house and the new powder press house respectively.

The first powder press house (9)

Its only known depiction is that on the first edition of the OS 25" map surveyed in 1857 and on the 6" map surveyed the following year. These maps show a dog-leg shaped building which is not marked or labelled on any of the 1859/1860 sketch plans. It occupied the full width of the area between a blast wall to its north, which separated it from the corning house, and a short feeder leat to the south which led water from the main leat to the turbine which powered the corning machinery (and possibly also the powder presses). The first powder press house and corning house blew up in 1871 (*The Westmorland Gazette and Kendal Advertiser*, 28 October 1871), the powder press house was rebuilt on the same site and is presumably the building just visible in this area on one of the 1873-1875 photographs. It appears to have consisted of two storeys with, at least at the south-west end, a gabled roof. A number of openings, especially at first floor level, are visible in the south-east wall; the photograph also suggests that this side of the building retained the dog-leg shape of the press house shown by the OS in 1857. It is possible that the north-east part of the dog-leg was the location of the corridor which in 1875 (and presumably before this date) linked the powder press house and the corning house (*Westmorland Gazette*, 3 July 1875). It blew up again in 1875 with the corning house while the new powder press house was being built. The newspaper report of this accident noted that 'the corning and press houses are built close together, being divided by a pyramidal wall of earth and stone, seven yards wide' (*Westmorland Gazette*, 3 July 1875); this distinctive blast wall still survives (see above).

No trace of the first powder press house now survives above ground and, apart from the photograph mentioned above, only a few details of its structure can be gleaned from documentary sources. The corning house had a sheet-iron roof that was being covered with felting when the explosion of 1871 occurred, the newspaper account indicates that the roof of the powder press house was to be similarly treated suggesting that it too had a sheet-iron roof. The same account indicates that there were two presses in the building, one broken down and the other charged at the time of the accident. Before going to the presses the mill cake from the incorporating mills was almost certainly broken up by hand (as described much later in the MMB) using wooden mallets.

The area which the powder press house occupied is still well-defined on the ground although how much of what survives is original or the result of later modifications (such as when the hydraulic accumulator was built here - see below) is uncertain. The massive blast bank flanks it to the north east while the cut into the natural slope on the north west and south west has been revetted with coursed rubble walling up to 2.1m high. Near its east end the south-west revetment wall curves towards the south to meet the north-west corner of the turbine house. The south-eastern limit is now marked partly by a short wall extending north from the remains of the turbine house and partly by the southern end of the wall reveting the south-east end of the massive blast bank. The ends of these walls, which do not quite line up with each other, are now separated by a 4m wide gap but on the 1900 site plan and 1914 edition of the OS 25" map a continuous wall is shown extending from the turbine house to the end of the blast bank. The south-east side of the short wall associated with the turbine house has the remains of a blocked opening visible it its face. This opening, about 1.5m

high and 0.8m wide, at some stage probably provided access between the turbine house and the area behind the wall where the later hydraulic accumulator was located. The curve in the revetment wall immediately beyond this opening (see this paragraph above) may have been designed to facilitate this access.

The new powder press house (10)

The new powder press house was built in 1875 on the site of an earlier expense magazine (*Westmorland Gazette*, 7 August 1875). The powder press house is shown on the OS 25" map of 1898 (revised 1896) as a rectangular building measuring about 10m by 4.75m with a short porch on its west side over the tramway. It is also depicted on the site plans of 1900 and 1903-12 where it is numbered 11 and labelled 'Press House'. It and four of the incorporating mills exploded in 1906 during a thunderstorm and, according to a newspaper account, the powder press house 'was demolished entirely, but the press itself - a very strong and comparatively new one - was only slightly damaged' (*Westmorland Gazette*, 30 June 1906). The official report on the incident noted that the building was constructed of wood with corrugated iron roofing (Explosives Inspectorate 1906, 4). The latter was seen to form a dangerous missile when the building exploded and the report indicates that it had been decided to replace it with a more suitable roofing material when the powder press house was rebuilt. The powder press house was also fitted with a lightning conductor but evidently not a very effective one (Explosives Inspectorate 1906, 9). The powder press house was rebuilt following this explosion and its depiction on the 1914 edition of the OS 25" map is identical to that of its predecessor on the 1898 map. According to the MMB a short tramway with brass rails led from the main tramway to near the press. The new powder press house contained a single press that was operated by turbine driven hydraulic pumps (see below for details of the powder press pump houses).

The new powder press house was demolished when the works closed and its site has since been landscaped to form a large caravan pitch. The latter is separated from the main leat by an east-facing scarp, 0.8m high on average, which may be the remains of the bed of the tramway that ran along the edge of the leat and linked the powder press house with the ripe charge house. South of the site of the powder press house a large blast bank survives which separated the former from the eastern range of incorporating mills; it is a maximum 3m high (west end) and tapers to the east. The blast bank was almost certainly built at the same time as the powder press house. Originally it was shorter (Ordnance Survey 1898a), but had been extended to its current length by 1912 (Ordnance Survey 1914a); this may have been in response to the explosion of 1906 in which burning debris from the powder press house carried to one of the incorporating mills (Explosives Inspectorate 1906, 4). It is shown on the site plans of 1900 and 1903-12 where it is described as a mound and wood barricade. A second blast bank, on the northern side of the powder press house, is oriented roughly north-east to south-west and is not shown on the OS maps. It is, however, depicted on the site plans of 1900 and 1903-12; on the latter it is shown with much more of an east to west orientation. On these plans it is also described as a mound and wood barricade. This barricade is shown as a separate feature, situated just beyond the northern foot of the

blast bank, on the sketch plan accompanying the HM Inspectors report into the glaze house explosion of 1903 (Explosives Inspectorate 1903, plate 3).

The powder press pump houses (11 and 12)
The new powder press house of 1875 was powered hydraulically and by the end of the 19th century, if not before, the pumps were apparently housed in a pair of pump houses built close to the site of the first powder press house. They shared a hydraulic accumulator with the cartridge press pump house (see section 6.2.4 below).

The second edition OS 25" map (revised 1896) has a 4m square building (11) adjoining the south-eastern end of the turbine house (which provided power for the corning house - see below) together with another building (12), rectangular in plan and measuring 6m by 3m, situated about 10m to the north. This second building was built against the south-west face of the massive blast bank that separated the first powder press house from the corning house. On the site plan of 1903-12 the northern building is numbered 25 and the southern one 26; both are given the descriptive label - 'Powder Press Pump House'. They are similarly described and numbered on the 1900 site plan although the one to the south appears to have been plotted slightly out of its correct position when compared with the OS map depiction. The northern pump house adjoining the blast bank is not shown on the 1914 edition of the OS 25" map, an indication that its demolition had already taken place by 1912. At the time the MMB was prepared, there were two sets of turbine driven vertical pumps but only one set of pumps worked the press at any one time, with the other set kept as a spare to allow for breakdowns and maintenance. If this method of working was adopted early in the life of the pump houses, it may be that the spare pump set was housed initially in this northern building. Nothing now survives of the latter above ground and the later widening of the blast wall (see 'The powder press houses' above) overlies part of its site.

The other pump house survives as a concrete floor, 4.1m by 2.6m, adjoining the rebuilt south-east side of the turbine house. This pump house may have been in existence by the mid 1870's because the south-east end of the turbine house, visible on one of the 1873-1876 photographs, had clearly been extended by this time (see below). National Trust volunteers cleared the surface of the floor of leaf mould in 2000 revealing a number of structural details. The floor slopes slightly to allow water to drain into a channel, situated between two raised concrete machine beds, that leads to a drain head which is still covered by an iron grating. A recess around the perimeter of the floor suggests that the walls were of timber. One of the machine beds measures 1.45m by 1m and 0.2m high whereas the other is 1m square and 0.3m high; both have chamfered edges with sawn-off bolts surviving near the corners.

The hydraulic accumulator (13)
This was located towards the western end of the area occupied by the first powder press house. It is shown as a circular structure on both the site plan of 1900 and also on the sketch plan of 1903 that accompanies the report by the Explosives Inspectorate into the 1903 explosion at the glaze house. On both plans it is numbered 33 but on the 1900 plan

it is also labelled 'Hydraulic Accumulator'. It is similarly referenced on the 1903-12 site plan although the structure itself is not outlined. It is not marked on the OS maps, perhaps because it was not a building as such. In addition to providing power for the cartridge compressing houses an accumulator was also needed for the powder press house so there must have been one on site by 1875 (if not before for the first powder press house) when the new powder press house was built.

On the surface all that survives is a large concrete block or platform, about 2.75m square and protruding up to 0.15m out of the ground. It is similar to some of the machine beds on the site in that it has a chamfered upper edge. However, the sawn-off iron fixing bolts are not at the corners but are located in the centre of each side, presumably because it supported a cylindrical structure.

The corning house (14)

Like the powder press house, the corning house had to be rebuilt on a number of occasions after disastrous explosions, but it was always located on the same site. The first corning house to be built is shown on the OS 25" map surveyed in 1857. The depiction is of a rectangular building measuring about 11m (north north west to east south east) by 5m situated on the eastern side of the main leat and separated on the south west by a blast wall from the first powder press house. It is also shown and labelled 'Corning House' on the 1859/1860 sketch maps. It (and the first powder press house) exploded in 1871 while its sheet-iron roof was being covered with patent asphaltic felting to keep out the rain (*Westmorland Gazette and Kendal Advertiser*, 28 October 1871) and blew up again in 1874 with 'the building being rendered a complete wreck' (*Westmorland Gazette*, 25 April 1974). Part of a large building is visible at this location on one of the 1873-1875 photographs. It appears to consist of two distinct compartments with the one at the north-west end possessing a gabled roof. This part of the corning house also appears to be narrower than the adjoining compartment which forms its south-east end; this last compartment has a broad hipped roof and its easternmost wall is pierced by at least one opening. Another explosion occurred in 1875 with disastrous consequences once again for the corning house (*Westmorland Gazette*, 3 July 1875); the first powder press house was also blown up. The rebuilt corning house that was shown on the second edition of the OS 25" map, revised in 1896, consists of a 'T'-shaped building measuring 10m by almost 15m overall with the stem part extending over the tramway which in this area was laid out beside and parallel to the main leat. The building also blew up in 1903 when the first glaze house was destroyed. The official report into this explosion describes the corning house as a timber-framed building with a single layer of boards nailed to the outside of the framing and having a roof of tarred felt (Explosives Inspectorate 1903, 4-5). The report concluded that tarred felt was not to be used in future for roofing danger buildings because, once airborne following an explosion, it could spread fire to other buildings; corrugated iron - of low gauge - was considered to be a much more suitable material (Explosives Inspectorate 1903, 9). The depiction of the corning house on the 1914 edition of the OS 25"map is identical to that on the second edition map. It is also shown on the 1900 and 1903-12 site plans where it is numbered 12 and labelled 'Corning House and Earth Barrier' - the latter a reference to the blast bank at the south

west. One of the photographs in the Willacy Collection appears to be of the north-western end of the corning house and probably dates to the late 1920s (Fig 28). It shows the end of a timber-framed building, gabled approximately south-east to north-west, with corrugated iron sheets used for both walls and roof. In the end gable wall two windows are visible at ground floor level with a third one above them in the gable apex. The tramway is visible entering the building near its corner through a sliding door of vertical boards; presumably this is the 'upper door' referred to by the Explosives Inspectorate (1903, 5). A timber walkway suspended above the main leat gave access around the north-west end of the building. The MMB and Explosives Inspectorate (1903, 5) indicate that internally the corning house was on two levels with a short tramway on the upper floor used for taking the pressed cake from the main tramway to near the corning machine. When the MMB was produced the corning machine was of the Hastie type and had been installed in 1903, presumably when the corning house was rebuilt after the explosion which also destroyed the first glaze house. It, like its predecessors (*Westmorland Gazette*, 4 April 1903), was powered by turbine. The pressed cakes were broken up into smaller pieces by hand and then passed through a series of rollers with the powder, now in grain form, landing on the sieves of the scry or separator that was situated on the lower floor. A doorway in the east wall of the corning house provided access to this floor (Explosives Inspectorate 1903, 5).

Figure 28. *Western end of the corning house (probably in the late 1920s), from the south west. (NMR: AA035276, reproduced by permission of David Willacy)*

As noted earlier the corning house lay within a depression excavated into the natural slope. The north-east and north-west sides are revetted and rendered and these walls survive to a maximum height of 2.4m. At its eastern end the north-east revetment turns through ninety degrees and heads towards the south for a short distance. Elsewhere the south-east side of the excavated depression is defined by a north-west facing scarp, 1.5m high on average. The massive blast bank (described above with the powder press houses) bounded the area occupied by the corning house on the south west. The corning house was principally shielded by its situation in the excavated hollow and by the massive blast bank, but the remains of a much smaller bank, up to 1.1m in height, lie just outside the north-east side of the excavated area and towards its eastern end. It is possible that this feature was also related to blast protection. A rectangular recess, 1.2m wide and 2m long, in the north-west revetment wall may have housed a staircase giving access to the lower floor area. Although the building has been demolished its site appears to be divided into two halves by a very slight scarp orientated north-north-east to south-south-west. This division may well reflect a genuine difference between the two halves of the corning house. The south-eastern half is at a slightly lower level and the vegetation growing over it (predominately Japanese Knotweed) is markedly different from that of the north-western half. Concrete plinths which would have supported the north-east and south-west walls of the corning house are also visible in the south-eastern half just beyond and laid out parallel to the inner faces of both the north-east revetment wall and the blast bank to the south west. The plinth to the north east is 0.9m wide and 0.15m high while the other one measures 0.55m wide and 0.1m high. The inner face of the revetted blast bank also contains two small rectilinear slots situated about 1.7m above its base.

The turbine house (15)

The turbine that provided power for the corning machine was located south of the first powder press house. On the OS 25" map surveyed in 1857, the turbine house is depicted as a 4m square building at the end of a short feeder channel leading eastwards from the main leat. A building at this location is not marked on the 1859/1860 sketch maps. The close proximity of the turbine house to the first powder press house may mean that power was also supplied for the presses from the very beginning, unless of course the latter were hand-operated screw presses. On later editions of the OS map an alteration to the south-east end of the feeder channel is shown while another cell, had been added to the turbine house on the south east (Ordnance Survey 1898a; 1914a). This structure was similar in size to the turbine house and at the time of these maps it was one of the pump houses for the new powder press house (see powder press pump houses above). The cell may have been added as early as the mid 1870s because one of the 1873-1875 photographs shows a long, single-storey rectangular building with a gabled roof and orientated approximately north-west to south-east at this location. Photographs showing the north-east wall of the turbine house were taken by Davies-Shiel and the National Trust in 1977 (Fig 29) just prior to consolidation; above and to the north west of a doorway was a window opening that no longer survives. The site plans of 1900 and 1903-12 do not label or number the turbine house; perhaps by this time it was simply regarded as an integral part of the attached powder press pump house (the proximity of the turbine to the pumps must mean that it

Figure 29.
The north-east end of the tubine house (which provided power for the corning machine) in 1977. (Reproduced by permission of the National Trust)

supplied them with power). On the sketch plan accompanying the report by the Explosives Inspectorate into the explosion at the glaze house in 1903, the turbine house and adjoining powder pump press house are shown as a single rectangular building numbered 13. The turbine also appears to have been damaged by this explosion because a contemporary newspaper account states that 'the corning house 80 yards (73.3m) away was also wrecked but there remained part of the turbine which had been working at the time of the explosion' (*Westmorland Gazette*, 4 April 1903).

A rectangular walled structure containing a turbine pit in its southern half is the site of the turbine house. The site was made safe in 1977 when the north-east wall was lowered and the south-western and south-eastern walls, which no longer survived, were partly rebuilt to prevent visitors to the caravan park accidentally falling into the turbine pit, which is 3.3m deep and 2.5m in diameter. The date of the work together with the initials DC MW MG DH are inscribed in the concrete capping on top of the south-east wall. The turbine was of the vertical type and was housed in a pit that received water from the main leat via the feeder channel. The arrangement of the turbine house over the pit is similar to that housed in the clock tower (see section 6.2.9 below). Water from the feeder channel entered the turbine house through an arched opening spanning most of the north-west side of the structure and must have entered the circular turbine pit via a wooden pentrough. Despite later blocking part of the arch is still visible in the north-west wall. The pit is not central to the building, which would have meant that water was directed at its northern half. The north-east wall survives to a height of 2.4m and is 0.6m wide; a doorway that allowed access to the machinery pierces it. This entrance now has a concrete lintel across its top that was presumably inserted during consolidation in 1977. Rusticated stone blocks are visible around the doorway and at the north-east corner of the building while dribbles of pitch on some of the stones suggest that the turbine house had a felt and pitch roof. It is possible

that a small opening high in the wall on the north-west side of the doorway provided a route for the line shaft that transmitted power to the corning house. Traces of the fixings for this machinery are visible on top a short length of wall which heads in a northerly direction from the turbine house towards the south-east end of the massive blast bank and also on top of the gable end wall of the latter. They consist of pairs of iron rods with washers on top of large stone blocks that now stand slightly proud of the main surface. A line shaft or pipe may also have been present at a lower level because the upper part of all but one of the buttresses that support the gable wall at the south-east end of the blast bank contain a rectangular slot, up to 0.15m wide.

The turbine house was modified at an unknown date to accommodate a new turbine. The arched opening was blocked and water was delivered to the turbine pit via an inclined cast-iron pipe, 0.4m wide, which still survives. Outside the turbine house, the mouth of the pipe is set into the centre of wooden boarding, angled at forty-five degrees, at the base of a wooden pentrough at the end of the feeder channel. Water discharged into the turbine pit about three-quarters of the way up its side. The only surviving evidence of fixings for the new machinery is a beam slot in the blocked archway, 0.2m square.

The glaze houses (16 and 17)

There were two locations where glaze houses were built at different times at New Sedgwick. In the glaze house the powder grains were smoothed and polished, often with graphite (blacklead) being added to the process. The first glaze house was constructed in 1857 at the northern end of the river terrace on which the majority of the works is situated, near where the main leat bends to the north west. This glaze house appears to have been completely rebuilt and another separate compartment added some time before 1896. In 1903 the glaze house blew up and was completely destroyed. The replacement glaze house was built at a new location a short distance away to the north west. For the purposes of this report these two locations will be referenced as the first glaze house and the new glaze house respectively.

The first glaze house (16)

It is shown as a rectangular building, about 8m long (north-north-west to south-south-east) by 6.5m wide, on the first edition of the OS 25" map surveyed in 1857. Power was provided by a waterwheel, housed in a covered waterwheel house (measuring 6m by just over 4m), that was fed by a short headrace from the main leat; both waterwheel and leat lay just outside the glaze house to the north. This glaze house is also depicted on the 1859/1860 sketch maps where it is labelled 'Glazing House'. By 1896 when the second OS edition 25" map was revised major changes had taken place. The 1857 glaze house appears to have been rebuilt because on its site the OS mapping now has an almost square building measuring approximately 7m long (north to south) by just over 6m wide. The headrace and covered wheel pit may also have been realigned while beyond them to the north a second compartment had been added. This is depicted as a rectangular building on the map, measuring 9m long and its east end (about 4m across) is narrower than its west end (5m wide); the waterwheel house, set in the space between the two compartments, measures

3m by 6m. An overflow channel between the main leat and the river is drawn on the map immediately north of the second compartment. A porch over the tramway, which ran along the narrow space between the main leat and the glaze house, is also shown butting up against the western side of both compartments and crossing the headrace. The porch was about 19m long and 2m wide. It is possible that the southern compartment was rebuilt in order to accommodate the tramway that was probably built some time after 1864 when the New Sedgwick Gunpowder Company took over the works (see section 6.2.10 below). The north-western corner of the 1857 glaze house was built right up against the east side of the main leat leaving no room for the insertion of a tramway to service both the glaze house and the first stove house which lay to the north. It is possible that the second compartment was added to cope with the increased production at the works following the construction of the second group of incorporating mills. A glaze house at this location is just visible on one of the photographs of 1873-1875; it shows the southern end of a single-storey building (southern compartment), gabled approximately north to south, with a window or vent in the centre of the south gable wall. A slightly higher roof is visible behind it which is either that of the waterwheel house or, and perhaps more likely, the roof of the northern compartment. On the 1900 site plan a simplified rectangle covering both compartments is shown; it is numbered 15 and labelled 'Glaze House'.

On 30 March 1903 the glaze house was wrecked by a serious explosion that blew two of the workmen to pieces, injured a number of others, destroyed the corning house and damaged several other buildings (*Westmorland Gazette*, 4 April 1903). A photograph of the remains of the glaze house after this event is reproduced by Tyler (2002, 218) and there is a similar photograph taken from a slightly different angle in the Willacy Collection (Fig 30). They

Figure 30.
The ruins of the glaze house after the explosion in 1903, from the east. (NMR: AA 035281, reproduced by permission of David Willacy)

show the glaze house reduced to a spread of rubble with the lower part of the waterwheel still in its wheel pit but with its upper section broken off; damaged and severed branches on the adjacent trees are also evidence of the ferocity of the blast. The report by the Explosives Inspectorate into the incident gives details of the building as it existed at the time of the explosion. It confirms the general layout as shown on the second edition of the OS 25" map and notes that the northern compartment, 25 ft (7.6m) by 11ft (3.3m), contained two glazing barrels and the southern one, 28 ft (8.5m) by 13 ft (3.9m), four glazing barrels and four glazing reels. The southern compartment was built of stone on its northern, eastern and southern sides, up to a height of about 5ft (1.5m), the drive shafts and gearing being carried along the tops of these walls. The rest of the building was of timber 'formed with a double skin' and the roof was covered with tarred felt (Explosives Inspectorate 1903, 4).

The only structural elements which survive at this location are the overflow channel together with an 'L'-shaped length of crudely constructed revetment walling, 1.1m high, protruding from the edge of the riverbank some 2m to the south of this channel. Further up the slope of the riverbank there are traces of a second revetment wall heading south from the edge of the overflow channel.

The new glaze house (17)

After the 1903 explosion a new glaze house was built a short distance to the north west of the first glaze house on a narrow strip of land between the main leat and the river. The new structure is shown on the 1903-12 site plan as two separate compartments, one on either side of a new headrace that took water from the main leat for a waterwheel which provided the power. A pair of blast banks is also shown with one at each end of the glaze house site; the latter is numbered 15 on the plan and labelled 'Glaze House'. The glaze house and blast banks are similarly depicted on the OS 25" map of 1914 (revised 1912). On this map each compartment measures just over 8m long (north-west to south-east) by about 5m wide; both had a porch over the tramway on their south-west side. This section of the tramway approached the glaze house from the south and terminated at the northern compartment. The rectangular waterwheel house, situated just above the river, is also marked in the space between the compartments; on the map this structure is nearly 4m in length and 3m in width. A wall revetting the riverbank is depicted just beyond the north-east side of the southern compartment.

Two photographs of the new glaze house are known to exist, both taken looking towards the site from the north. One was published in 1929 (Imperial Chemical Industries 1929, 343) and was recently reproduced by Tyler (2002, 218). The second photograph is in the Willacy Collection and is of Thomas Faulkner fishing in the River Kent with the new glaze house visible in the background (Fig 31). This photograph is particularly informative because it was taken when the leaves were off the trees so that both compartments are clearly visible. Each was a separate single-storey rectangular structure gabled north-west to south-east. Both sat on top of a large platform whose north-eastern side rose high above the river and was revetted with stone walling. A timber walkway projected out towards the river from near the top of the revetment and the side facing the river had safety railings to prevent accidents.

Figure 31. *Thomas Faulkner fishing with the new glaze house in the background (probably in the late 1920s), from the north. (NMR: AA035274, reproduced by permission of David Willacy)*

The wheel pit pierced the centre of the revetment and the large waterwheel that it held is clearly visible protruding well out in front of the revetment. The arched tunnel-like waterwheel house above it shows up as being very white indicating that it was of concrete construction.

According to the MMB (page 20) there were three glazing drums in each compartment, all measuring 7ft (2.1m) long and 4ft(1.2m) in diameter. The new glaze house, unlike the one it replaced, was almost certainly built without any glazing reels because these were now housed in a separate reel house at the northern end of the site (see below). The reason for separating the two types of machines may have been to help reduce the possibility of explosions or because of a reduction in the production of powder which required reeling; it is stated in the MMB (page 36) 'that no reeling is now carried out' at New Sedgwick. However the reel house (see below) was obviously keep in working order in case the situation changed.

Although the new glaze house has been demolished the outline of its principal features and elements such as the blast banks are still clearly discernible on the ground. Towards the end of 2000 National Trust volunteers cleared the scrub growing over the remains and

removed some of the leaf mould. A pair of irregular rectangular hollows, measuring a maximum of 6.8m long, 4.4m wide and 0.8m deep now represent the sites of the compartments; the northernmost is partially edged by fragmentary stone wall footings. Both hollows have been partly infilled by stone rubble that seems to have been dumped into them from the south west. The headrace which separates them is about 1.7m wide and 0.8m deep. The wheel pit, although partially infilled with rubble from demolition, is still about 1.8m deep and the recesses that held the axle of the waterwheel are still visible on either side and, though not in their original positions, large stone blocks complete with securing bolts survive. The former waterwheel may have been of high breast-shot type. Part of a concrete arch (a piece of the waterwheel house roof) has the foundation date for the waterwheel house (and presumably the rest of the glaze house) on it. The date is only partly legible since the final digit has been largely erased through damage. The first three digits are 190 so the final one must have been a number between 3 and 9. If it was a 3 then it would imply that the new glaze house was the direct replacement of the first glaze house, but if it were a higher figure then it would suggest that the old glaze house was rebuilt and served for a few years. This would seem to be a most unlikely scenario and 1903 is, perhaps, the most likely date for its foundation. The revetment wall between the compartments and the river is well preserved and is a particularly striking feature in front of the southern compartment. Here it survives to a height of 3.7m (including a small parapet), its lower part is battered but the upper part rises vertically. Also in this area is the last surviving fragment of the timber walkway; it consists of a single horizontal timber beam projecting from the upper part of the revetment wall towards the river.

The two blast banks that flanked the glaze house, one at either end, are well preserved and are about 2.7m high. A stone wall with a slight batter revets the inner face of each blast bank and the ends are also revetted (Fig 32). The lower part of the revetment wall corner at the south-west end of the southern blast bank has a deep chamfer to facilitate access to the glaze house. The course of the tramway on the south west side of the compartments is also still traceable with a number of timber sleepers still in their original positions. These

Figure 32.
The southern compartment and revetted blast bank of the new glaze house, from the north west. (NMR: AA012918)

are 1.7m long and, like the impressions of the sleepers found by the saltpetre refinery, are spaced 0.9m apart; some still have their iron spikes that held the rails in place.

The stove houses (and attendant boiler houses) (18 and 19)

Stove houses were used to dry the gunpowder and at New Sedgwick there are two separate locations where a total of at least three stove houses were built at different times. The first two were constructed (one a replacement for the other) at the same location on the eastern side of the main leat some 70m north-west of the original glaze house. The final stove house was constructed on a new site further away from the main part of the works. The original stove house occupied a very restricted area between the leat and the top of the riverbank which here falls steeply down to the River Kent. By 1896 both the course of the leat and the edge of the riverbank in this part of the works had been altered and a new and larger glaze house had been erected. A new glaze house was built after March 1903 (when its predecessor exploded) on a fresh site much closer to the stove house, to prevent explosions communicating from one building to the other, this meant that the latter also had to be re-sited. A new location was chosen about 50m to the north north west of the first stove house, but on the opposite side of the leat. A separate boiler house provided heat for the stove houses; like the former this went through similar stages of rebuilding and was also re-sited after 1903. For the purposes of this report these two stove house locations will be referred to as the first stove house and new stove house respectively; the boiler houses are also be described with their respective stove house.

The first stove house (18)

The original stove house must have been built at the inception of the works because it is depicted on the first edition of the OS 25" map, surveyed in 1857; it also appears on the sketch maps of 1859-1860 where it is labelled 'Stove'. On the OS map it is rectangular in plan, with a narrower projection at the north end, measuring a maximum of 16m (north-west to south-east) by almost 7m wide; a small almost 4m square out-shot or porch is shown butting against the southernmost corner of the south-east side. Sometime between the first and second edition (revised in 1896) of this map, the building was replaced by another stove house which partly overlay the outline of its predecessor but with the majority built slightly further to the south. It was still rectangular in plan, but now had narrower projections at both ends, with maximum dimensions of 19m by 9m; a small out-shot, set at an angle, butted against its south-east end. The out-shot and main building are separated by a line on the map that extends from the main leat to the riverbank. This may indicate the site of a water channel because near the river the line forms one side of a feature reminiscent of the end of a tailrace. According to Davies-Shiel (*pers comm*) there is a reference in the Gilbert Gilkes & Co. contract order books to a 9-horse power turbine being supplied for the stove house in April 1884. Tyler (2002, 204) also has the stove house being revamped at this date with new pipes being installed, but does not give his source. The provision of a turbine is curious because a stove house would not normally require a power source and there are no other buildings in the immediate vicinity that could have been powered. It is uncertain when the original stove house was demolished, but there are at least three possible occasions. The first may have been when the tramway was installed at New Sedgwick (probably during

the second part of the 1860s or early 1870s - see section 6.2.10 below), the second when the leat in this part of the works was rebuilt (it is suggested in section 6.2.1 above that this may date to the early 1870s) and the third may have been connected with the manufacture of blasting cartridges (these were normally dried in a separate compartment from the one used for the loose powders and their production commenced in 1880 at New Sedgwick). According to the depiction on second edition of the OS map, the tramway terminated at the south-western corner of the stove house; what appears to have been a walkway led from the end of the tramway along the west side of the building to a small extension (probably a porch) projecting over the leat. The second stove house is numbered 16 on the site plan of 1900 but incorrectly labelled 'Store'; it is similarly depicted and numbered on the plan accompanying the Explosives Inspectorate report of 1903 where is correctly called 'Stove'. The roof timbers and door of this building were damaged in March 1903 during the explosion at the glaze house. Fortunately the contents of the stove house did not ignite, this was partly due 'to the stove having been put into thorough repair comparatively recently' (Explosives Inspectorate 1903, 5).

The second stove house no longer survives but the outline of its eastern side is preserved by a revetment wall that helped to strengthen the riverbank and extends down to the river edge. Although the stove house had gone this wall was still shown on the 1914 edition of the OS 25" map. Is up to 3.2m in height and has a pronounced batter for much of its length. The end of a culvert is visible high up in the wall; water exiting from the culvert has deposited much limescale around this opening. The culvert extends from the main leat and its original function is unclear, but latterly it may have functioned as an overflow taking water from the base of the leat (for additional details see section 6.2.1 above). The rendered eastern side of the main leat which was adjacent to the stove house is still in very good condition and is of much better quality than that beyond the stove house to the north. A brick pillar, 1.2m high and 0.4m wide, has been built against the inner face of the eastern side of the leat; it may have supported the probable porch shown at the end of the walkway on the second edition OS 25" map.

The boiler house associated with the original stove house is also marked on the first edition OS map; it was a small rectangular building (measuring 4m by just over 3m) situated about 2m to the north west of the former and sharing the same orientation. A broken line on the map, to the north east just outside this structure, may be a drain leading to the river. The main leat in this part of the works has clearly been rebuilt and in section 6.2.1 above it is suggested that this event may have taken place during the early 1870s. The boiler house must have been demolished by or at this time because a comparison of the OS maps reveals that its site was utilised by the new course of the leat. The replacement boiler house was built further to the south and the second edition OS map indicates that it was a much more spacious affair, square in plan and about 6m across. A small projecting structure at its northernmost corner was probably a chimney. It no longer shared the same orientation as the stove house (which one side touched), presumably a reflection of topographical constraints imposed by the limited space available between the leat and the riverbank. All that survives of this boiler house above ground is a low stony mound with traces of revetment

walling, 0.8m high, visible in the side facing the river. An iron pipe, at the head of a short channel leading to the river, is situated about 2m north of the mound.

A linear blast bank is depicted on the second edition of the OS 25" map (revised 1896) a short distance to the south east of the stove house. This was installed in order to satisfy Amending Licence No. 254, which specified that a mound had to be erected between the glaze and stove houses (Explosives Inspectorate 1903, 3). It is also shown on the site plan of 1900 but is less regular with a slightly different orientation to that shown by the OS. This blast bank no longer survives because it was demolished in order to provide a site for the new glaze house which was built following the horrific explosion in March 1903.

The new stove house (19)

After the explosion in March 1903, which destroyed the glaze and corning houses, a new stove house was built consisting of two separate drying buildings. It was situated on the western side of the main leat within a massive, flat-bottomed rectangular depression (revetted on all sides) excavated into the natural slope; unlike the siting of the first stove house location, this provided the new stove house with good all round blast protection. A revetted entrance passage at the north-east corner of the excavated area provided access between the drying houses and the tramway. On the 1903-12 site plan the stove house is numbered 16 and labelled 'Stove'. Measurements for the drying houses taken off the 1914 edition of the OS 25" map indicate that the one to the north west was about 7m by just over 4m whereas its neighbour was slightly wider being approximately 7m by 5m. Each had a porch at the north-east end. According to the MMB (page 23) one building was for drying blasting cartridges and the other for drying loose powder; internally each consisted of a central passage with racking to support trays on either side. A small, subterranean boiler house to the south of the stove house provided the piped hot water that heated the drying houses.

Although the superstructures (presumably of timber or corrugated iron) of the drying houses have been destroyed, there is still much surviving evidence of the stove house site itself. The vertically sided rectangular depression (with its revetment walls) is well preserved; it measures about 14m (north-west to south-east) by 12m and is up to 2.8m in depth. The interior is divided into two rectangular compartments by a cross-wall, 8m long and 1.9m high, which butts against the revetment wall of the south-west side of the depression. There was a drying building in each of these compartments and partial clearance of the floor of the south-eastern compartment in autumn 2000 by National Trust volunteers exposed the foundations of the north-east end of the larger of the two drying houses. A number of concrete plinths are visible, each measuring 0.35m wide; they form the footprint of a building, about 5.5m wide, with a short porch about 2.7m deep at its north-east end. The porch appears to have been modified over time because the porch on the 1914 edition of the OS map, like the one depicted at the other drying building, is much longer extending across the whole of the space between the end of the drying house and the revetment wall that bounded the north-east side of the depression. The entrance passage leading into the depression is also well preserved, it is 2.2m wide and flanked by tall revetment walls (Fig 33). On the lower south-east side of the depression, some of the original material dug out was mounded

Figure 33.
The entrance to the new stove house, from the east. (NMR: AA012910)

up on this the potentially weakest side in order to give even better blast protection. To the north east of the entrance passage the outer face of this extra material has been revetted and there is also an angled internal wall within the body of the mound thus formed.

The boiler house, shown on the 1914 OS map, was located underground, to the south of the drying rooms. It appears to have built partly into the natural slope and also into some of the material excavated from the stove house depression. Surprisingly it seems to have been constructed over the site of Robin Hood's Well. Presumably the spring was harnessed to provide water for the hot water pipes in the drying buildings. The spring is no longer managed and has now partly flooded the boiler house whose doorway has been blocked by an iron grille to prevent access. The doorway is set in the south-west wall of the boiler house whose outer face is 4.2m long and is supported by a pair of small buttresses built against it. There is a tiny forecourt in front of the doorway that is bounded on the north west and south west by revetment walls, 2.4m high. A short flight of steps gives access to the forecourt from the south east. Beyond the steps the approach to the boiler house is flanked on the south by an irregular mound of ash and coal-derived clinker which must be waste from the boiler fire. This low mound measures approximately 10.0m by 8.0m.

The flue from the boiler was inserted just below the ground surface and extends westwards for about 26m up the natural slope. There is an inspection pit about half way along its length. It measures 1.7m long and is covered by four removable iron plates resting in an iron frame; the flue visible in the pit consists of a brown ceramic pipe. The route of the flue is not visible on the surface between the boiler house and inspection pit but west of the pit its course is marked by a low bank that terminates at a 'chimney'. The latter is simply a vertical section of pipe centrally placed on top of a brick plinth, 1.3m square, which was

depicted on the 1914 edition of the OS map. To the rear of the plinth is an irregular depression full of bricks which reveals an opening or hatch in the side of the plinth which gave access to the upper part of the flue and base of the chimney, presumably for periodic maintenance and cleaning. In this respect it is interesting that in the account of the stove house in Faulkner's notebook it is stated that the chimney was swept every Monday morning.

The reel house (20)

The reel house, the most northerly processing building on the site, was where the dust was removed from fine powders (often used for sporting or military purposes) using revolving horizontal reels covered in fine meshed cloth through which the dust escaped. It appears to have been erected during the re-arrangement of the northern end of the works occasioned by the explosion of March 1903 which started in the glaze house. Up until this event reeling had taken place in the southern compartment of the glaze house (Explosives Inspectorate 1903, 4). The new reel house must have been built soon after the explosion because in Faulkner's notebook there is a reference to a 10-horse power turbine of 1903 at the reel house. The building is first shown on the 1903-12 site plan on which it is numbered 34 and labelled 'Reel House'. It may not have been used a great deal because when the MMB (page 36) was prepared it was noted that reeling was no longer carried out at New Sedgwick. However, a brief description of the reel house and its contents is also given, which suggests that the building was still being maintained. It consisted of two separate compartments, one on either side of a short headrace that brought water from the main leat to drive the turbine that powered the reels. Each compartment housed a pair of reels that measured individually 8ft (2.4m) long and 2ft (0.6m) in diameter. On the 1914 edition of the OS 25" map (revised 1911) each compartment is about 5m by 4m in size with a porch attached to the west end which extended to the edge of the main leat; the porches probably provided covered unloading/loading from the tramway which was also extended to serve the reel house. A revetment wall is shown just beyond the eastern side of the compartments.

Although the superstructures at the reel house site house have been removed, the remains of the headrace and the lower part of the two compartments are still clearly visible. The latter survive as a pair of platform-like features (of unequal size) built on the bedrock of the lower part of the riverbank. On the east, above the river, a stone revetment wall, up to 1.7m high with a slight batter strengthens them. At both ends it turns through ninety degrees to form the north wall (0.7m wide) of the northern platform and the south wall (0.6m wide) of the southern platform. In places, especially to the north, these walls stand slightly above the upper surfaces of the platforms which thus have a floor-like appearance. The western sides are obscured by tumble. Three iron bolts, complete with nuts, protrude through the rubble-covered floor of the northern platform and are angled towards the river. It is not clear how many of the visible remains are those of the actual buildings or merely the platforms on which the superstructures were erected. The headrace ends near the west end of the platforms and its walls now stand some 1.4m above the top of the latter. The collar of a large diameter iron pipe, with an integral metal plate, is visible in the end wall of the headrace. It must be the remnants of the pipe which took water to the turbine although the rest of it, together with the turbine has gone. On the other side of this wall a channel, about 1m wide,

continues the line of the headrace between the compartments to the river. The channel has a concrete base flanked on either side by walling; that to the south is very poorly built and looks like a much later addition. The channel exits through the eastern revetment wall of the platforms by means of an arch. A short flight of steps is visible on the south side of the channel. They are contained in a recess in the east revetment wall of the platforms and lead to the edge of the river; wall footings protruding into the river are visible beyond the steps (high water levels at the time of the EH survey prevented more detailed examination of this area and there may be other features still extant). It is possible that the steps originally provided access to the turbine. A timber sleeper, still *in situ*, is visible to the north just beyond the headrace; it provides evidence that the tramway extended up the west side of the reel house whereas on the 1914 OS map the tramway is shown terminating at the south-west corner of the southern compartment.

The dust house (21)

The location of the original dust house is uncertain. The first edition of the OS 25" map shows an almost square building about 7m across on the site of what later was certainly the dust house. This almost square building is also depicted on the 1859/1860 sketch maps but not labelled. Reference is made in a newspaper article to the building of a new dust house where work commenced in 1873 and was completed in 1874 (*Westmorland Gazette*, 7 August 1875); it is also stated that the machines for the new dust house were made in 1873. The new building was clearly erected on this site because the site plans of 1900 and 1903-12 show a building here numbered 18 and labelled 'New Dust House'. It may be that the new dust house was built on the site of the old one but against this is that in the newspaper account it is also said that the usual practice at New Sedgwick was to have a replacement building ready before demolishing the old one. It is just possible, therefore, that the original dust house was located somewhere else on the site. The new dust house is shown on the both the second and 1914 editions of the OS 25" map as a rectangular building, 7m by 6m, with a porch on its south-east side over the tramway. A building at this location is also visible on one of the 1873-1875 photographs. It is a single-storey rectangular stone building with a gabled roof and at least one, possibly two, windows in its south-east wall. The open porch has a sloping roof. Initially the machinery inside the new dust house must have been hand-operated but by 1900 an electric motor had been installed in a small stone building adjacent to it that still survives (see below). At the time of the MMB (page 26) two machines were used for dusting and sizing: one a wooden separator which was underdriven, had a rotary motion and used solely for black and cartridge powders; the other a hand-operated separator used for bright powders. It is quite likely that the mechanically driven separator was installed when the electric motor house was erected, presumably replacing a hand operated machine. The old hand operated separator referred to by the MMB was probably one of the machines manufactured in 1873.

The dust house has been demolished but a low, oval stony platform with a slightly hollowed top and edged by a west-facing scarp (up to 0.6m high) marks its site. Further scarps, rather amorphous in nature and perhaps from dumping, are also visible at the northern end of the platform. A single concrete machine bed, holding two iron bolts and with chamfered

upper edge, survives near the southern end of the platform and may have been related to the mechanical separator. The dust house was built close to the riverbank, a length of which has been protected and strengthened with revetment walling.

The electric motor house (22)

This small, single-storey stone building, rectangular in plan and measuring 6.8m by 3.1m with 1.7m high side walls, was erected during the last years of the 19th century (Fig 34). It is not shown on the second edition of the OS 25" map revised in 1896 but is depicted on the site plan of 1900 on which it is numbered 32 and labelled 'Shed for electric motor'. It is similarly described and numbered on the site plan of 1903-12 and also appears on the 1914 edition of the OS map; on this map a footpath is shown leading away from it towards the cartridge press pump house. Electricity for the motor may well have been generated at the latter.

Figure 34.
The electric motor house from the west. (NMR: AA012927)

The electric motor house has rubble walls, roughly coursed except at the corners, which are of squared rubble with quoins. The doorway in the north-west gable wall has sides of squared blocks which support a substantial rusticated, rectangular stone lintel. The single window opening in the south-west wall has a stone sill and the base of the roof forms the lintel. About half way along the north-east wall there is a smooth rectangular area of concrete, 0.6m by 0.45m, with bolts or fixing straps at the corners. Presumably this once held a plate or piece of machinery, perhaps connected with the transfer of drive from the electric motor to the mechanical separator in the dust house. Its lower half is perforated by two metal pipes, centrally placed and one above the other (about 0.2m apart), whose ends are almost flush with the concrete surface; each is 3.5cms in overall diameter. The gable walls, 2.6m high, to south east and north west are raised to form a small parapet above the

roof which is arched and made of concrete. There is a small chimney or ventilator with a metal cowl, now largely obscured by ivy, at the south-east end of the roof. The present door and window frame are of fairly recent origin because on a photograph of 1977, taken by Davies-Shiel, the doorway and window appear as open voids. The door is kept permanently locked so the interior of the building was not seen during the EH survey, but according to Davies-Shiel (*pers comm*) none of the original machinery survives inside.

The heading house (23)

It is not known where the heading-up process took place during the early years of the works. The heading house whose location is known from maps and plans was not, according to a newspaper report, erected until 1873. The same newspaper also refers to a packing house being erected in that year, but this is almost certainly just a further reference to the heading house rather than to another building (*Westmorland Gazette*, 7 August 1875). The heading house is shown on the OS 25" maps published in 1898 and 1914 as a rectangular structure measuring nearly 12m north-east to south-west by at least 6m in width with a porch at the centre of its south-east side over the tramway. On the site plans of 1900 and 1903-12 it is numbered 19 and labelled 'Heading House'. It is visible on one of the 1873-1875 photographs, which shows that it was a stone building with gabled roof and a pair of windows in its southern gable end. The porch over the tramway was also enclosed, being built of stone, with a gabled roof. Remarkably there appears to have been a small chimney that may have vented a stove used to heat paraffin wax. The latter was used for waterproofing the calico bags which contained the powder in the barrels (see page 34 of the MMB). The building no longer survives but an irregular shaped hole in the ground, 0.5m deep, surrounded by a curved outward-facing scarp on the west and north, marks its site.

6.2.4 The manufacture of blasting cartridges

The Explosives Act of 1875 made the filling of blasting cartridges illegal except on licensed premises. Prior to the act this had been carried out away from the works, often by the quarrymen and miners using candlelight to see by - a dangerous practice! (Marshall and Davies-Shiel 1969, 84). After the Act most gunpowder manufacturers obtained licences to produce blasting cartridges at their works. Production at New Sedgwick commenced in 1880 following an amending licence that allowed an expense magazine to be converted into a cartridge compressing house for which hydraulic power was required. Additional hydraulic power was needed for a second cartridge compressing house built a few years later. A new pump house was built specifically to serve these cartridge compressing houses and was situated a short distance to the south west of the turbine house that provided power for the corning house. A dynamo to produce electricity for at least part of the works was also probably installed in the cartridge press pump house by the end of 1900. This pump house and the powder press pump houses shared a single hydraulic accumulator that was situated on the site of the first powder press house (see section 6.2.3 above).

The cartridge compressing houses (24 and 25)

There were two cartridge compressing houses at New Sedgwick where cartridges were formed under great pressure. One was situated above the river at the eastern edge of the

main area of the works and the other was built in the bottom of a deep cutting that was dug into the natural slope above the main leat, 50m west north west of the upper expense magazine. For the purposes of this report the cartridge compressing houses have been labelled 1 and 2. Davies-Shiel (*pers comm*) has had access to the contract order book of Gilbert Gilkes & Company who supplied turbines to New Sedgwick and has found references to turbines being supplied for the cartridge compressing houses (turbines are also referred to in Faulkner's notebook where mention is made of the cartridge presses). There is no evidence that the compressing houses had their own water supplies to power turbines - indeed the topographical location of cartridge compressing house 2 in relation to the main leat would appear to rule out such a possibility. One explanation is that there is duplication and confusion in the documentary sources and what are being referred to are the turbines in the cartridge press pump house.

Cartridge compressing house 1 (24)

This building started off life as an expense magazine but was converted into a cartridge compressing house in 1880 (Explosives Inspectorate 1883, 2). A rectangular building measuring approximately 6m by 5m, presumably the expense magazine, is shown at this location on the first edition of the OS 25" map surveyed in 1857; it does not appear on the 1859/1860 sketch maps. Although the amending licence allowed the cartridges to be packed in the same building, a dedicated packing shed appears to have been constructed fairly shortly afterwards (see this section below) (Explosives Inspectorate 1883, 6). In 1883 the cartridge compressing house blew up (*Westmorland Gazette*, 14 April 1883), killing three workers; the Explosives Inspectorate's report into the explosion describes the building and gives a plan of its interior. The building measured 24ft (7.3m) by 19ft 6in (5.9m) and its walls were of stone, about 2ft (0.6m) across, lined with wood. The floor was also of timber supported on joists about 3ft (0.9m) above ground level. The roof was of wood covered externally with felt and contained two small skylights. In the east wall was a central door with a window to either side; there was a platform immediately outside this entrance. The cartridge press was located in the centre of the building and was a bookbinder's hydraulic press (Explosives Inspectorate 1883, 5); the pressure for the ram would have come from the cartridge press pump house. The cartridge compressing press house was rebuilt and on the second edition OS 25" map (revised 1896) it is shown as an almost square building measuring about 6m across with a large porch along most of its eastern side covering part of the tramway. The depiction on the 1914 edition of the OS map is similar although the porch appears to have been altered. On the site plans of 1900 and 1903-12 the building is numbered 17 and labelled 'Compressing House'. When the MMB was written the building contained two hydraulic pressing machines; one produced 100 pellets and the other 68 pellets at each pressing.

The building no longer survives but a tongue-like earthwork, about 0.4m high, marks its site. It contains stone and brick rubble and protrudes from the western side of the caravan park road that follows the west bank of the river. A vertical iron pipe, 0.5m high and 0.03m in diameter, with two metal collars around it, projects through the surface of the earthwork. The pipe presumably supplied water under pressure from the cartridge press pump house.

Bricks around it are stamped ‘Claughton Manor Brick Co Caton’- bricks with the same stamps also occur near the cooperage (see section 6.2.9 below). A linear hollow, about 2m wide and 0.2m deep, leads away from the earthwork in the direction of the pump house. It probably marks the site of both a footpath marked on the OS 25” maps published in 1898 and 1914 and also the line of the buried pipe from the pump house.

Cartridge compressing house 2 (25)

The second cartridge compressing house was situated on the western side of the leat at the bottom of a huge cutting dug into the slope. The precise date of this cartridge compressing house is uncertain but documentary and cartographic evidence indicate that it was built some time between 1883 and 1896 (revision date for the second edition of the OS 25” mapping). The report by the Explosives Inspectorate into the glaze house explosion of 1903 states that since the explosion of 1883 (at cartridge compressing house 1 - see above), Amending Licence No. 597 has ‘allowed the erection of an additional cartridge press house at a distance of 77yards (70.4m) from the glazing house and 66 yards (60.3m) from the corning house’ (Explosives Inspectorate 1903, 3). It is depicted on the 1900 and 1903-12 site plans where it is numbered 28 and labelled ‘Compressing House’. Its portrayal on the second and 1914 editions of the OS mapping is almost identical. Measurements taken from these sources indicate a rectangular building, about 7m long (north-east to south-west) by 4.5m. A slightly off-centre porch is also shown extending over the tramway from the south-east side of the building. The cutting in which the compressing house was situated was clearly designed to give good blast protection and also to facilitate an easy gradient for the tramway; its construction therefore is unlikely to have preceded that of the building by more than a few days or weeks at the most. The maps also indicate that the top of the cutting above the building to the west was either revetted or had a blast wall. Despite its well-protected and concealed position the compressing house still suffered damage in the glaze house explosion of 1903. The explosion lifted and damaged the roof and the door jammed. The two men who were working in the building at the time escaped through the windows which were blown out, fortunately one of them was able to release the hydraulic pressure for the press before departing (Explosives Inspectorate 1903, 5). The hydraulic pressure would have been brought to the building in an iron pipe from the pump house; there are now no above ground traces of this pipe in either the cutting or near the site of the compressing house. According to the MMB this building contained one press which was able to produce 72 pellets at each pressing.

There is a photograph looking up the cutting, probably taken in the late 1920s, in the Willacy Collection (Fig 35). The north-east end of the compressing house is just visible in the background. It was a single-storey affair gabled north-east to south-west, with a pitched roof (probably of timber) lightly covered by what looks like felt. In the foreground the tramway is visible crossing the main leat by means of a plank bridge. The gauge was quite wide and the flat-bottomed rails were held in position by track spikes. The sides of the cutting were supporting bushes, saplings and trees when the photograph was taken and, apart from becoming more rampant, the vegetation was still much the same when EH surveyed the cutting in 2002.

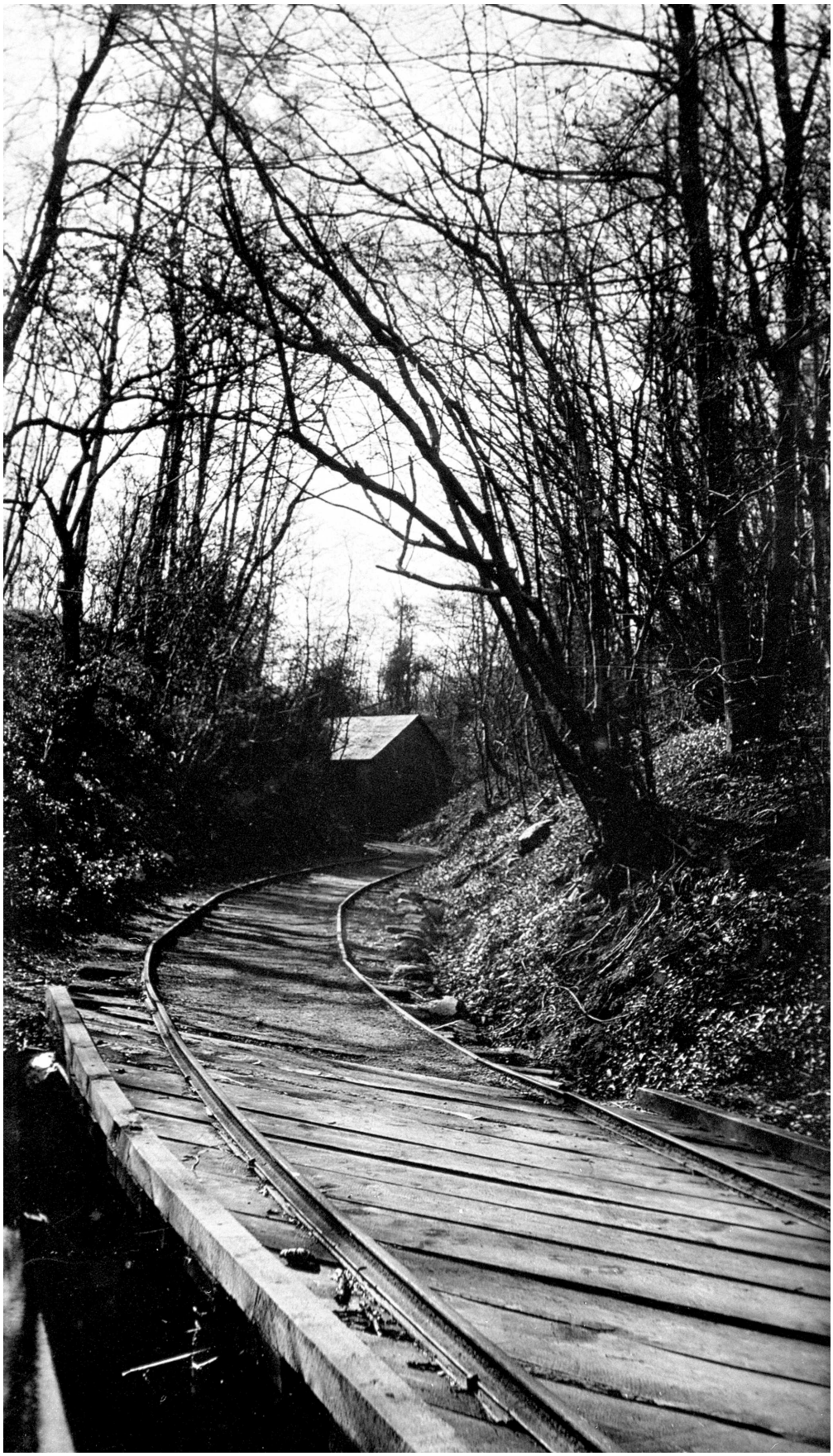

***Figure 35**. Cartridge compressing house 2 and the tramway (probably in the late 1920s) from the east. (NMR: AA035275, reproduced by permission of David Willacy)*

The building no longer survives but earthwork remains indicate that it stood on a raised platform cut into the rising ground to the north west. On the south east the platform is revetted with stone to a height of 0.4m above the base of the cutting. The former is about 6.5m long by 4.5m and is subdivided into two parts by a crudely fashioned cross-wall up to 0.7m high. This wall may be nothing to do with the cartridge compressing house and probably relates to the use of this part of the site for ammunition storage during World War II. Immediately east of the platform a square feature, partly embanked, has been dug into the side of the cutting and is almost certainly the site of an ammunition dump. A similar feature is also visible near the entrance to the cutting on its southern side, some 8m west of the main leat.

The cutting, 11m across on average, must have been a major undertaking and still survives to a depth of about 5m. In places bedrock has been exposed to a maximum depth of 0.9m. The sides of the cutting have been colonised by rabbits whose burrows are causing erosion. Some of the excavated spoil was dumped just outside the cutting to form external banks, about 0.9m high, along its northern and southern edges. They probably helped to give additional blast protection but their presence cannot account for all the spoil that was removed when the cutting was made. Some of it may have gone into blast bank construction elsewhere on the site. Two likely candidates are the pair of blast banks opposite the cutting which occupy the area between the main leat and the riverbank (they are certainly later than the 1873-1875 photograph which shows the central area of the works). They flank (one on either side) the caravan park's eastern road which here follows the course of one of the tramways; the banks were probably designed to provide the first glaze house location with blast protection. They are about 3.4m high and have different shapes; the one to the west is a sub-circular mound with a broad summit whereas the eastern one is oval in plan and has a narrow top.

The cartridge press pump house (26)

This was located some 30m to the north east of the new powder press house on the eastern side of the main leat. The first depiction of this building is on the second edition of the OS 25" map, revised in 1896; a rectangular structure, about 7m by 5m, is shown. No independent headrace to this building is marked on the OS map suggesting that water was probably taken off the headrace which supplied a near-by turbine house (15) (the one that powered the corning house). By October 1900 the pump house had been extended to the south west with the result that its principal orientation was now north-east to south-west. This is how it is drawn on the site plans of 1900 and 1903-12 where it is numbered 27 and called 'Cartridge Press Pump House'. This extended building is depicted on the 1914 edition of the OS 25" map where it measures about 11m long by 6m. The map also indicates that the south-west end contained a separate compartment, this was probably the dynamo house that provided electricity for buildings such as the electric motor house situated next to the dust house. In Faulkner's notebook there is reference to a 6-horse power dynamo 'of 1900' which was probably housed in this compartment. There is now no evidence on the ground for a wall or partition separating the dynamo house from the rest of the pump house, this may mean that this building complex was remodelled after the map was produced perhaps

in the late 1920s under ICI ownership. Two short headraces are also marked on the OS map leaving the main leat in the direction of the extended pump house. In the MMB (page 32) it is stated that 'there are two sets of pumps, one set being kept for use when the other is being overhauled'. Leaf mould that had accumulated above the floor of the cartridge press pump house was removed by National Trust volunteers towards the end of 2000; this revealed many structural details that would otherwise have remained hidden.

The surviving remains indicate that the extended pump house was built in a depression dug into ground that rises about 2.2m above the pump house on the north west. The superstructure no longer survives but was presumably timber framed and clad in wood or corrugated iron. The rectangular floor area is well preserved and measures 11m by 6m and is divided longitudinally into two parts; the one to the south east was the machine floor and the other to the north west was the turbine area (Fig 36). This second area consists of a stone-edged pit, rectangular in plan, and about 10.1m long, 2.4 m wide and 1.3m deep. Tubular iron railings have been erected around it to keep people out. Three smaller rectangular pits, about 1.2m deep, are spaced out at intervals in its bottom and, apart from the northernmost one (foreshortened slightly at the south-east), span the full width of the bottom. The bottom of the northernmost pit has collapsed into the main tailrace of the works which carried used water back to the river; its arched roof is just visible.

Figure 36.
Cartridge press pump house and near-by blast bank from the north east. (NMR: AA012904)

Each pit held a turbine and the slight difference in layout may reflect the point from which each was supplied with water and also the chronological development of the pump house;

the northernmost turbine pit, for example, lies within the area occupied by the shorter pump house depicted on the OS map revised in 1896. Water for the northernmost turbine pit probably came from the headrace of the nearby turbine house that produced power for the corning house. In the south-west side of this headrace, near its eastern end, there is an iron pipe, 0.5m in diameter with an integral metal plate above it, that seems to be heading towards the pump house. The metal plate is about 0.7mwide and extends upwards from the top of the pipe for another 0.7m. Water for the other two turbine pits was supplied from the main leat via a pair of purpose-built headraces. These two headraces are not identical (the southernmost is slightly shorter and narrower than its companion) which may mean that they (and the turbines which the served) were constructed at different times thus mirroring the initial establishment of the cartridge compressing houses. Any possible phasing may be even more complex because on the 1914 edition of the OS 25”map the northern most headrace is depicted as being the shortest of the pair. The tailraces terminate about 8m from the pump house and a pair of inclined iron pipes, one from each headrace, carried the water from the ends of the tailraces to the turbines (presumably this arrangement increased the force of the water hitting the turbines). Broken sections of these pipes, diameters 0.45m (northern one) and 0.35m (southern one), are visible protruding from the face of the scarp which rises above the north-west side of the pump house. The end of each headrace was fitted with a spade-like cast-iron sluice gate, 1.2m high, which controlled the flow of water entering the pipes. Each consisted of a plate set in a housing lowered and raised by a pole and thread mechanism; the latter still survives at the end of the northernmost headrace. A debris catcher, inclined at 45 degrees, was fixed to the side walls of each headrace in front of the sluice gates in order to prevent water-borne rubbish entering the turbines. Grooves, bolts and holes in the rendered side walls attest to their former existence. Two rotten timber beams, each held in a pair of slots, cross the north-west end of the southernmost tailrace beside the main leat. They carried the tramway, which here followed the eastern edge of the leat, across the headrace. The tramway also crossed the northernmost headrace and a pair of slots that held the ends of the supporting timbers still survive in the upper part of each of its side walls.

Returning to the machine floor, this is where the actual pumps were located but all have been removed apart from four machine beds. These appear to be made of concrete apart from the one at the north-east end which also contains bricks. Their measurements (working northwards from the south west) are as follows: 0.93m by 0.65m and 0.26m high; 1.3m by 1.36m and 0.04m high: 1.6m by 1m and 0.35m high with chamfered upper edge; 1.2m by 0.45m and 0.35m high - its upper edges (apart from the one to the south west) are chamfered. Most still have the stub ends of iron bolts, set in lead, which held the machines in place. Three angled chutes, of varying sizes, penetrate the floor along its north-western edge immediately above the turbines. They probably housed drive belts that linked the turbines to the pump machinery. The central chute has a timber beam still in situ, set horizontally into the floor alongside it; attached to it is a second beam angled at 45 degrees. Narrow drainage channels, whose upper parts are recessed to support iron gratings that no longer survive, cross the surface of the floor. Traces of a slot containing at least one iron bolt are

visible along the south-eastern edge of the floor; it may have been the seating for a wall plate.

The cartridge packing houses (27-29)

There were at least two - and probably three - cartridge packing houses at New Sedgwick which were in use at different times. Although cartridge compressing house 1 was also licensed in 1880 to pack cartridges (when permission was given to convert it from an expense magazine into a compressing house), it is clear from documentary evidence that a dedicated packing house was in existence by 1883 (Explosives Inspectorate 1883, 6). No doubt this was the packing house situated at the southern end of the works, about 40m to the south west of the saltpetre refinery complex. A second packing house was built at the very end of the 19th century in a deep cutting above the western side of the main leat near cartridge compressing house 2, but it had a relatively short life. There are the remains of a ruined building on the riverbank, 70m north north east of cartridge compressing house 1, that do not appear on any of the plans or maps used for this report, but James Guy recollects that it was also a packing house. For the purposes of this report the cartridge packing houses have been labelled 1 to 3; number 2 no longer survives as an above ground feature.

Packing house 1 (27)

This, the original cartridge packing house, was located at the southern end of the site. The report into the explosion at cartridge compressing house 1 (Explosives Inspectorate 1883) contains sufficient information about cartridge production at New Sedgwick to date the construction of this packing house to some time between March 1880 and April 1883. It is depicted on both the second (revised 1896) and 1914 (revised 1912) editions of the OS 25" map, as a rectangular building measuring 8m (north-east to south-west) by 4m with a narrow porch at its north-east end over the tramway which terminated at this building. It also appears on the site plans of 1900 and 1903-12 where it is numbered 24 and called 'Packing House'

The packing house has been demolished but its site is marked by a rectangular platform, 7.5m (north-east to south-west) by about 5.9m. Its south-eastern side is revetted with crude stonewalling to a height of 1m; this revetment also continues part of the way along both the south-west and north-east sides. The coal-derived clinker-covered floor of the platform is stepped by another revetment wall, following the platform's main axis and set approximately 2.7m back from the revetment along the south-east side. The space between these revetments consists of a very irregular stony hollow. The north-west edge of the platform is not very distinct but it may end at the foot of a large blast bank. The latter, about 2m high, is marked as a mound on the site plans of 1900 and 1903-12. A low bank together with a short stone revetment abut the south-west side of the platform and define a rectangular space measuring 3.8m by 3m - perhaps at some stage a shed or lean-to was attached to this end of the packing house. A slight shelf that must be the site of the tramway approaches the north-east end of the platform. Immediately adjacent to the latter, the south-east edge of the shelf is revetted in stone which may have formed a foundation for the porch.

Packing house 2 (28)

Between 1896 (Ordnance Survey 1898a) and 1900 the southern end of the deep cutting containing cartridge compressing house 2 was extended in a south-westerly direction for about 45m. It terminated in an expanded depression in which was built a second cartridge packing house. The cutting and packing house are first shown on the site plan of 1900; on this plan, as on the 1903-12 site plan, the packing house is numbered 29 and labelled 'Packing House'. The building had gone by the time of the 1914 edition of the OS 25" map (revised 1912), and must therefore have had a very short life. The cutting and expanded terminal still survived though and were depicted as an earthwork on this map. The site plans indicate that the tramway serving the nearby cartridge compressing house was also extended along the bottom of the cutting to serve the packing house.

There are now no visible traces of the packing house, probably because much of the extended cutting has been in-filled. All that survives of the southern part of the latter is an irregular linear hollow, up to 1.5m deep. Above this hollow to the east is a large flat-topped earthen mound, about 2.8m high, that was presumably made from spoil dug out during construction of the cutting. Surprisingly the mound does not appear on the site plans (or on the OS 25" map published in 1914) although it must have served as a blast bank providing a barrier between the packing house and the corning house which were about 65m apart. A flat-topped irregular mound, 0.7m high and with an oval depression at its eastern end, survives to the north west immediately above the remains of the packing house cutting. It is unlikely that it was part of the gunpowder works and is probably of World War II origin (it may have been related to the storage of munitions); multiple stands of heavily rusted barbed wire are visible nailed to the trees at its western end.

Packing house 3 (29)

The remains of a ruined building survive just above the river between cartridge compressing house 1 and the site of the first glaze house. No building is shown at this location on any of the maps or site plans consulted by EH for this report. Coverage is good for the first few years of New Sedgwick's existence and also for the final years of the 19th century and the first decade or so of the 20th century. It is likely, therefore, that this building was built and demolished either in the period between 1860 and 1896 or that it was constructed some time between 1912 and closure of the works in 1935. Davies-Shiel recorded the remains on his plan and suggested that they might represent an early corning house. This is most unlikely because, although the corning house was destroyed on several occasions, cartographic and documentary evidence indicate that it was always rebuilt on the same site beside the main leat. Tyler also depicts the ruins on his plan and identifies it as a smithy but gives no evidence for this assertion. It seems very unlikely that there would have been a smithy in this area of the works given the relatively close proximity of so many powder processing buildings. There is quite a lot of coal-derived clinker near the remains that may have influenced his interpretation but this type of clinker is present elsewhere on the site and appears to have been widely used as ballast for the tramway (it also occurs over the site of packing house 1). James Guy who was employed at New Sedgwick from 1924 to closure has a recollection that this was a packing house. This would seem to be a very

plausible identification given the presence nearby of both cartridge compressing houses. In addition, Faulkner's notebook compiled in *c*1925 refers to two packing houses at the works where women were employed to wrap the cartridges. Packing house 1 must have been one of them and as packing house 2 had been demolished well before this time, it seems very likely that the building under discussion was the other packing house. However, one of these buildings appears to have fallen out of use by the time the MMB was prepared because this source refers to only one cartridge packing house. Here six women were employed and a handwritten note has been added to the MMB (page 35) stating that this was sufficient to cope 'with the output from any two of the cartridge presses'.

Field remains indicate that the building overlooked the river and was set at the broad north-east end of a raised trapeze-shaped platform or spread of material about 0.8m high (perhaps the remnants of a demolished blast bank). A revetment wall, 0.9m high, must relate to the south-west side and south-east end wall of the building, while its north-east side is defined by a bank, 0.3m high internally, with an entrance gap at either end. These remains indicate that the building probably measured about 5.7m by 2.7m. The corner of the trapeze-shaped platform south east of the building has been revetted with stone to which traces of rendering still adhere. The north-western edge of the platform is followed by a linear hollow, up to 3m wide and 0.7m deep, with traces of a stone kerb along its north-west side; there is also a low back scarp beyond the hollow on this side. The hollow is either a path or the site of a spur that left the main tramway to service the building.

6.2.5 The storage of gunpowder at the works (magazines)

Expense magazines were small buildings used to store part-manufactured gunpowder between processes whereas the finished product was housed in a store magazine removed from the main part of the works where it was kept until despatch. According to the MMB (page 34) powder destined for blasting cartridges was also stored in barrels at the store magazine until the cartridge compressing houses were ready to receive it. One of the items stipulated by the 1772 Gunpowder Act was that gunpowder magazines or storehouses had to be of brick or stone and be situated at least 50yd (45.7m) from any mill building (Cocroft 2000, 28).

The expense magazines (24, 30-32)

In addition to the upper and lower expense magazines discussed below there is documentary evidence for at least two others. The lower expense magazine appears to have replaced an earlier one that was located on the eastern side of the main leat, between the incorporating mills and the first powder press house. This early expense magazine (30) was demolished to provide a site for the new powder press house that was being built in 1875 when the corning house and first powder press house exploded. The only reference to this expense magazine is contained in the newspaper report of the coroner's inquest into the deaths resulting from this accident (*Westmorland Gazette*, 7 August 1875). It may not have been built during the initial construction phase of the works because it does not appear on the first edition of the OS 25" map (surveyed in 1857) or on the 1859/1860 sketch maps. A building screened by trees is visible at this location on one of the 1873-1875 photographs

that may be this magazine (it seems unlikely to be the new powder press house because this was still under construction in 1875). The photograph shows a single storey rectangular building on top of a raised stone base with a hipped roof and two openings (possibly ventilation shutters) in its east wall.

This second expense magazine (24) is depicted but not labelled on the first edition of the OS 25" map surveyed in 1857 and situated on top of the riverbank some 80m to the east north east of the corning house. It was converted into a cartridge compressing house as a result of Amending Licence 113 dated 3 March 1880 (Explosives Inspectorate 1883, 2). More detailed information about this magazine is contained in the description of cartridge compressing house 1 (see section 6.2.4 above).

The upper expense magazine (31)

This was situated about 45m to the north east of the corning house and may have been built in 1880 as the successor to the early expense magazine near the river which was converted into cartridge compressing house 1 during that year (see above). It is just possible that the upper expense magazine replaced an earlier building (of unknown function); a white feature, largely concealed by trees, is visible at this location on one of the 1873-1875 photographs which could be either part of a building or merely an area of snow. The expense magazine is first shown on the second edition of the OS 25" map of 1898 (revised 1896) and again on the edition of 1914 as a rectangular building, 5m by 4m, with a porch over the tramway which ran outside the north-west wall, along the eastern edge of the main leat. On the site plans of 1900 and 1903-12 it is labelled 'Upper Expense Magazine' and bears the number 14. The upper expense magazine suffered during the glaze house explosion of 1903 when its roof was damaged, its window blown out and the door blown in (Explosives Inspectorate 1903, 5). The building has been demolished but the pair of blast banks that flanked it, one to the north and the other to the south, are well preserved and are also shown on the OS maps and site plans. A stone wall surmounted by a trapezoidal parapet, 2.3m high overall and designed to prevent the banks collapsing on to the tramway and into the leat, revets the western end of each bank. The inner side of both blast banks has been slightly cut back by the creation of a caravan pitch between them. A third blast bank, mound-like rather than linear in form, is situated between the southernmost of the pair of blast banks and the site of the corning house. It is not marked on the OS 25" mapping but is depicted on the site plans of 1900 and 1903-12 where it is labelled 'Mound'; presumably it was designed to give additional blast protection to both the corning house and upper expense magazine should one of them explode. It appears to be of earth, is about 3.2m high, and partly overlies a bank of material that flanked the eastern side of the tramway in this area.

The lower expense magazine (32)

This was situated about 53m to the north of the incorporating mills and had been built by June 1875. It apparently occupied the site initially chosen for the new powder press house but this intention was changed and the latter was built about 40m to the east north east (*Westmorland Gazette*, 7 August 1875). The magazine is shown on the OS 25" maps of 1898 and 1914. On the site pans of 1900 and 1903-12 it was numbered 10 and labelled

'Expense Magazine'. It was built into the natural slope and the maps indicate that it was a rectangular building measuring just less than 8m east to west by about 5m wide. The plans show what looks like a short blast wall extending north from near its north-east corner. The eastern part of the magazine survives as a stony hollow, about 0.7m deep, perhaps indicating that this end of the building had a raised floor and was used for storage. Powder was brought to the western part of the magazine from the south via a spur from the main tramway. The maps indicate that in front of the magazine walls revetted the tramway, one on each side. On the ground this part of the course of the tramway survives as a short cutting, 1.4m wide, with the revetment walls surviving to a height of 0.8m. An 'L'-shaped earthen blast bank, 1.7m high, on the south and east helped to give protection from explosions in the powder press house and incorporating mills. Given its closeness to the incorporating mills, ripe charges were also probably stored in this magazine. Indeed James Guy said, when interviewed, that ripe charges were 'taken and put into a ripe charge house or expense magazine'. Further support is provided by the entry for the powder press house in Faulkner's notebook, which under powder refers to both the ripe charge house and expense magazine.

The southern end of the tramway cutting leading from the expense magazine has been levelled and is now occupied by a propane gas cylinder on a concrete platform. The gas is used to heat a modern toilet block, situated a short distance to the west and belonging to the caravan site. The toilet block is marked on the plan in Wilson's guidebook but is incorrectly placed for it is drawn partly on and extending east of the site of the lower expense magazine (Wilson nd). Patterson compounded the error by including the eastern part of Wilson's toilet block on the plan in his book, numbering it 13, and interpreting it as a toilet block associated with the works. He similarly failed to appreciate the origin of the modern toilet block (also on the plan in Wilson's guidebook) which is located above the western side of the main leat, south west of the corning house; on the plan in Patterson's book this toilet block is numbered 9.

The store magazines (33-35)

New Sedgwick had at least one and possibly as many as three store magazines, which were not all in use at the same time. They were located west of the main leat in the eastern end of Low Park Wood well away from the main manufacturing part of the works. This location provided good natural blast protection in the form of low hillocks and standing timber. For the purposes of this report the store magazines have been labelled 1 to 3.

Store magazine 1 (33)

Earthworks situated on the lower south-east slope of a hillock, some 80m west of the former mixing house, may represent the earliest magazine. Nothing at this location is shown on any of the maps or site plans consulted by EH which provide good coverage for the first few years of New Sedgwick's existence and also for the latter part of the 19th century and first decade of the 20th century. It is likely therefore that the earthworks relate to a structure that was constructed either between 1860 and 1896 or after 1912. However, as store magazine 2 (the only documented store magazine, known to have been in existence by 1896) occupies a better protected location that is even further away from the processing

buildings, it seems unlikely that the earthworks are those of a store magazine built between 1912 and closure of the works. Moving the store closer to the main part of the works would seem to be a retrograde and thus unlikely step. It is even possible that the earthworks belong to the World War II activity at New Sedgwick, but their form and relationship to other gunpowder features at the site makes this unlikely. Most probably the earthworks represent the site of the original store magazine that was built by the Sedgwick Gunpowder Company Ltd., perhaps around 1860, and which was later replaced by store magazine 2; the latter may have been erected soon after 1864 when the New Sedgwick Gunpowder Company took over the works. But, it is just possible that they are the remains of something else connected with gunpowder manufacture, such as the site of the charcoal retorts and associated coppice barn (see the charcoal house, section 6.2.2 above) which may have gone out of use in 1884 and whose location is also not known.

Amongst Richard Shaw's plans of 1859 are drawings for a magazine which may, as Crocker (1993, 14) suggests, have been for a store magazine. The magazine is essentially the same on these drawings (a single-storey rectangular building measuring 24ft (7.3 m) by 20ft (6m), but two alternatives are given for an entrance - one a covered loading shed and the other a porch (KRO: WD/CAT/A1951). Perhaps these were the blueprints for store magazine 1. The other possibility is that the plans were intended for an expense magazine at New Sedgwick, and in this respect it is interesting that the dimensions on the drawings are very similar to those of the early expense magazine (converted into cartridge compressing house 1 in 1880) situated near the riverbank. But map evidence indicates that this magazine was erected in 1857 (unless it was later rebuilt). The only other known early expense magazine at the works is the one that was demolished to provide a site for the new powder press house (erected during 1875). However one of the 1873-1875 photographs appears to show part of this magazine; sufficient is visible to confirm that it was not based on Shaw's design.

The earthworks of this probable store magazine consist of an approximately rectangular depression, about 8m long (north west to south east) by 4m and 0.9m deep, embanked on the north-east side; access into this feature was from the south east. The depression may have been designed to provide ventilation for a building with a raised floor built above it. To the south of the depression are the remains of a small platform with a stone revetted front scarp (0.5m high) and a cut scarp (0.4m high) defining its rear edge. The depression and platform were approached from the east by a cinder track measuring up to 5m across and with remnants of a stone kerb, 0.2m high. The track loops back on itself to form a turning circle in front of these features, which suggests that it may have been laid out with horse-drawn carts in mind. Store magazine 2 at New Sedgwick, like the one at the Cylinder Hill sub-site at Elterwater Gunpowder Works (Jecock *et al* 2003, 21), was similarly provided with a turning circle for carts. The eastern part of the cinder track appears to continue the line of a track, depicted on the later editions of the OS maps, heading west from a thoroughfare in front of the saltpetre refinery complex (see section 6.2.10 below).

Store magazine 2 (34)

This building was positioned behind and on the west side of a small hillock just over 150m west of the earliest block of incorporating mills. It is depicted on the second and 1914 editions of the OS 25" mapping (revised respectively in 1896 and 1912), and also on the site plans of 1900 and 1903-12 on which it is labelled 'Store Magazine' and numbered 23. This may be the magazine which Tyler (2002, 198) refers to as having been built in Low Park Wood by the New Sedgwick Gunpowder Company Ltd. who acquired the works in September 1864. The maps are consistent in showing a long building (18m by a maximum of 10m in width); its northern side was made up of a number of short projections producing a stepped-like appearance. It no longer survives above ground and its site is occupied by a caravan pitch, but the track from the main part of the works and the turning circle which serviced it seem to be preserved in the present internal road system of the caravan park. The site of the store magazine lies just outside the western limit of the area surveyed at large-scale by EH.

Store magazine 3 (35)

A large square building that is only shown on the 1903-12 site plan may represent a third store magazine. It is neither numbered nor labelled suggesting that it may have been a temporary structure not directly concerned with the actual manufacture of gunpowder. It lay at the northern foot of a natural hillock, about 170m north west of the earliest block of incorporating mills, on the south-west side of a track leading from the main part of the works into Low Park Wood. In front of the building the track was widened to form a loading/ unloading area. Patterson (1995) was unable to find a function for this building (numbered 28 on his plan), Davies-Shiel (*pers comm*) thinks that it may have been a packing house while Tyler (2002, 202) suggests that it was a magazine. It was clearly part of the gunpowder works because it was within the licensed area but it is not near any power source and its distance from the process buildings, together with its location in the same area as the other two magazines, may mean that it was indeed a store magazine. Its non inclusion on the 1914 edition of the OS map (revised 1912) indicates that it had a very short life and may simply have been erected, for example, so that store magazine 2 could be refurbished. Store magazine 3 belongs to the period following the glaze house explosion of 1903, which resulted in a major building programme taking place at the northern end of the works. It seems not impossible that refurbishment or upgrading of buildings required elsewhere on the site may also have been added to this programme. This possible store magazine no longer survives and its location was not included in the area surveyed at large-scale by EH.

6.2.6 Testing the gunpowder

Testing of the finished gunpowder for its quality and reliability was initially carried out by firing a mortar over a measured distance on the proofing range. Later such tests were supplemented by less visual demonstrations carried out in a proofing house.

Proofing range

One of the most striking features at the works is the site of the proofing range which consists of a long avenue of trees orientated south south west to north north east, parallel

Figure 37.
The proofing range from the south. (NMR: AA012928)

with the main leat situated about 60m to the west (Fig 37). Near its northern end the avenue is joined by a second but much shorter cross-avenue and together they produce a cruciform plan that dominates the central manufacturing area. The proofing range is laid out so that its southern end opened on to the space between the saltpetre refinery complex and the charcoal store. The date of the range is uncertain: it does not appear on the 1873-1875 photographs (at that time the central area appears to have been an open grassy space), nor is it shown on the second edition of the OS 25" map (revised 1896), but it is depicted on the 1914 edition (revised1912). On this map the trees making the cruciform plan are shown rather schematically and not individually, which may indicate that they had yet to become well established. A similar proofing range, dating to the latter half of the 19th century, existed at the Oare Gunpowder Works in Kent and was lined with Wellingtonias (Cocroft 2000). There is no practical reason for the cruciform plan but local tradition has it that the trees were planted as a memorial to those killed in World War I. The cartographic evidence

clearly demonstrates that this cannot have been the case because the avenues existed before the war broke out. If there is a connection with the commemoration of war dead then the Second Boer War may be a more likely context. In May 1900 the workforce at New Sedgwick was given a half day paid holiday to celebrate Queen Victoria's birthday and 'as a recognition of the relief of Mafeking' (*Westmorland Gazette*, 26 May 1900); this suggests that the events in South Africa were very much in the public's mind. According to James Guy, around 1916 a small test mortar was situated at one end of the long avenue for firing balls down the range. A photograph of the New Sedgwick mortar has been published (Tyler 2002, 214).

Both avenues still survive; the trees are of sycamore (with the exception of a horse chestnut and copper beech at or near the southern end of the long avenue) and are planted about 6m apart (probably representing an original planting space of 20ft). A number have died or been felled but the National Trust have replaced some with saplings. Sycamore was probably chosen because it is fast growing, while the choice of two different species of trees at the southern end suggests a desire to create an ornamental approach. Apart from at the northern end, the trees of the long avenue have been planted on a pair of low banks, one on either side of the avenue, which stand to a height of 0.3m. The interior of the avenue between the banks has been roughly surfaced with coal-derived clinker. No evidence for embanking or surfacing is visible in the short avenue suggesting that it had a purely ornamental or commemorative function. Burrowing animals (or World War II activity) have probably created a large amorphous hollow within the eastern part of this avenue, 0.4m deep. A separate length of bank is visible just beyond the eastern side of the long avenue near its southern end. Its function is uncertain, but its proximity to the avenue and similar form to the banks of the latter raises the possibility of it being the remnants of an even earlier proofing range.

Proofing house (laboratory) (36)

The proofing house was situated 40m north of the works entrance in the unlicensed area. It first appears on the 1914 edition of the OS 25" map (revised 1912) and survived until 1977 when it was demolished during alterations for the caravan park. On the map it measures just over 4m long and slightly less in width. The proofing house, although obscured by vegetation, is visible on National Trust photographs of the works dated 1977 (Fig 38). They show a single-storey affair whose sides were clad with tongue and groove boarding and entered on the east through a porch with a window on its south side. The porch roof, gabled west to east, was covered in corrugated iron sheet and was embellished with a decorative metal ridge crest and (at its east end) a finial. The main roof was gabled north to south with a pointed finial at each end of the ridge. A brick chimney stack with a ceramic chimney pot is visible at the north end of the building indicating that it had a fireplace.

A water pumping station that serves the gate house cottages now occupies its site. The pumping station lies within a rectangular excavation - cut 1.2m into the natural slope - which is probably the platform originally created for the proofing house.

Figure 38.
The proofing house in 1977, from the south. (Reproduced by permission of the National Trust)

6.2.7 Ancillary buildings within the powder manufacturing area (37-47)

These include a watch house, an office, a shed for empty tubs and a number of small buildings, some of which were privies. In addition to the buildings described below a tiny rectangular structure, 4m long by a little over 2m wide, is depicted on the 1914 edition of the OS 25" map where two tracks cross in the southern central part of Low Park Wood at NGR SD 5060 8806. It was a long way from the gunpowder manufactory (340m to the north west of incorporating mill 1) which may mean that it was not related to the works at all. As a result it has not been numbered or included on any of the diagrams produced for this report.

The watch house (37)

The first reference and depiction of a watch house at New Sedgwick is contained in the architect Richard C Shaw's drawing of 1859 for a new saw mill which also incorporated a watch house and a clock tower above the turbine house (CRO(K), WD/CAT/A1951) (see also section 6.2.9 above). The new saw mill was probably built in 1859 but it is not known what provision was made for a watch house before this date. References to a watch house and fire engine in newspaper articles (*Westmorland Gazette*, 3 July 1875; 7 August 1875) indicate that by the late 1860s or beginning of the 1870s the watch house adjacent to the clock tower had been supplemented or replaced by a second, more centrally placed and more widely visible watch house overlooking the centre of the works. This new watch house is shown on the second edition of the OS 25" map (revised 1896) as a rectangular building, measuring about 12m by 8m, situated a short distance to the west of the saltpetre refinery complex. On the 1900 site plan this building is numbered 20 and labelled 'Watch House, Oil House & Fire Engine Shed'; it is similarly numbered on the 1903-12 site plan which simply describes it as 'Watch House'. Two extra cells, one on its north-west side and the other to its south-west end, had been added by the 1914 edition of the OS map (revised 1912); they more than doubled the size of the watch house. The 1900 site plan is particularly

important because it identifies where the fire engine was housed. It has been suggested (Crocker and Crocker 1992, 9) that this was one of the functions of the open-fronted shed south of the cooperage but this location is rather far removed from the main part of the works where the engine would have been needed for the washing down of process buildings (to remove gunpowder residues) prior to maintenance and to put out fires. It is possible that the works lacked a fire engine during the early years because in April 1859, when a small fire broke out in a shed, the fire engine from the nearby Basingill works was borrowed (*Westmorland Gazette and Kendal Advertiser*, 16 April 1859). The newspaper account into this incident conveys the impression that the New Sedgwick workforce was inept at using this kind of appliance, but the works certainly had its own fire engine by about 1869 (*Westmorland Gazette*, 28 October 1871). The watch house must also have provided changing facilities because according to a newspaper account 'a robing room' was speedily added to the former after the corning and powder press houses exploded in 1871 as a result of 'a suggestion from the Government Inspector' (*Westmorland Gazette*, 7 August 1875). This accords with James Willacy's recollection that the changing rooms were located in the middle of the works. There is a handwritten note in the Patterson Collection that a 'man's clothing took fire in [the] watch house' on the 24th of December 1919. This second watch house does not survive and its site is currently occupied by the reception car park for the caravan site.

The possible search house (38)

A long rectangular building, measuring almost 16m by 5m, is depicted on the first edition OS 25" map and on the 6" map (both surveyed 1858) at the northern end of the site, south-west of the weir and to the west of the main leat. It is shown abutting the western side of a path, which on the 25" map appears to have been widened in front of and to the south of this structure, that extended south from Hawes Bridge and through the works on the west bank of the river. This public footpath existed before the works was built and the Justices ordered its closure at the Kendal Quarter Sessions in January 1860. The footpath was diverted to the east bank of the river via a recently built footbridge situated just outside the southern end of the works. The bridge must have been erected very early on in the life of the works because it is shown on the 1859/1860 sketch maps associated with the closure and re-routing of the footpath (see section 6.2.9 below). Returning to the long building, its only known depiction is on these OS maps suggesting that it had a short life. It was a considerable distance from the rest of the works so it seems unlikely to have been a process building (although it is not known where buildings such as the heading house were located during the early years). Before the footbridge was built (allowing easy access to the entrance at the southern end of the works), gunpowder employees living north of New Sedgwick, especially on the east bank of the river, may well have come to work via Hawes Bridge and entered the site at its north end. This building could have been erected to provide search and changing facilities for these workers and presumably ceased to function once the footbridge had been opened.

The building has gone but its site survives as a very low platform, about 12m (almost north to south) by 5m and at best 0.2m high, on top of the narrow natural terrace between the river

and the valley side. The western side of the platform may even have been cut into the foot of the natural slope whereas a slight bank marks its northern end. Another bank, up to 3m across and 0.3m high, is situated 6.5 m to the east of the building. It may mark the eastern edge of the track that was widened in this area or even the remnants of a small thoroughfare in front of the building. A low bank, adjacent to the weir, crosses the track 30m north of the possible search house. When the footpath was formally closed in1860 it was ordered that it 'be stopped up with earth' (CRO(K) WQ/O/15) and it is possible that the bank relates to this. Alternatively it and a hollow at its eastern end may belong to the World War II activity at New Sedgwick and be the remains of a checkpoint; there is much rusty barbed wire nailed to the trees in the vicinity.

The office (39)

A small rectangular building, labelled 'office', is depicted near the north-east corner of incorporating mill 6 on two of the 1859/1860 sketch maps (CRO(K) WDB/35/779; WDB/35/564). It is not shown on any other map or plan and was probably demolished when the northern range of incorporating mills was built which appear to occupy its site,

The shed for empty tubs (40)

The second edition OS 25" map (revised 1896) shows a small rectangular building, about 3m by 1.75m in size, situated approximately 4.5m to the east of the ripe charge house. On the 1900 site plan it is numbered 30 and labelled 'Shed for empty tubs'. It appears to have gone by 1912 when the map was revised for the 1914 edition. A building is not shown at this location on the 1903-12 site plan, but another building with the same label and number has been sketched on the plan a short distance north west of the wheel pit of the northern group of incorporating mills. This is clearly a mistake because this 'building' is merely a part of the headrace that brought water from the main leat to the waterwheel and is shown as such on the OS 25" maps.

The privies north of the corning house (41 and 42)

A small, rectangular building (41), that no longer survives, was situated just north of the corning house and is depicted on both the site plan of 1900 and also on the sketch plan accompanying the Explosives Inspectorate report into the glaze house explosion of 1903. On these plans it is numbered 13 and on the 1900 plan it is labelled 'Privy'. By the time the site plan of 1903-12 was prepared it had been replaced by a second privy (42) located about 25m to the north east in the area immediately south of the southernmost of the pair of blast banks that flank the upper expense magazine. This plan also numbers it 13 and calls it a privy. It is possible that the first privy was destroyed or relocated as a result of the glaze house explosion in 1903, which also destroyed the corning house. The second privy similarly no longer survives (it could even have gone by 1912 because it is not depicted on the 1914 edition of the OS 25" map) but its site may be represented on the ground by a shallow rectangular depression measuring about 3m by 2m. A slightly hollowed linear feature, about 2m wide and 0.3m deep, leads away from its north-east corner and is possibly the remains of a path.

The small building at the southern end of the licensed area (43)
The southern end of the licensed area was marked by a drystone wall, now reduced to a stony bank, which was part of the original boundary wall around Low Park Wood. A small roofed structure, of unknown function, was built adjoining its northern face; the building is shown on both the second (revised 1896) and 1914 editions of the OS 25" mapping. It no longer survives but a slight broadening in the remains of the stone wall may reflect its former presence. Perhaps it was a privy for the men who worked in the preparing house, situated 30m to the north.

The small building near packing house 1 (44)
The second (revised 1896) and 1914 editions of the OS 25" mapping show a small, almost square building on the riverbank a few metres south east of packing house 1. It no longer survives but it may have been a dedicated privy for the women who worked in the packing house.

The small building near the western range of incorporating mills (45)
A tiny rectangular building, situated about 3m to the south of the waterwheel house of incorporating mills 1-6, is depicted on the OS second edition 25" map (revised1896) and also on the edition of 1914. Although crudely shown on the 1900 site plan, it was neither labelled nor numbered. Its purpose is not known, but it may have been related to the incorporating mills given its close proximity to them. It no longer survives, but measurements taken from the 1914 OS map indicate that it was about 2.75m by 2m in size. Perhaps it was a privy for the mill workers.

The possible building near the ripe charge house (46)
A tiny rectangular building, of unknown function, with a projection on its south side was roughly sketched on the 1903-12 site plan about 25m to the north east of the ripe charge house. It is not known if it was ever built, because its only known depiction is on this plan where it is neither labelled nor numbered.

The small building at the northern end of the works (47)
What appears to be a rectangular building, approximately 8m (east to west) by 4m, is marked on the first edition of the OS 25" map (surveyed 1858) about 80m south of the possible search house (see above). It no longer survives but was situated on the western edge of the main leat. The only evidence for this structure is the map but the latter gives no clue to its function. The EH survey has indicted that it was situated in the bottom of a small quarry pit. If this building was connected with the gunpowder manufacturing process (against this is its distance from the rest of the works) then the western side of the quarry pit would have provided limited blast protection.

6.2.8 Other gunpowder related features within the powder manufacturing area

This section is concerned with blast banks and the evidence for stone and gravel/earth quarrying.

The blast banks (Fig 10)

Blast banks and blast walls are generally closely associated with a particular building and have therefore been described with the relevant process house. The blast banks, especially the smaller ones, appear to be routinely omitted from the OS maps with the result that dating these features is often difficult. In the case of the store magazines, blast protection was also provided by natural hillocks. Some of the process buildings were also placed in the bottoms of large depressions dug into the natural slope that helped to provide additional protection.

The quarries

A stone quarry, cut into the side of the valley on the west bank of the river, is present near the northern end of the site. It is first shown on the second edition of the OS 25" map (revised 1897) and had nearly doubled in size by 1911 when revision took place for the 1914 edition (Ordnance Survey 1914b). It must have provided stone for building and repair at the works and it is tempting to equate its increase in size between the two maps with the major rebuilding programme following the glaze house explosion of 1903. The quarry still survives and measures about 38m (north to south) by 18m; its west face rises to a height of *c*8m. It is similar in shape and area to the 1911 OS map depiction. Earthworks in its bottom suggest that its northern end may have been used for storing munitions during World War II.

Tyler (2002,196) says that large quantities of stone were also obtained from beyond the works on the eastern side of the river. On this bank of the Kent there is a large abandoned stone quarry at NGR SD 5103 8818, opposite the new stove house, which is shown on an estate map of *c*1850 (CRO(K) WDB/22/68.5), but it does not appear on any of the OS maps which is surprising if it was still being used in the latter part of the 19th century. It has also been suggested that this may have supplied the stone for the gunpowder works at Old Sedgwick (Jecock and Dunn 2002, 34).

A quarry pit also survives at New Sedgwick, cut into the side of a natural hillock, to the west of the incorporating mills. It first appears on the second edition of the OS 25" map (revised1896) on which it is labelled 'Gravel Pit'; it is depicted too but not labelled on the 1914 edition of the map. Close inspection of its eroding sides indicates earth rather than gravel; perhaps it was created to provide material for blast bank construction. It lies just outside the boundary of the EH large-scale survey and is currently used as a caravan pitch; its steep sides are up to 4.5m high.

6.2.9 Buildings and structures outside the powder manufacturing area

These are situated at the southern end of the works in the unlicensed area and include the work's entrance plus nearby suspension bridge, a clocking-in shed, a gate house, a cooperage/sawmill complex, an open-fronted shed and a stable with a possible water trough nearby. There were also a number of ancillary buildings that no longer survive.

The entrance to the works and nearby suspension footbridge

It was forbidden to bring any item into the gunpowder works that might cause an explosion, from obvious items such as matches to clothes with metal buttons. These regulations were normally enforced by searching workers, and often visitors too, at the entrance to a gunpowder works (Fitzgerald 1895, 307). How strictly such a precaution was observed varied from site to site; at Elterwater the foreman was criticised by the HM Inspector for allowing workers to come and go as they pleased during the day (Explosives Inspectorate 1878, 5-6). At New Sedgwick, although the main entrance to the works was always at the southern end of the site, initially employees coming from the Natland and Kendal areas to the north and north east may have entered the site at its northern end (see section 6.2.7 above). Apart from the ford across the Kent at the south end of the Old Sedgwick Gunpowder Works, the nearest bridge giving access from the east bank of the Kent to the southern end of New Sedgwick was situated lower down the river at Basingill (Force Bridge). This was an inconvenient location for northern workers and their use of the bridge would have necessitated a lengthy detour. All this changed when the Sedgwick Gunpowder Company Ltd. built a new footbridge across the river immediately beyond the southern entrance. The footbridge is not shown on the first edition OS 25" map (surveyed 1857) but is marked on the1859/1860 sketch maps; on one with a date of 1859 it is labelled 'New Wood Bridge' (CRO(K) WQ/A/H/15) (Fig 6). In the first few years a public footpath ran through the works, an unsatisfactory and dangerous state of affairs. The bridge may have been built both to discourage the public from walking through the works and also to ensure that all employees came in at a single point of entry for searching, clocking in etc. In January 1860, following a decision taken at the Kendal Quarter Sessions (CRO(K) WQ/O/15), the works part of the footpath was legally closed and re-routed along the east bank of the river via the footbridge. The latter was swept away

Figure 39.
The suspension footbridge across the River Kent, from the north east. (NMR: AA012831)

in October 1874 during a flood (*Westmorland Gazette*, 7 August 1875). The bridge was rebuilt (work probably started soon after the flood) by Francis James Willacy as a suspension bridge (Fig 39) which (according to his great grandson (David Willacy)) is reputed to contain suspension rods reused from an earlier bridge in Scotland. The suspension bridge may have been better suited to the wide river crossing and thus less vulnerable to damage than the earlier wooden bridge. By 1982 the suspension bridge was in need of restoration and this was undertaken in 1988; on reopening in April 1989, the ribbon across the bridge was cut by Mrs Thomas Hornyold-Strickland of Sizergh Castle (*Westmorland Gazette*, 14 April 1989).

At the southern entrance of the works a high stone cross-wall extended between the main entrance gate and the riverside ensuring that workers had to pass through either the main gate or a smaller doorway in the wall to the south of the former. The path to the doorway was revetted on its eastern side. Searching would not necessarily involve a dedicated building - none are shown on maps - although a later extension to the gate house (see this section below) might have also been used for this purpose.

The clocking-in shed (48)

The clocking-in shed (Fig 40), a small timber-clad building immediately inside the entrance to the works, was erected after 1912 (Ordnance Survey 1914a). It is built upon a stone-revetted platform with a concrete floor. The shed is divided by a brick wall into two compartments; the smaller one to the south was used for storing the work's bicycle and the main compartment contained the clock and two opposing racks for the 'IN' cards and the 'OUT' cards (James Willacy, *pers comm*).

Figure 40.
The clocking-in shed from the north west. (NMR: AA012833)

The gate house: offices and foreman's house (49)

The gate house (Fig 41), now numbers 1 and 2 'Gate House Cottage', formed part of the original gunpowder works and is shown on the first edition of the OS 25" map (surveyed 1857). The building, as its name implies, stands at the entrance to the site, and its substantial size and internal arrangement indicate that it was built to combine the functions of gate house and foreman's house (confirmed by James Willacy). The positioning of the foreman's house beside the main entrance meant that the foreman was ideally located to supervise and control people and traffic entering or leaving the works. The building was slightly extended before the OS map revision of 1896 and was divided into two cottages after the works closed.

Figure 41.
The gate house from the south east. (NMR: AA012835)

The original building of 1857 had a two-storey main block, gabled to north and south, with a narrow wing, two storeys high over a cellar, and with a single-pitch roof, projecting from the rear south-west corner. By 1896, when revision for the second edition of the OS 25" map took place, a gabled single-storey extension had been added to the rear of the house, abutting the original wing, and a free-standing gabled single-storey outbuilding had been erected behind the wing, and a small addition, since demolished, had been added to the front. The house and the additions are built of coursed rubble, the east elevation of the house retaining the slobbered mortar which must have characterised its original appearance, the other walls having later, denser render. The roofs are all slated.

The two-storey main block has four rooms on each floor, two at the front and two at the rear, those on the ground floor with fireplaces set back-to-back in a central cross wall which runs from the rear, those on the first floor set in the gable-end walls, an unusual arrangement

which explains why the house has three chimney stacks rising through its roof. The original fenestration of the house has been subject to some changes, but most of the original windows have segmental-arched heads with stone rubble voussoirs: where these are hidden by later render, the distinctive shape of the window head can still be observed. When, no doubt soon after 1857, a weighbridge, identified by the letters 'W. M.' for weighing machine on the OS map revised in 1896, was installed in the road in front of the gate house, immediately inside the gates, an office to serve it was also built against the front elevation of the house (Fig 42); the office is visible on one of the 1873-1875 photographs. Another photograph in the Willacy Collection indicates that this office was replaced, probably during the early 20th century, by a structure that was different in form. James Willacy when interviewed described it 'like a porch affair - came out with the weighing arm inside it, you see and you just stepped out of the office door into this place and every vehicle was entered, they were put down, the gross and the tare and the net'. Perhaps this structure was demolished in 1938 when Henry Hornyold-Strickland turned the whole of the gate house into residential use (see below). Changes to the fenestration of the east wall, namely the displacement of the original window lighting the first-floor south room when a toilet with its own its own small window was created within it, are also likely to date from the division of the building into two cottages. The south wall has two original ground-floor windows, that on the first floor being an insertion which cuts a blocked fireplace opening, and the rear wall has three original windows. The north wall has a single ground-floor window, evidently original; the doorway replaces an original stair window.

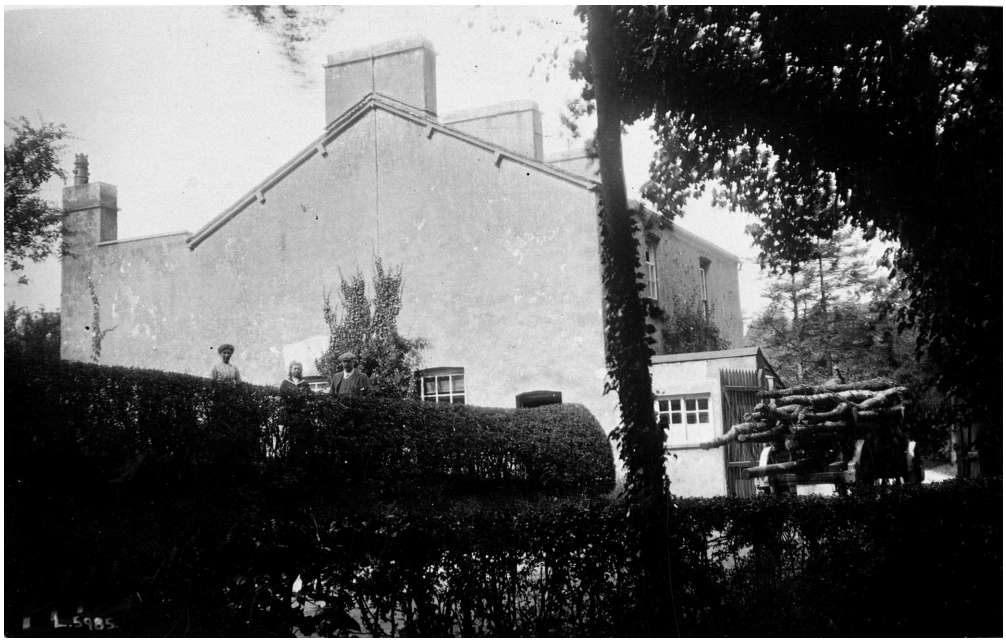

Figure 42.
The gate house and weighbridge office (prbably in the late 19th or very early 20th century) from the south. (NMR: AA035270, reproduced by permission of David Willacy)

The house has two original front doorways in its south gable wall, one into the front room, the other into the rear room, both reached from a path which opened from the roadway immediately in front of the gates which controlled access into the site. Of the two doorways into the house, both are now covered by open timber porches with slated roofs, that at the front opened into a single room which must have been intended as a general office which, in conjunction with the later office associated with the weighbridge, controlled and recorded people and the delivery of raw materials and the despatch of gunpowder. A doorway (later

converted into a window which still survives) in the east wall of the gate house provided access between these two offices. The rear door was the front entrance into the foreman's house, of which the remaining three ground-floor rooms of the main block formed part. All three rooms, arguably a dining room and parlour at the rear and a private office at the front, were interconnected, and there was also a doorway between the private office and the front room which was a general office. The first floor of the foreman's house was reached by a staircase which rose against the rear wall of the north front room. The staircase had a lobby at its foot which must have been lit by a window lost when the present doorway was inserted. The staircase rises in a straight flight to a small square landing from which doors originally opened into both front rooms and into the rear north room. The doorway into the rear room was blocked when the house was subdivided which was no doubt when the combined bathroom and toilet was created in the corner of the south front room and the fenestration altered. The rear south room appears originally to have formed part of the service quarters, reached from the first floor of the original rear wing. In 1938 Henry Hornyold-Strickland 'Redecorated the old gate house of the Gunpowder Works & installed Council water at a cost of £111, making it quite an attractive residence', the following year spending a further £47 'providing new bath & range' (Strickland Archive, Sizergh Castle).

The house retains a number of original mid 19th-century fittings, including some door and window architraves which incorporate mouldings cut on the splay, a shape still in use today but one which was newly introduced at this time and was thus then the height of fashion. A number of doors with four sunk panels survive, the mouldings like those of the architraves but combined with a bead. An elaborate chimneypiece of black-veined marble, with a moulded shelf supported on brackets with colonettes, survives in the ground-floor rear south room and another chimneypiece in the rear north first-floor room has a stone surround with chamfered and stopped edges.

The foreman's house had an external doorway into the dining room, from within which a door led directly into the rear wing. This, when first built, had a single ground-floor room with a fireplace opening wide enough for a kitchen range in a stack against its rear wall. Its north wall, which must have contained a door and window, was taken down on or after the construction of the addition against its north side. A partition at the south end of the kitchen hides steps down to a cellar, which only extends under its south half, and a staircase up to a room on the first floor, from which a doorway opens into the first-floor rear south room in the main block. The entrance into the latter room has mid 19th-century fittings, but the doorway from it into the rear north room has a modern door and architrave, confirming that it belongs to the subdivision of the house.

The gabled single-storey addition, which abuts the rear wall of the main block and the north side of the wing, and which was built between 1857 and 1896, may have been a scullery. It has two north windows and a west doorway, the latter with a mid 19th-century four-panelled door which could be the reset outer kitchen door. An entrance lobby with a north door shields this doorway. A small outhouse and earth closet, erected by 1896, is situated

immediately west of the cottages. The surrounding slope has been cut away to accommodate the building and is revetted by a stone wall, almost as high as the outhouse itself.

Features west of the gate house (50-51)
The land to the west of the foreman's house, which now serves as garden and paddock to Gate House Cottage, has only recently been enclosed, but there is some evidence to suggest that it was used as a smallholding by the foreman. Narrow cultivation ridges, between 1.2m and 2m wide, survive along a slight north-facing slope within the paddock and are bounded on the north by a low bank, 0.2m high; they may be the remains of lazy beds or an attempt to improve the pasture.

A pig-sty (50) may have been situated on a rectangular platform, 12m by 6m, terraced into the slope, to the west of the gate house. Orientated approximately east to west its rear scarp is up to 1.3m high. The spoil from the cutting has been partly dumped to form a bank on its northern side, 0.7m high, but much of the material must have been pushed forwards, creating a level area to its east. An enclosure with a small roofed structure at its western end, probably an animal pen and shelter, is shown here on the second edition of the OS 25" map (revised 1896); a building is also depicted on the 1903-12 site plan but had gone by 1912 (revision date for the 1914 OS map). The effort that must have been expended in the construction of the platform appears to be disproportionate to the function of the structure shown on the map; the platform was used during World War II and it is therefore possible that it was created then, thus removing any traces of the earlier feature (see section 6.3.1 below).

The second and 1914 editions of the OS map also show a small building (51) to the north of the platform. Currently a corrugated iron shed occupies the site. The latter may date to World War II but it is likely that this shed replaced the earlier structure, which would have left a ready-made building platform. The original may have been a chicken coop or something similar. Closer to the gate house, two small earthen platforms lie just outside the present garden fence. The more northerly of the two is circular with a cut scarp to its rear, 0.7m high, while the other is better defined, having a more rectangular appearance and a very slight internal scarp not more than 0.2m high. One of the 1873-1875 photographs shows a few small trees in this area. A large haystack is also visible beside the road leading from the gate house into the main part of the works, but other more specific features cannot be discerned.

The Cooperage complex (52) (Fig 43)
The cooper's yard includes a water-powered saw mill, machine shop and cooper's shop which were built as part of the original gunpowder works and are shown on the first edition of the OS 25" map surveyed in 1857. A new saw mill, incorporating a watch house and a clock tower above the turbine house (Fig 44), were built to architect's drawings dated 1859. The second edition of the OS map shows that by 1896 (when it was revised) further extensions had been added. These include what was probably a joiners shop, built as an extension of the original saw mill complex, and a building within the angle of the two saw mills - this last

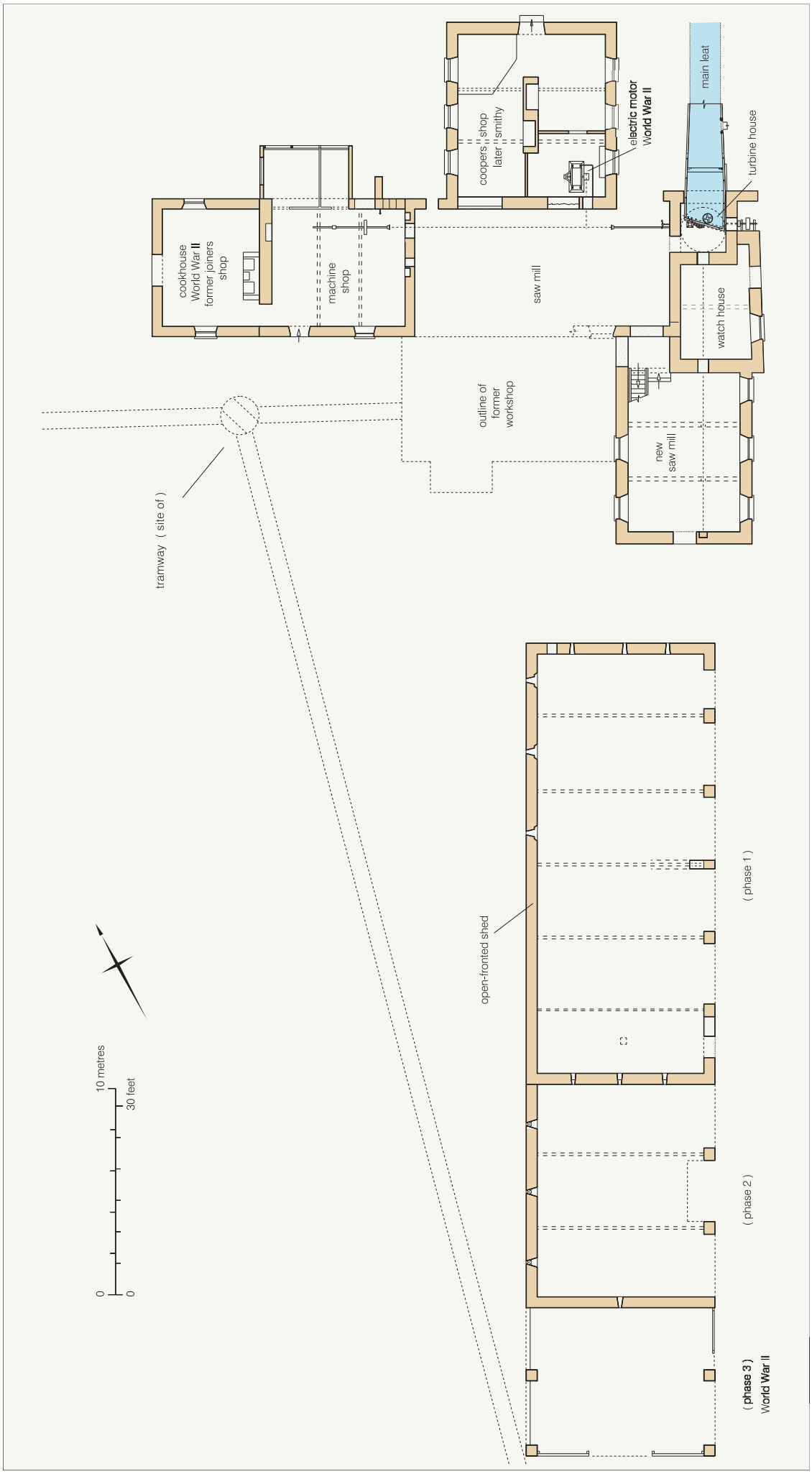

Figure 43. *English Heritage plan of the cooperage complex and open-fronted shed*

Figure 44.
The new saw mill, watch house and turbine house from the north east. (NMR: AA012852)

addition served by a tramway leading into the complex from the south (see section 6.2.10 below).

The 1857 buildings: saw mill, machine shop and cooper's shop

The 1857 OS map, surveyed when most of the principal buildings of the gunpowder works had been erected but before the site was totally complete, shows a 'T'-shaped group of buildings set at the southern end of the mill race which runs through the site. These buildings can be identified as the original saw mill with a machine shop at its west end, a cooper's shop projecting to its north, and a turbine house, which powered the line shafting, attached to its north-east corner. The functions of all except the building interpreted as a machine shop are known from designs drawn up in 1859 for a new saw mill (see below).

The saw mill was a tall, single-storey building, rectangular in plan, gabled to east and west. Much of its south wall has been demolished, as has its roof, but otherwise its walls, which are built of stone rubble, survive where they double as those of adjacent buildings. Thus the east gable wall and the west end of the south wall survive at the base of the walls of the new saw mill. The inner face of the east wall retains the scars of the saw mill's pitched roof, and some sawn-off purlins, while the return wall, true to the architect's plan, has a wide doorway close to its east end, and it now stops at the splayed east reveal of the first window. At a higher level, the base of the heightened wall retains the stubs of a number of sawn-off common rafters, and the cut-off lead sheet which evidently lined the gutter. The whitewashed inner face of the west wall survives, with a wall box close to the eaves at its north end to support the line shaft which led through into the machine shop beyond. A bearing box in the centre of the wall, less than a metre up from the floor, probably supported the end of a drive

shaft, perhaps driven by a belt down from a pulley wheel on the upper shaft. The north wall is virtually complete, doorways at each end flanking the central section which has a broad low gable and two wide original ground-floor openings, both now blocked, through into the contemporary cooper's shop. These last two openings, being internal, have timber lintels on both sides, the other doorways noted having external segmental arches with stone voussoirs.

The machine shop, built in line at the west end of the saw mill and of equivalent height and width, is constructed of stone rubble with a slate roof. It has a pair of windows in its south wall, both with external segmental-arched heads with stone voussoirs and internal timber lintels, the western window later converted into a door (see red brick patching and other evidence). The eastern window retains its original stone sill. The north wall has an external doorway close to its east end, its head like the original south opening, evidence of further openings having been lost in the later rebuilding of this wall.

The interior of the machine shop is open to the roof which is carried on two king-post trusses, each truss having a tie-beam, a king-post with an expanded head and foot, the latter through-bolted to the tie beam, struts, principal rafters supporting two sets of trenched purlins, and a ridge-piece. A line shaft once ran the length of the north side of the room, close to the eaves; grease on the east wall, below the wall box, indicates its use; the bearing box has been removed from the west wall, the recess blocked and whitewashed over. The shaft survives between and slightly beyond the two trusses; it is in several lengths, is supported on the tie beams, and has a large pulley wheel for a belt down to a former machine east of the easternmost truss. The east wall has a further bearing box for a line shaft which ran just south of centre and was supported by brackets indicated by cut-outs in the underside of the tie-beams. Since the box does not pass through the wall, this line shaft must have been powered from the main shaft close to the eaves.

OS maps indicate that between 1857 and 1896 a small projecting extension or outshot was added against the north side of the machine shop, entered through the original external doorway in this wall. The stub of the east stone rubble wall of this outshot survives, butting against the wall of the machine shop, but all other walls have been lost. The outshot is so small that it cannot itself have had an external doorway, and it is therefore possible that its construction led to the conversion of one of the two south windows into a doorway, unless there was another doorway in the lost length of the north wall. The outshot shown on the 1896 map (Ordnance Survey 1898a) is still shown on the 1914 edition of the OS 25" map (revised 1912), but it was subsequently replaced by the existing larger outshot, built slightly further west, leaving the original external doorway clear once again. The new outshot, which has a slated, single-pitch roof run in continuation with that of the machine shop, has outer walls of shuttered concrete. It probably dates from the World War II occupation of the site. The north wall has three windows, each with fixed small-pane glazing, and the west wall a wide, blocked doorway. Inside, the roof slope is supported on a single purlin, and inserted timbers support the foot of the original machine shop roof where the original stone wall has been removed. In place of this wall is a one-brick thick wall which also returns to

divide the room into two unequal bays, one lit by a single north window, the other by two windows. The larger room is the one with the blocked west doorway.

The cooper's shop which opens from the north side of the saw mill is single-storied with an attic floor which is partly in the roof. It is built of roughly coursed rubble, is gabled to north and south, and has a slate roof. Its east and west walls each have three ground-floor windows, all with shallow segmental-arched heads with stone voussoirs and individual stone sills, while the north gable wall has, in the centre, a ground-floor doorway with a taking-in door over into the attic, both under flat arches with stone voussoirs. Steps lead down to the ground-floor doorway which has a ledge and beaded-batten door; the attic door over, which is slightly narrower, has a plain ledge and batten door.

The interior of the cooper's shop was considerably altered when it was converted into a blacksmith's shop, and again when a room containing an electric motor was created within it. It must originally have had a clear ground floor interrupted only by the timber posts or cast-iron columns needed to support the centre of the two beams which supported the joists and floorboards of the attic floor. These were removed when the pair of blacksmith's hearths were inserted, but cut-outs for the joists, blocked by the inserted hearths, confirm that there were once joists here. Two wide doorways with timber lintels opened through the south wall of the cooper's shop into the interior of the saw mill: that to the west now has a brick blocking, that to the east one of stone rubble. There is no evidence that power was ever led into the cooper's shop, nor any indication of where access was gained to the attic floor. The two timber beams that carry the attic floor run the full width of the building, upright posts at either end rising up the wall face to stub ties which support queen-post trusses. The queen posts are through-bolted to the collars, and the principal rafters support two sets of trenched purlins per side. This particular type of truss was deliberately used to create headroom; in textile mills in Yorkshire, timber forms were used from the 1820s into the 1840s, after which cast-iron became more usual (Giles and Goodall 1992, 75, fig 128). Timber is likely to have been found entirely satisfactory in buildings of lesser size, such as this cooper's shop, and to have continued in use longer.

At some time, probably in the late 19th century, the cooper's shop was converted into a blacksmith's shop, a central chimneystack with two opposed but offset hearths being inserted down the centre. The stack is built of stone rubble and brick, the latter used around the hearths and for the single stack which rises to the roof but has been removed above it. The two hearths are now represented solely by recessed openings, the containers of the coals which projected into the interior having been lost. Metal sheets to encourage draw hide the tops of both hearths which have segmental brick arched heads supported by iron straps. The main part of the stack rises only as high as the top of the two cross beams, though it is likely that the attic floor was removed when the smithy was created in order to remove a potential fire risk.

The last major alteration to this building, probably during the military occupation of the site during World War II, was the creation of a room in its south-east corner to house an

electrically-powered motor which drove the line shaft down the saw mill and machine shop. This room has a concrete floor, shuttered concrete walls, an inspection window in its north side, and a doorway, created from an original window, in its east wall. It has a flat, boarded ceiling. The motor has lost any maker's plate, but the now-blocked slot in the saw mill wall indicates where a belt passed up to a pulley wheel on the line shaft in the saw mill. The motor is likely to have been used when there was insufficient water to drive the turbine.

The turbine house, called the 'Water Wheel House' on the architects plans of 1859 (see below), is depicted on them as a square structure built against the north end of the east gable wall of the saw mill. The main leat entered it from the north east (Fig 45), through what appears to have been a grated opening, driving a turbine wheel which is not depicted on the plan, which itself powered a vertical shaft with bevel wheels transferring the drive to a shaft along the saw mill. The turbine pit, called the 'Wheel Case' on the 1859 drawings, is circular in section, stone-lined, and now contains a later water turbine.

Figure 45.
Detail of the new saw mill showing the arched opening from the main leat into the turbine house which served the cooperage, from the north east. (NMR: AA012853)

A pair of footbridges crossing the main leat facilitated access to the northern part of the cooperage complex. The first, which no longer survives, was situated immediately to the south of the former field wall marking the south side of Low Park Wood (Ordnance Survey 1898a). The other was just to the north of the turbine house and although it has gone, a stone-revetted structure (either a ramp or the remains of steps) which gave access to it from the road is still extant. This structure is situated on the side of the road just beyond the north-east corner of the turbine house and stands 0.9m high.

The 1859 buildings: new saw mill, watch house and clock tower

In 1859 the Kendal architect, Richard C Shaw, was commissioned to design a new saw mill for the Sedgwick Gunpowder Works. Two signed sheets of designs, 'No 1' dated 'May 1859', 'No 2' dated just '1859' (CRO, Kendal, WD/CAT/A1951), which were carried into effect, were for a second saw mill, the new saw mill, which abutted and was constructed at right angles to the original saw mill of 1857. The new saw mill, which incorporated a 'Watch House' at the north end of its ground floor, abutted the south-east corner of the original saw mill and turbine house, the latter structure being heightened as a clock tower above the original turbine house. The new building bears no dates, but it is probable that it was built in 1859.

The new saw mill, a two-storey building built of roughly-coursed stone rubble with good quoins, is gabled to north and south and has a slate roof. Its ground-floor doorways and windows have flat arches with stone rubble voussoirs, while the first-floor windows, including the inserted taking-in door in the south gable wall, have rectangular stone lintels. The building, as noted above, was built much as shown on Richard C Shaw's designs. The ground floor had an independently-entered 'Watch House' at its north end (there was later a watch house within the licensed area - see section 6.2.7 above). This room, with a door and window in its front, east wall, contained a fireplace or stove; the drawings show a flue rising in the south-west corner at first-floor level, as well as a chimney stack, which survives, above it. An opening in the rear wall, part of the original saw mill, was fully blocked when the new saw mill was erected. Blocked openings high up in the north and south walls indicate the position of wall boxes which supported the line shaft which passed through the 'Watch House' into the ground floor of the new saw mill.

The new saw mill had two original entrances on the ground floor, one in the south gable wall directly into the main ground-floor room, the other into a lobby behind the 'Watch House', in the angle between the two saw mills. This lobby opened off the saw mill yard and gave access to both saw mills; a doorway off its northern side opened directly into the original saw mill, while to the south stone steps gave access down to the ground floor of the new saw mill and a timber staircase rose up to the first floor. The ground floor of the new saw mill, south of the Watch House, consists of a rectangular room with three front and two rear windows. The 1859 plans and elevations show the outline of a third rear window, balancing that above it, next to the staircase up to the first floor, but there is no evidence that it was built. The jambs of the door off the saw mill yard into the lobby survive, but recent rebuilding of insecure masonry in this area has removed any other evidence. The ground floor of the

new saw mill was the only floor which was originally powered, since it is the only one to have a line shaft running along it. The shaft, which had passed through the 'Watch House', ran the full length of the ground floor. Cut-outs in the underside of the two beams indicate where suspension hangers were fixed, and the inner face of the south wall has a blocked recess, with a timber lintel, to support the end of the shaft.

The first floor of the new saw mill is open to the roof and, because it runs over both ground-floor rooms, is an irregular L-shape in plan. It has four front and three rear windows, and as designed and built it originally had no opening in its south wall. There was originally no power on this floor, which is likely to have been used for the storage of tools and raw materials. The roof is carried on two full-width king-post trusses with a half truss spanning from the corner of the original saw mill and the front wall. The king-posts, through-bolted at the base, have expanded heads and feet, and support inclined struts. The principal rafters carry two sets of trenched purlins per side.

The new saw mill is built in the local vernacular tradition, but the architect made a feature of one of the component parts of his new building, the clock tower above the heightened turbine house. The turbine house, with its round-arched entrance from the main leat, dates from 1857, rose to the height of the buttress and housed the central drive shaft which was powered from the turbine and had bevel gears into both the original and the new saw mills. The existing turbine, shaft and the mechanism to adjust the flow of water to the turbine were probably installed around 1920 (see section 6.2.1) by Gilbert Gilkes & Company (who in 1928 became Gilbert Gilkes & Gordon (Crocker 2000, 96)). The control mechanism was operated by turning a cast iron wheel which projects into the north-east corner of the original saw mill. The wheel is cast with the name 'GILKES' and place 'KENDAL', and the instructions 'OPEN' and 'CLOSE', accompanied by arrows indicating that the wheel should be turned

Figure 46.
The clock tower above the turbine house in 1977 before partial demolition, from the east. (Reproduced by permission of the National Trust)

clockwise or anticlockwise to achieve these results. Turning the wheel activated a worm gear on the shafts. The clock tower which was raised above the turbine house is square in plan, Italianate in detailing, and had a shallow pyramidal roof with oversailing eaves and an oval ball finial. The clock chamber was entered, as the 1859 architect's drawings show, through a doorway in its south wall reached from a staircase at the north end of the first floor of the new saw mill. The doorway is now blocked, and the stairs have been removed. A two-light east window lit the clock chamber, and the north wall housed a clock which was set within a shaped, decorative ashlar surround. The Italianate detailing was decorative, but the clock was an important feature on the site. The clock tower was largely demolished in 1977 but the National Trust (Fig 46) and Davies-Shiel took photographs, prior to its demolition. The National Trust photograph also shows that at some time a narrow corrugated iron structure, with a sloping roof, was built against the east wall of the clock tower/turbine house; it is also visible from the north on one of the photographs taken by Miss Gardner in *c*1945. Perhaps also relevant to the saw mills is a reference in Faulkner's notebook to a 'Trent dynamo' at the 'S Mill'.

The buildings constructed between 1859 and 1896

Map evidence indicates that between these years a one-room block, arguably used as a joiners shop, was built against the west end of the 1857 machine shop, and that a further building was erected in the angle between the two saw mills, a tramway entering from the west. A detached building, function unknown, was built on the northern side of the machine shop.

The joiners shop is single-storeyed but slightly less tall than the building it abuts. It is built of coursed rubble, is gabled to the west, and has a slate roof. The north and south walls each have single windows with heads identical to those of the machine shop. The west gable wall has a central ground-floor doorway of reasonable width with a stone flat-arched head.

The building within the inner angle of the saw mills has been demolished. It is likely to have been a single-storey shed which served as a covered area for timber and perhaps machinery. A length of tramway, independent of that in the powder manufacturing part of works, ran from a position close to the site entrance and after a junction entered the building from the west (see section 6.2.10 below).

Some of the machinery from the saw mills has been removed and left by the side of the track, situated to the west of the cooperage. This includes two cast iron saw benches made by the firm of Marshall (& Sons) Ltd., Gainsborough, one with part of the circular saw blade still surviving. There are also a number of line shafts, one attached to a circular grindstone, 0.7m in diameter. At least 18 concrete machine bases have also been dumped in the vicinity and comprise blocks, 0.5m square, each with a recess on one side to hold the 'shoe' of the machine.

The National Trust recorded a detached building (53) to the north of the machine shop in February 1992. It was then in a ruinous condition and was demolished shortly afterwards;

no traces of it were seen during the present survey. The building is partly visible on one of the 1873-1875 photographs, showing a gabled roof; the building is also depicted on the second and 1914 editions of the OS 25" map. On the plan in Patterson's book it is numbered 29 and incorrectly labelled 'Turbine Tower' (Patterson 1995). Its function is unknown but it could have been the original smithy.

The open-fronted shed (54) (Figs 43 and 47)

The open-fronted shed, south of the cooperage, was built in three stages, and although the earliest of these, at the north end, is not shown on the first edition of the OS 25" map (surveyed 1857), it was probably built shortly after that map was surveyed in order to serve the newly-established gunpowder works. One of the 1859/1860 sketch maps shows what must be the first phase of the shed as an open rectangle with a cross through it (CRO(K) WDB/35/779), confirming its early date. The second edition of the OS 25" mapping (revised 1896) depicts the building with its first extension; the second extension is likely to date from the military occupation of the site during World War II. The shed is not labelled on the site plans of 1900 and 1903-12, but it is likely that carts used by the works were housed in part of it, and timber stored in the rest of it. On the plan in Crocker and Crocker (1992, 9) the building is annotated 'Fire Engine, Stables, etc.' but the identification is not based on historic sources.

Figure 47. *The open-fronted shed from the south south east. (NMR: AA012848)*

The original part of the open-fronted shed, as just noted, is at the north end. Six bays long, gabled to north and south, and built of stone rubble with good quoins, it has a corrugated iron roof that must replace slates. The six-bay long open front has four wide central bays flanked by narrower end bays, the five stone rubble piers which separate the bays each supporting the end of a roof truss. The gable walls, which have corner returns at the front,

each contain three rectangular vents level with the eaves of the building. The vents have external stone lintels. The interior of the shed may originally have been subdivided since the central pier is narrower than the rest and is in fact part of a stone rubble cross wall, now curtailed and partially rebuilt, the line of which is continued by isolated cobbled footings in the shed floor. Except at the very front, the wall does not rise to the underside of the truss over it.

Three deep slit vents in the rear wall of the north half of this part of the shed, each one set centrally within a bay, appear to be secondary. Originally 1.4m deep, their lower two-thirds since blocked, they each have external timber lintels, and the masonry on either side of them in many cases shows signs of disturbance caused by their insertion. The vents have a stepped inner splay, some retaining timber planks which may have allowed them to be closed off. There is a further insertion at this end of the shed in the form of a small rectangular opening low down in the north gable wall, close to the rear corner. This has an external timber lintel as well as some bricks in its side wall: it is now blocked and its purpose is uncertain. The south end bay has been partitioned off from the rest of the interior by a timber partition of upright planks. The narrow room so created has a lath and plaster ceiling with a small hatch mid-way back, and the original open front has been narrowed by the insertion of a rubble wall to create a doorway with a ledge and batten door. The five king-post trusses of the shed are modern, like their corrugated iron covering. The shed floor is of earth.

The first south extension of the shed is identical in width to the original part but is slightly less tall. It has a three-bay wide, open front with stone piers and rubble rear and gable end walls. The piers are of rock-faced rubble with dressed back corners, a feature found on incorporating mills 7 and 8, which date from the late 1860s. The enlargement of the shed could be part of the expansion of the site initiated after the change of ownership in 1864. The rear wall has three slit vents which rise to the underside of the timber wallplate but internally have stone heads, and the apex of the south gable wall has a smaller slit vent with a stone lintel. The roof has been replaced, almost certainly during World War II; it is supported on a pair of king-post trusses bearing the graffiti ‘Aug 43’ and ‘Clayden/Docherty/ Ross/Mills/Scully’. Its roof, covered with corrugated iron sheeting, was renewed when the second extension was built (see below). A cut-out in the sheeting in the front of the central bay created extra headroom for waggons using the shed. The shed floor is of earth.

The second south extension of the shed is of the same width and height as its predecessor, but it is different from the rest of the shed in having a simple structure which consists of four shuttered concrete piers that support two king-post trusses and a roof covered with corrugated iron sheeting. The two-bay front was open, but the south gable wall was originally closed by corrugated iron sheets. The sheets were attached to the face of a truss and to a framework of posts with mid rails below it; the mid-rail in the central bay was later cut out and the sheeting removed to create an end entrance. A low, concrete sill wall across the two rear bays suggests that they may once have been closed. Maps indicate that this extension is later than 1896, the use of shuttered concrete, found elsewhere on the site in association

with work carried out during the military occupation of the site during World War II, suggesting that period. It overlies the site of a small, detached structure (55), possibly a privy, at the end of the first south extension of the open-fronted shed (Ordnance Survey 1914a).

The stable, water trough and possible harness room/barn (56-58)

A small stable (56) (identification confirmed by James Guy), shown on the second and 1914 editions of the OS 25" map, is situated beside the western perimeter of the unlicensed area to the west of the cooperage (Fig 48). It has been well-maintained and appears to have been in use until fairly recently. Measuring 4.2m by 3.3m, it is built of rubble with roughly dressed quoins and a single doorway in its north-eastern end. The gabled roof is of slate. The interior is rendered and subdivided into two stalls.

Figure 48. *The small stable to the west of the cooperage, from the north east. (NMR:AA012847)*

A small structure (57), situated about 28m to the north north east of the stable, is depicted on both the second and 1914 editions of the OS 25" map. All that survives above ground (and now in a ruinous condition) is what may have been a water trough associated with the stable. It is made from the carcass of an iron boiler and was mounted on a brick plinth, 0.5m high, partly covered in pitch (NMR photograph AA012901). The bricks are marked with the name 'Claughton Manor Brick Co Caton'. The materials used suggest that it is contemporary with the gunpowder works, but is always possible and that they were re-used and that the structure relates to the nearby World War II conversion of the western end of the saw mill complex into a cookhouse. To the north of the boiler carcass is a brick base, 0.5m square and only two courses high; its date and function are uncertain. The OS maps also show that there was a rectangular building (58), approximately twice the size of the stable, between the stable and the water trough. No traces survive but it may have been a harness room or a barn in which hay and straw were stored for the stable.

Other buildings which no longer survive (59-63)

There were a number of other ancillary buildings in the unlicensed area but they no longer survive. A rectangular building (59), marked on the second and 1914 editions of the OS 25”map, stood beside the southern end of the tramway to the cooperage. There are no indications of any structure now only a slightly more level area at the foot of the natural slope. By 1912, the date of the revision for the 1914 edition of the map, another large building (60) had been erected to its south. Today a modern timber-store shed (NMR photograph AA012839) occupies its site. This shed is built on a platform cut into the natural slope; it is possible that the platform is related to the 1912 building although it has clearly been enlarged because its western scarp cuts later dumping. To the west of these structures, at the end of a track, lay a single building (61). By 1912 a second building, (62), had been erected immediately beyond it to the north. Neither survives having been replaced by a wartime garage (see section 6.3.1 below) but they were built upon a platform dug into the natural slope to a depth of 1.2m. A small rectangular building (63) is also marked on the second and 1914 editions of the OS map to the west of the northern part of the open-fronted shed; its site is now occupied by a storage shed of World War II origin (see section 6.3.1 below).

6.2.10 Transport

This section is divided into two parts; one dealing with the tramways and tracks within the licensed and unlicensed areas of the works; the other with transport to and from New Sedgwick.

Tramways

Cartographic evidence indicates that there were two separate tramway systems on the site. The longest lay within the licensed area and was used to transport powder between the processing buildings. The bogies (waggons) probably had brass wheels (*Westmorland Gazette*, 3 July 1875) to prevent sparks and James Willacy recalls that because the site was fairly flat they were pushed by hand. The other tramway was very short and occupied the unlicensed area. This section will look at the overall development of the systems rather than looking in detail at all the surviving remains. The latter often survive near a building and any details have been included in the relevant building description.

The tramway within the licensed area

Tyler (2002,198) is almost certainly correct in dating the tramway to after 1864 when the New Sedgwick Gunpowder Company Ltd. took over the works. Its exact date is uncertain but it was probably installed during the second part of the 1860s or early 1870s when the new company were investing heavily in new buildings and plant at New Sedgwick. There is a reference in a newspaper article to the laying in 1874 of ‘a tramway from the [ripe] charge house to it [the lower expense magazine] and on to the new [powder] press house’ *(Westmorland Gazette*, 7 August 1875). The section of the tramway extending northwards from the saltpetre refinery complex also appears on one of the 1873-1875 photographs; a bogie on the track is also visible. A few of the 1857 buildings, such as the green charge house, may even have been moved to accommodate the tramway. The first depiction of the

latter is on the second edition of the OS 25" map (revised 1896). Cartographic evidence shows that the layout of the tramway around the central part of the works changed little in subsequent years and when changes took place they were designed to link new or repositioned buildings with the rest of the network.

In summary, the tramway depicted on the 1896 map ran west from the saltpetre refinery to the mixing house and then north to the ripe charge house with spurs giving access to incorporating mills 1-9 and the lower expense magazine. The tramway then went to the new powder press house and continued its route in a north-east direction, beside the eastern edge of the main leat, to serve the corning house, upper expense magazine and the first glaze house. At the latter the tramway turned towards the north west and terminated at the first stove house. A short spur left the tramway south of the first glaze house and went to cartridge compressing house 2 on the western side of the main leat (this spur must be a later addition because blasting cartridges were not made at New Sedgwick until 1880). Another line left the tramway at the end of the first glaze house and headed in a southerly direction along the riverbank to link cartridge compressing house 1 (a former expense magazine), the dust house, the heading house and packing house 1 where it terminated (the short section between the saltpetre refinery complex and the packing house may also be an addition given that this last building was not erected until sometime between 1880 and 1883). The eastern road of the caravan park, now on a marked embankment, has been built over the course of this last line for much of its route.

By the time of the 1900 site plan the spur to cartridge compressing house 2 had been extended to packing house 2; this addition is also depicted on the 1903-12 site plan but had gone by 1912 when the 1914 edition of the OS map was revised. The 1900 site plan also indicates changes to the tramway north of the incorporating mills but this is probably a mistake because it is not supported by the 1903-12 site plan or by the 1912 OS map which continue to show the arrangement of tracks marked on the second edition OS map. The next major change to the tramway took place after the explosion at the first glaze house in 1903 and affected the northern end of the works. The end of the tramway serving the first stove house was lifted as far as the new glaze house and a new section of tramway was installed at the junction with the line that ran south along the riverbank; it seems likely that

Figure 49.
Remains of the tramway crossing over the main leat between the new stove house and the reel house, from the north. (NMR : AA012921)

in order for the junction to work efficiently a waggon turntable was probably installed where the lines crossed. This new line crossed the main leat and ran in a northerly direction to the new stove house and beyond to the reel house which entailed another crossing of the leat. This crossing may have been a rather rickety affair and the surviving evidence indicates that two iron pipes, with standard gauge rail chairs fitted to their tops, were set vertically into the base of the leat (Fig 49). The chairs presumably held longitudinal timbers that supported the track bed. One of the pipes has fallen over but the other is still upright.

Returning to the southern end of the new line, after crossing the leat it entered a 55m long straight cutting on its way to the new stove house. This survives as a substantial earthwork (Fig 50) cut into the lower part of the valley side and measures about 4.2m across and up to 1.4m deep. In places it has been cut into the bedrock and some of the excavated material has been heaped up on the east side of the cutting, presumably to provide blast protection from the adjacent new glaze house. At its south end this bank merges with a well-formed short blast bank that extends east to west from the cutting to the edge of the main leat; it is about 1.7m high and its east end has been revetted with stone to prevent collapse into the leat. This section of the tramway may have been re-used in World War II, suggesting that either it was not lifted when the works closed or that it was re-laid after the outbreak of hostilities. The evidence for this comes from the siting of former munition dumps whose arrangement in the vicinity of the cutting and new stove house suggests a relationship of some sort with the route of the tramway. Indeed several dumps were rather awkwardly placed on the narrow space between the main leat and the bank on the eastern side of the cutting (the west end of their platforms are cut into the bank confirming that they post-date the cutting). The bank was breached in a couple of places to give access to them and it is difficult to see how these features were serviced unless a tramway was being used.

Figure 50.
The tramway cutting south west of the new glaze house, from the south east. (NMR: AA012926)

The tramway within the unlicensed area

This short tramway may have been installed at the same time as the one in the licensed area. It is shown possessing an identical 'T'-shaped layout on both the second (revised 1896) and 1914 (revised 1912) editions of the OS 25" mapping but is not depicted on the site plans of 1900 and 1903-12 - these are principally concerned with features in the licensed area. It was probably used for moving timber and materials as it was associated with the cooperage complex and the open-fronted shed (see section 6.2.9 above). It is no longer visible but part of its course (now obscured by dumping) was occupied by a pair of temporary huts during World War II. Either a turnout (point) or a waggon turntable must have been installed at the junction of the stem and crossbar of the 'T'-shaped layout so that bogies could be moved from one track to the other.

Tracks

The OS maps and site plans show a network of tracks and paths crossing the site and linking the various buildings. Some will have existed before the works were established and a few are now surfaced internal roads serving the caravan park. The principal road entered the works through the main entrance at the southern end of the unlicensed area and continued in a northerly direction past the cooperage complex to a thoroughfare between the watch house and saltpetre refinery complex; this is still the only vehicle route into the site. A number of separate tracks left the thoroughfare to service the store and processing buildings in the vicinity (heading house, charcoal store and incorporating mills). A track than ran east to west crossed the main leat on a bridge (Ordnance Survey 1998a: 1914a) that no longer survives, and passed close to the north side of the mixing house. The track is visible as an earthwork, 8.2m wide and 0.8m high (its flat top is 4.2m in width), between the eastern side of the main leat and the entrance into the caravan park. This track and also linked with other tracks, which gave access to store magazine 2. A long track left the thoroughfare in a north-east direction and went to the first glaze house location providing access to the powder press house, the powder press pump house and corning house on the way. When the 1873-1875 photographs were taken part of its eastern edge, to the north east of incorporating mills 7-8, was revetted with massive stone blocks standing at least two courses high. Two straight footpaths left this track opposite the cartridge press pump house: one went to the electric motor house and the other to cartridge compressing house 1. This long track is now one of the principal surfaced roads in the caravan park. At its north end the track originally crossed the main leat and followed its western side to the north end of the works. Sometime after March 1903 part of this route was utilised by an extension of the tramway that served the new stove house and the reel house. On the western side of the central part of the works, the maps show a meandering track skirting the mixing house, incorporating mill 1 and cartridge compressing house 2. This again is largely preserved in the surfaced road that provides access to the caravan emplacements on the western side of the main leat. The main leat was bridged where tracks or footpaths crossed it. One such crossing was photographed in the late 1920s and is part of the Willacy Collection. It was near and to the north of the site of the first stove house and the photograph shows a plank bridge leading to a doorway in a short wall on the western side (Fig 51). The wall and doorway are a most curious feature and may have been for blast protection, unfortunately

Figure 51.
Footbridge across the main leat north west of the new glaze house (probably in the late 1920s), from the south. (NMR: AA035277, reproduced by permission of David Willacy)

these features no longer survive. A footbridge also crossed the main leat behind incorporating mills 7-9 (Ordnance Survey 1898a: 1914a).

To and from the site

The movement of goods to and from the works has not been researched in detail for this report. It is uncertain what the transport arrangements were during the early years of the works but it is known that the original company had magazines built in Wigan, Durham, South Wales and Cornwall (*Westmorland Gazette and Kendal Advertiser*, 25 June 1864). It is possible that the nearby Kendal extension (completed 1819) of the Lancaster Canal was used by the original company; a specially constructed canal wharf for the earlier Old Sedgwick Gunpowder Works was already in existence on the outskirts of Sedgwick village (Jecock and Dunn 2002, 31). According to Tyler (2002, 199) a dedicated railway siding ('Swinglehurst's Siding') and a warehouse were installed at nearby Hincaster Junction for New Sedgwick in the 1870s. Presumably from then on most of the raw materials destined for the works were brought to this warehouse by rail with the finished gunpowder being taken away by the

Figure 52.
The gunpowder warehouse at Hincaster Junction, from the east. (NMR: DP001584, reproduced by permission of Christopher Dunn)

same means. Transport between the warehouse and New Sedgwick was by horse and cart, but latterly a motor van was used for the gunpowder (Halliwell 1964). The warehouse still survives and is situated at NGR SD 5121 8481 on privately owned land beside the present West Coast mainline railway (Fig 52). The building is currently used as a farm implement shed but before this part of the interior was converted into a small office. The single-storey building measures 14.8m by 7.4m, walls are of coursed slate rubble with limestone quoins. There are windows in each gable end with stone jambs, sills and lintels. It has a slate roof with large skylights in the central area and the interior of the building has a raised floor. In the northern wall there is a large double sliding door accessed by a ramp, but this appears to be a later insertion. In the southern end of the east wall is an original loading bay, with a decorative wooden canopy that faced on to the siding; the track of the later has been lifted.

6.3 Phase 3. The features post-dating the gunpowder works (World War II)

During the World War II the former gunpowder works was requisitioned and used as a munitions depot. There is no evidence to suggest that the old gunpowder works was equipped with the facilities to manufacture shells or other ammunition. The army re-used many of the buildings and structures that had not been destroyed when the works closed and also erected a number of temporary huts, mainly around the gate house and cooperage. According to local residents the Women's Land Army was also active here; no independent confirmation of their presence was discovered but timber production at the saw mills would be consistent with the type of activities the Land Army were engaged in. Where military features were encountered during the survey close to or utilising structures or features associated with the gunpowder works they have been included in the individual descriptions of the gunpowder monuments. The more isolated and discrete wartime structures are described below and include buildings and associated structures, the sites of munition dumps, trenches and a few miscellaneous features. The features are labelled or highlighted on the phase diagram (Fig 62) which accompanies section 7.3 below.

6.3.1 Buildings and associated structures

These include the depot guard house, concrete hut bases, a cookhouse and field oven, a storage shed, a garage and a loading platform (with a shed).

The guard house

Immediately outside and to the east of the entrance to the gunpowder works are the foundations of what was probably the guard house for the depot. No building is shown at this location on any of the maps or site plans produced during the life of the works so the remains are unlikely to relate to the gunpowder industry. However, a very dilapidated building was photographed here by Davies-Shiel (reproduced in Tyler (2002, 216)) and the National Trust (Fig 53) during the late 1970s. The single-storey timber building had sides clad in tongue and groove boarding and a felt-covered roof gabled north to south; a large ventilator-like feature with a cylindrical top was centrally situated on the roof ridge. There was a window in the centre of the southern end and two windows and a porch (with a gabled roof) on the west side. The building was situated on the edge of the riverbank which here falls steeply

Figure 53.
The World War II guard house at the entrance to New Sedgwick in1977, from the west. (Reproduced by permission of the National Trust)

down to the to the water's edge. All that survives are nine shuttered concrete pillars, no longer all upright, whose tops would have provided a level base at road level for the floor of the building.

The concrete hut bases

Several huts were situated near the gate house and cooperage. Their superstructures no longer survive but the rectangular concrete platforms which formed their floors are still extant. According to local oral tradition, the huts were used for a variety of different purposes including barracks, showers, mess room and cinema.

Several were erected in the field to the west of the gate house, alongside the southern boundary hedge. They were linked to one another and to other parts of the depot by concrete paths. The floors of three of these former huts are oriented roughly north-east to south-west and each measures on average of 11m by 5m. In two of the huts the site of a stove is represented by a kerbed square, 0.8m across and 0.15m high. At least one of the two westernmost platforms has a recess, 0.12m wide and 0.05m deep, visible in places along its perimeter that would have held timber framing or corrugated iron cladding. To the rear of the easternmost platform is a low revetment wall, 0.3m high, while along its east side there is a raised concrete kerb. The iron fixings for the superstructure still survive at each corner of this platform. These huts had been dismantled by August 1945 (RAF 106G/UK653/13-AUG-1945/3158-9). Animal sheds now stand on two of the platforms.

Two further hut platforms, both oriented at right angles to the three previous huts, lie to their east. One is terraced into the slope and occupies a pronounced cutting that may pre-date the hut platform (see section 6.2.9 above). Two animal sheds now stand on this platform, which also has a projecting concrete threshold, 1.0m wide. Little survives of the easternmost

hut base, but its site is marked by a rectangular depression, open at its north corner, and a few lumps of concrete, up to 0.6m across. Outside this pair of huts the concrete pathway branched with one arm (now surviving as a grassed-over terrace) heading northwards towards two concrete kerbs, perhaps the remains of another structure, near the north-east corner of the field. The gate house was probably also used as accommodation, perhaps by the officers. According to a local informant, the two concrete hut bases situated a short distance to the north north west of the gate house in the woodland were where the depot showers were located.

A second concentration of hut bases is situated close to the cooperage complex. The first pair is located to the south of the open-fronted shed in the triangular space between the main road to the caravan park and a track. The northern platform is used as a small car park by a local anglers club and the access to it from the south crosses the other platform. Another pair of platforms, also end-on to one another, was built just beyond the western side of the open-fronted shed. They overlie the route of the tramway that served the unlicensed area of the former gunpowder works. These platforms are now completely engulfed by a finger dump to a height of 1.8m, but when EH surveyed this area in December 2000 the end of one was still visible and the other platform was found by probing. This last platform is not shown on the EH survey plan (Fig 10) but has been drawn schematically (like the other platforms that are now partly obscured or broken up) on the relevant phase diagram (Fig 62). Two more platforms, similarly end-on to one another, occupy the former yard to the west of the cooperage. The western perimeter of the yard was cut back to accommodate the hut platforms which are now partly buried by modern dumping which is particularly prevalent in this area. Air photographs of 1945 (*loc cit*) show that the northern platform supported a pair of huts and the southernmost a single large hut, all with gabled roofs. The function of these huts is uncertain but their proximity to the cookhouse (see below) suggests that at least one would have been used as a mess room.

The cookhouse and field oven

During World War II the machine shop at the western end of the saw mill was converted into a cookhouse, a long, low, cast-iron range, set in a brick casing, being built against the east wall. The range has an open fire flanked by two ovens, the doors of which are cast with the words COOKING and ROASTING. Smoke from the range was led up a pipe that rose in front of the wall behind the range and then passed through a hole mid way up it into a flue within its thickness. The hole in the wall survives, but not the pipe. A notice board by the door in the gable end wall is of wartime date, having columns headed LAST F.., DUTY ROSTER and COOKS DUTIES ETC (Fig 54).

About 30m to the north of the cookhouse is the remains of a small, rectangular field oven that is similar to a modern barbecue. It is constructed of three or four courses of brick, with gaps left between some of the bricks for ventilation, and has a cooking grille made of assorted iron rods, pipes and part of a drain cover. Around it are a number of contemporary rubbish items, including a broken ceramic plate bearing the NAAFI insignia and a Mitchell and Butler brown glass beer bottle.

Figure 54.
Duty roster board on west wall of World War II cookhouse. (NMR: AA012938)

The storage shed

A single-storey shed (Fig 55), with timber framing, and clad in corrugated iron is situated immediately south of the cooperage on the site of an earlier gunpowder building (see section 6.2.9 above). The floor is of solid concrete and the building has double doors indicating that it was able to accommodate reasonably wide loads.

Figure 55.
World War II storage shed to west of open - fronted shed, from the north east. (NMR: AA012860)

The garage

The garage was constructed on the site of an earlier gunpowder building (see section 6.2.9 above). The garage (Fig 56) is a timber-framed single-storey affair with a corrugated iron exterior and internal timber cladding. In the floor is a timber-lined inspection pit. The collapsed remains of a lean-to extension, also of corrugated iron, lie beside the southern side of the main structure. A concrete base, 2m square, is situated beside the front of the garage to the north and was constructed in the 1970s. According to a local informant it was the site of a dog kennel (a low headstone, situated a short distance to the north, marks the site of a dog's grave).

Figure 56.
World War II garage north west of the gate house, from the east. (NMR: AA012837)

The loading platform and associated shed

A loading platform is situated near the western edge of the track to the rear of the open-fronted shed (Fig 57). Its front is revetted with walling made from broken concrete slabs and stone; it is 1.1m high, 1.8m deep and also contains timber in its construction. A small, single-storey concrete hut, with a single-pitch roof of corrugated iron and a recently replaced door, is situated at one end of it.

6.3.2 The storage of munitions

About fifty platforms or hollows, generally rectangular in plan and some with low banks around their edges, were recorded (or observed in the woodland just beyond the limits of the large scale survey) by EH. They are almost certainly the sites of World War II munition dumps. It is envisaged that these features were stances on which munitions were piled up on and protected from the elements by tarpaulins or shelters. On average the stances measure about 6m by 4m and 0.8m to 1m in depth. They generally occur in the more densely wooded parts of the site, suggesting that advantage was taken of the tree canopy

Figure 57.
World War II loading platform and hut to rear of open-fronted shed, from the south south east. (NMR: AA012840)

to conceal them from enemy aerial reconnaissance. Some are associated with the tracks which served the gunpowder works while others appear to relate to the course of the tramway, suggesting that part of it was still extant or had been re-laid. The main concentration is located in the northern part of the works. In this area a number are situated south of the reel house on a low natural terrace between the river and the main leat. The rest are located to the west of this leat at the foot of a natural slope that forms the valley side; many are cut into this slope. Among the latter there is a particularly fine example to the west of the northern end of the new glaze house. It consists of a rectangular platform, 6.3m by 4.2m, with a revetment wall to the front, 0.6m high. Several hollows were surveyed on top of the slope to the north of the new stove house; it is possible that some of these were also related to the storage of munitions. The next, but smaller concentration of stances, occurs to the west of the early block of incorporating mills where three platforms that lie within the survey area have been cut into the foot of a natural hillock. About ten further platforms, similarly cut into rising ground, are also visible in this area just west of the limits of the EH large scale survey. One near a caravan park toilet block is particularly well-preserved and has low side banks flanking its interior; it measures 5m by 9m (over banks) and has been dug into the natural slope to a depth of 1.7m. Between these two concentrations there are at least four stances associated with the cutting that contained cartridge compressing house 2 and packing house 2.

The sites of some of the former gunpowder process buildings also appear to have been used for storage, the blast walls providing ready-made protection and cover. The National Trust's clearance of leaf mould on the site of the new stove house revealed a spread of broken glass on the floor of the easternmost compartment. Much of the glass is from

bottles and some pieces still have their crimped metal tops in place. The glass is partly fused and has obviously been subjected to extremely high temperatures. The bottles themselves may have been phosphorous grenades. The No. 76 Self-Igniting Phosphorous grenade was a variation on the Molotov Cocktail and, although it could inflict unpleasant burns, was designed to produce dense white smoke that would effectively immobilise a tank crew (Chamberlain and Gander 1974, 46). It was normal practice to store phosphorus grenades and other incendiary or pyrotechnic bombs within a ring of broken glass or pebbles to act as a fire break in the event of accidental ignition; it is possible, therefore, that the broken glass is simply indicative of the storage of this type of weaponry. Independent confirmation for the presence of phosphorous grenades at New Sedgwick came to light in September 2000, following a local television report on the clearance work by the National Trust volunteers. The report encouraged a former nurse to come forward who had treated the victims of an accidental explosion of these grenades at New Sedgwick. Apparently the unlucky soldiers attempted to seek relief from their burns by jumping into the main leat; the nurse later married one of these men.

6.3.3 Trenches

There are a number of trenches at various locations around the site suggesting that either the army had installations in place to defend the depot against enemy action or that troop training (perhaps for the Home Guard) was also taking place at the site. The trenches take two forms: the first consist of simple rectangular depressions which may have been two-man weapons slits (slit trenches); the second comprise much longer trench systems. These consist of a single ditch with an outer bank and their courses are characterised by a number of angular changes in direction.

A short line of slit trenches is present to the west of the open-fronted shed just close to the field boundary that marks the western edge of the unlicensed area of the former gunpowder works. They vary in size but the best preserved is 3.4m by 1.3m and 0.6m deep; the southernmost still contains the corrugated iron sheeting that was used to strengthen the sides of the trench. Further slit trenches were constructed on at least two of the natural hillocks that lie to the west of the central part of the works; in all cases they are sited a little below the summit of their respective hillock and two are associated with a trench system. Of these slit trenches, a single example occupies the eastern edge of the hillock that rises above the early block of incorporating mills (platforms relating to the storage of munitions are also cut into the foot of this hillock). Another two are situated along the north-western edge of the adjacent hillock to the south; a trench system also ascends the southern side of this hillock near to the site of store magazine 1. This trench system was laid out as a combination of a square and bastion trace (Anon 1933, 64), with the slit trenches providing cover to the north west. The trench survives as a meandering ditch, 0.7m deep and 2.0m wide, with a 0.8m high bank along its west edge.

A second trench system occupies the western side of the hillock that lies to the north west of the lower expense magazine. Its angular course has been interrupted by an underground reservoir (installed on top of the hillock for the caravan park) and a caravan pitch has truncated

its northern end. At best the trench is now 2m wide and survives to a depth of 0.5m; the bank on its western lip is up to 0.4m high. A pair of shallow ditches may represent the remnants of third trench system; each is about 2m wide. They are located on a natural slope between the site of the corning house and cartridge compressing house 2, on the west side of the main leat. They may once have formed a continuous feature but any link has been obscured by a modern track that now separates them to give access to a caravan pitch. The easternmost ditch is 0.5m deep with a low bank along its southern edge. A fourth trench system may have been situated on the western side of the tramway opposite the remains of the new glaze house. A scarp following an angular route is all that now survives; any continuation to the west lies under dumped material used to create a massive platform for caravans. This possible trench system was located near to the southern end of the main concentration of munition dumps that occupied much of the northern part of the site (see above).

6.3.4 Miscellaneous features

These include a cistern and two small brick structures; the latter may have related to a ram installed on the edge of the river for civilian purposes in 1942.

The cistern

A cistern, 0.7m deep, lies to the south of the field oven (see section 6.3.1 above) on the edge of the track which gives access to the western part of the caravan park. Its walls are principally of concrete but the southern side appears to contain a mixture of brick and stone. Its northern end was damaged when the track was widened in1977. This cistern is not marked on any of the maps consulted for this report suggesting that it is late in date and probably related to the military occupation.

Two brick structures probably related to the Blake Ram

During 1942 a Blake Ram was installed on the west bank of the river to supply water for cooling milk at nearby Larkridge Farm; apparently the ram was not able to function properly due to interference by the military (see section 4.3 above). Two small, redundant brick-built structures that may be the remains of the ram are visible on the western side of the river close to the edge of the water; they lie a short distance to the south of the weir that served the gunpowder works. The northern one has the seating for a grating in its roof whereas the other has a solid concrete roof with an opening for a door in its south wall. They are clearly of relatively modern origin and if not related to the ram, perhaps they were connected with supplying drinking water or for monitoring water quality.

DISCUSSION

The individual features and buildings at New Sedgwick have been described and discussed in detail in section 6 above. What follows here is a general commentary aimed at providing a historical perspective and summary of the site's overall development. Phase diagrams (Figs 58-62) have been produced for each of the principal phases of activity described below. The early editions of the OS 25" maps have been used to construct the diagrams relating to the gunpowder works; map evidence has also been supplemented with additional information derived from documentary sources and field investigation. In order to assist the reader the gunpowder buildings on these diagrams have been highlighted, numbered and annotated. The numbers are also present (in brackets) in section 6. 2 (above).

7.1 The pre-gunpowder landscape (Phase diagram Fig 58)

With the exception of field walls and tracks the EH survey produced only a short bank and the remnants of an early weir that were demonstrably earlier than the gunpowder works. The early weir is particularly interesting and its presence may indicate possible industrial activity on the eastern edge of the site prior to the construction of the works. This weir crosses the River Kent near the central part of the works and on the riverbank near its western end there are the possible fragments of a leat leading away from it. In section 6.1.2 above it is suggested that this may have served an early watermill. But this had probably gone long before the works were planned and it and the weir clearly had no influence on the works itself or its layout.

7.2 The gunpowder works

7.2.1 The early years under the Sedgwick Gunpowder Company Ltd. (1857-64) (Phase diagram Fig 59)

Approval to construct the gunpowder works was given at the Easter Quarter Sessions held in Kendal in April 1857 (CRO(K) WQ/O/15). Construction must have proceeded very rapidly because the weir, main leat and the principal processing buildings are all shown on the first edition of the OS 25" map surveyed in that year (Ordnance Survey 1895). In the licensed (manufacturing) area the saltpetre refinery, the preparing house, the green charge house, the early range of incorporating mills (mills 1-6) together with their integral waterwheel house, the first powder press house, the corning house (and its nearby turbine house which may also have served the powder press house), the first glaze house, the first stove house (with its attendant boiler house) are all shown. The function of most of these buildings is known from annotations on the 1859/1860 sketch maps. Two buildings are also depicted on the OS map near the river, but it is not possible to ascertain their functions from the sketch maps, indeed one of them is not even depicted on these. The northern building must have been the expense magazine that in 1880 was converted into cartridge compressing house 1 while the southern one may possibly have been the forerunner of the new dust house that was built at this location between 1873 and 1874. In the unlicensed area to the south the gate house at the entrance to the works is marked on the 1857 map together with the cooperage complex which at this date included a saw mill, machine shop, cooper's shop and turbine house.

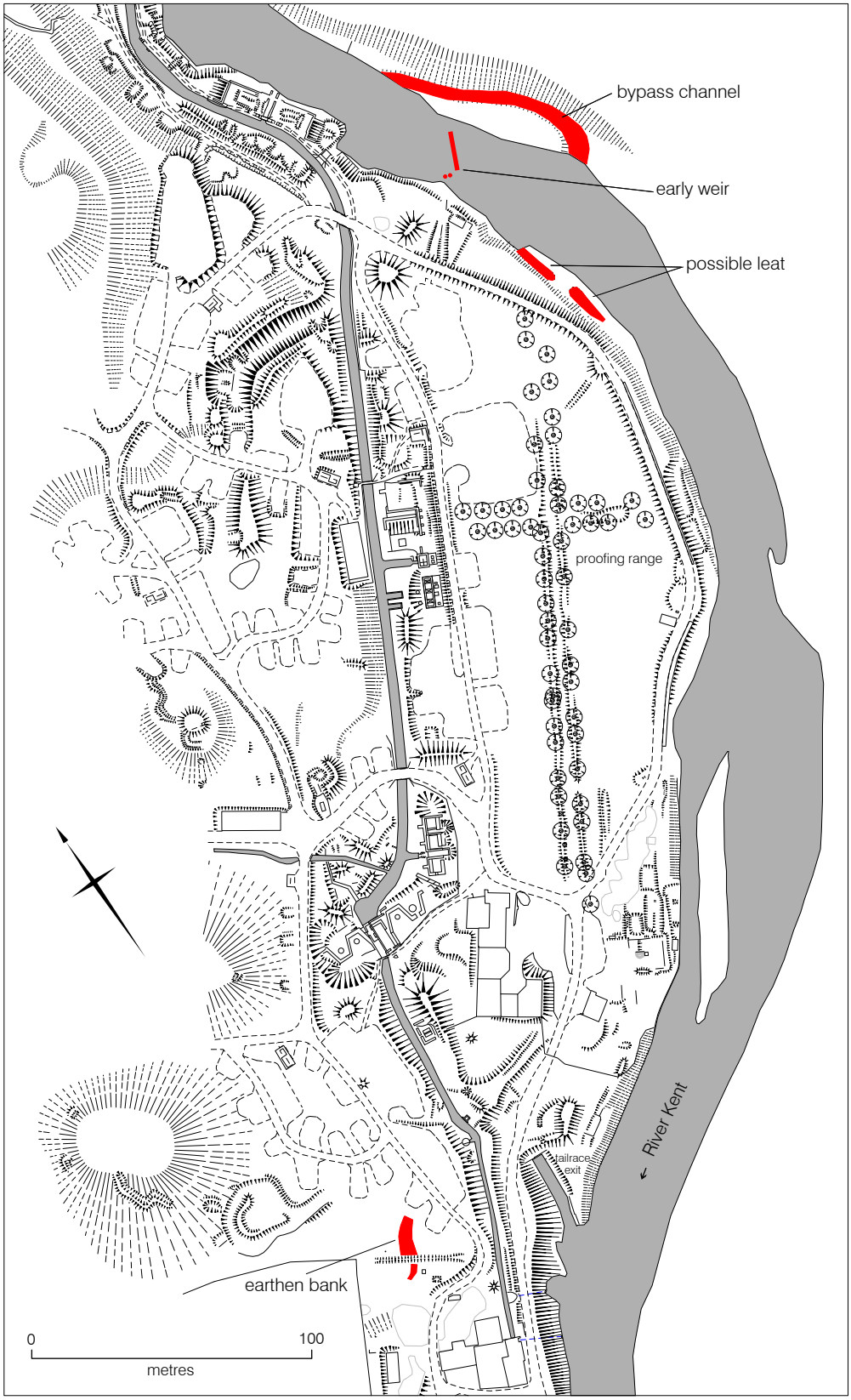

Figure 58. *Plan showing features (shown in red) which pre-date the gunpowder works*

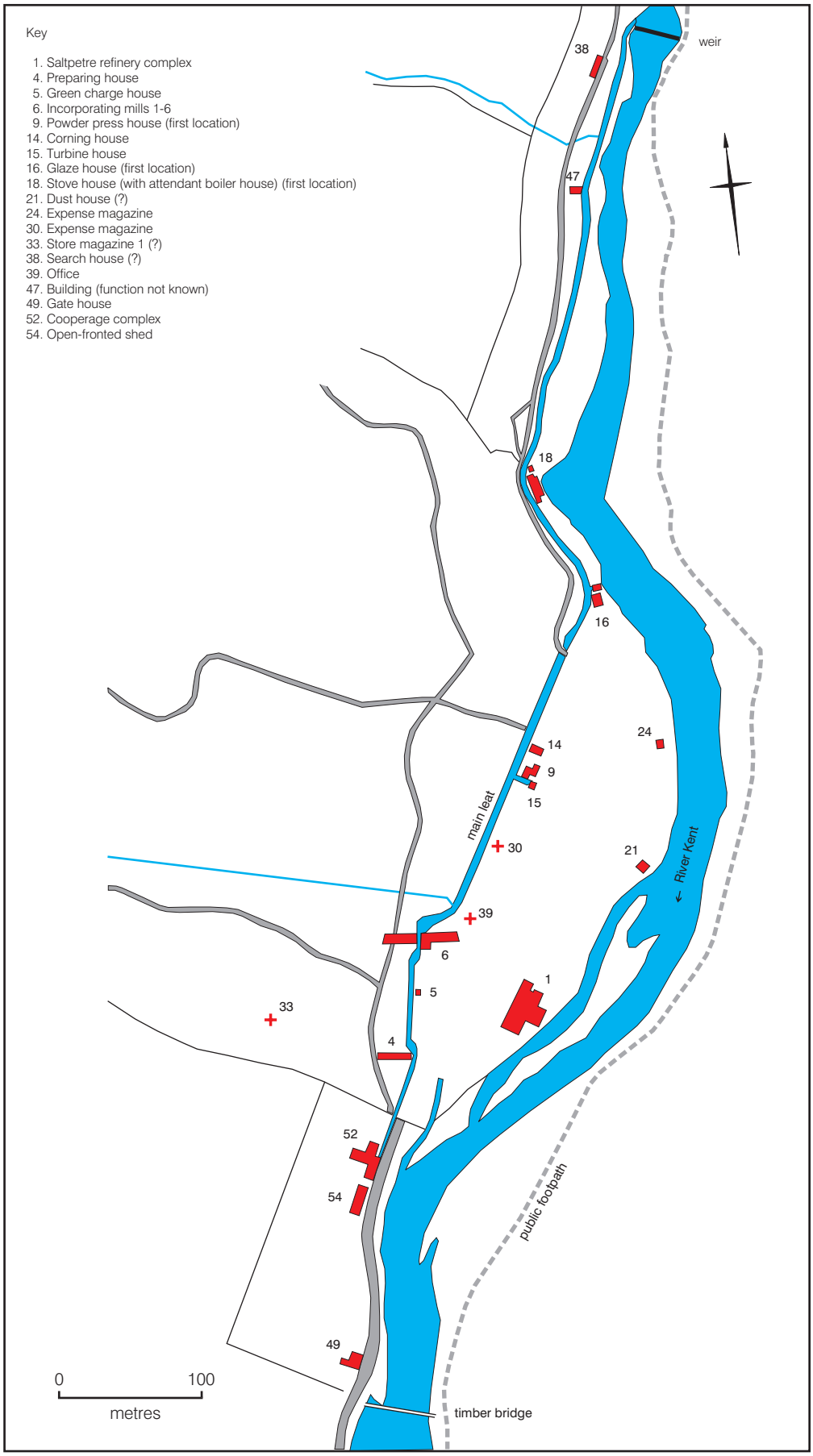

Figure 59.
Plan of the works during the late 1850s / early 1860s

The works, however, was not yet complete and further buildings and structures were erected during the ensuing years. A timber footbridge was built across the Kent immediately outside the main southern entrance to the works between 1857 and 1859 (see section 6.2.8 above). This was probably built partly in anticipation that permission would be given to re-route a footpath - that ran from Hawes Bridge southwards through the works - to the opposite bank of the river (this was granted at the Kendal Quarter Sessions in January 1860 (CRO(K) WQ/O/15)). The bridge also made it easier for the workers to reach the gunpowder works and to enter via the southern entrance. It is possible that until the bridge was opened some of the employees entered at the northern end of the licensed area, hence the building, perhaps a search house, which is marked in this area on the first edition of the OS 25" map, surveyed in 1858 (Ordnance Survey 1880). In addition to the main office within the gate house, a small building labelled 'office' is shown on two of the 1859/1860 sketch maps very close to incorporating mill 6. It had a very short life because it must have been demolished when the New Sedgwick Gunpowder Company Ltd. erected the second range of incorporating mills in the late 1860s (see section 6.2.7 above). In 1859 plans for a second saw mill (which also included a watch house and clock tower) were drawn up by Richard Shaw, a Kendal architect, and probably implemented during the same year. The new saw mill was built against and at right angles to the saw mill shown on the 1857 map within the cooperage complex. The north part of the open-fronted shed to the south of the cooperage may also have been erected during this early period. Sometime after 1857 an expense magazine was built in the area between the incorporating mills and the first powder press house. This positioning of an expense magazine between the incorporating mills and the powder press house with a second expense house (that on the 1857 map) between the corning house and glaze house, was an arrangement that lasted for the life of the works even though both magazines were later replaced by expense magazines at new locations (see section 6.2.5 above). Strickland's original application to erect the works also contained provision for a store magazine(s) to be built in Low Park Wood to the west of the main part of the works (see section 4.2 above). A store magazine is not depicted on the OS maps or on the 1859/1860 sketch maps suggesting that it may not have been erected immediately. However, possible remains of an early store magazine were discovered by EH in the south-east corner of Low Park Wood and in section 6.2.5 above have been described as store magazine 1. In this section it has also been suggested that the plans for a magazine which the Kendal architect, Richard C Shaw, drew up in 1959 may relate to these remains.

The layout of the site established by the Sedgwick Gunpowder Company Ltd. is markedly different to that of the nearby Old Sedgwick Works which was the first gunpowder manufactory to be established in Cumbria in *c*1764. The site chosen by Strickland for New Sedgwick was virtually unencumbered by earlier features or buildings that had to be taken into consideration when planning the layout of the new works. As a result it was possible to design a layout and arrangement of store and processing buildings from afresh (taking into account of course the constraints and advantages imposed by the natural topography) that should have given the best possible plan to enable manufacturing processes and the movement of powder between buildings to be carried out in a logical and efficient way and, in theory at least, giving enough space between buildings to satisfy government legislation

and to reduce the possibility of accidents. There was also plenty of room for later expansion of the works and for the adoption of new processes. It is surprising, therefore, that the arrangement of buildings was not a total success; the original powder press house and corning house were built much too close together with the result that - despite having a massive revetted blast bank between them - when one exploded the other often followed suit as happened in 1871 and again in 1875. At the inquest which followed this last explosion, the Government Inspector, Major Ford, is reported to have said that 'to my knowledge there is no other [gunpowder] manufactory where the corning and press-houses are so near together' (*Westmorland Gazette*, 7 August 1875). In comparison Old Sedgwick was built before legal controls were placed on the industry with the result that John Wakefield's company was able to build its works around an existing hamlet (hardly safe or convenient for the adoption of a sensible layout) which occupied a strip of land that topographically was much too restricted to allow sufficient space to be given between the processing buildings and for the site to evolve and expand (Jecock and Dunn 2002, 38). When additional incorporating mills were required in or around 1790 they had to be built some 500m down river from Old Sedgwick at Basingill (Hunt and Goodall 2002, 3).

These early years at New Sedgwick were not incident free. In April 1859 the County police sergeant was dispatched from Kendal to New Sedgwick on horseback in order to check out a fire that had started in one of the sheds at the works (*Westmorland Gazette and Kendal Advertiser*, 16 April 1859). Later in the same year an explosion occurred in one of the incorporating mills which also broke a few panes of glass in the saltpetre refinery complex (*Westmorland Gazette and Kendal Advertiser*, 24 September 1859). The company invested a tremendous amount of capital and effort into the works with the result that they appear to have lacked sufficient resources to develop markets, such as those overseas, which contributed to the financial difficulties which led to the company's demise in June 1864 (*Westmorland Gazette and Kendal Advertiser*, 25 June 1864).

7.2.2 Expansion, consolidation and compliance with new legislation (1864-1900) (Phase diagram Fig 60)

The New Sedgwick Gunpowder Company Ltd. took over the business in September 1864 and in 1886 became a family concern when Henry Swinglehurst brought out the other partners (see section 4.2 above). It was not long before new building work commenced under the new company. The output of a gunpowder works was largely dependent on the number of incorporating mills that it was equipped with; additional mills were commonly built as a gunpowder works become established. By 1869 a second range of incorporating mills had been erected (initially these comprised two mills (mills 7 and 8) but a third (mill 9) had been added by 1889) (see section 6.2.3 above). The new mills were different in form from the earlier mills and were separated from them by a tall blast wall. The new mills did not remain unscathed for long and were severely damaged in an explosion in 1869 that occurred while they were being used to produce sporting powder, which was much stronger than ordinary powder. The explosion spread to the other six mills and resulted in a single fatality. The blast also forced open the doors at the preparing house and broke the windows in the saltpetre refinery complex (*Westmorland Gazette and Kendal Advertiser*, 22 May

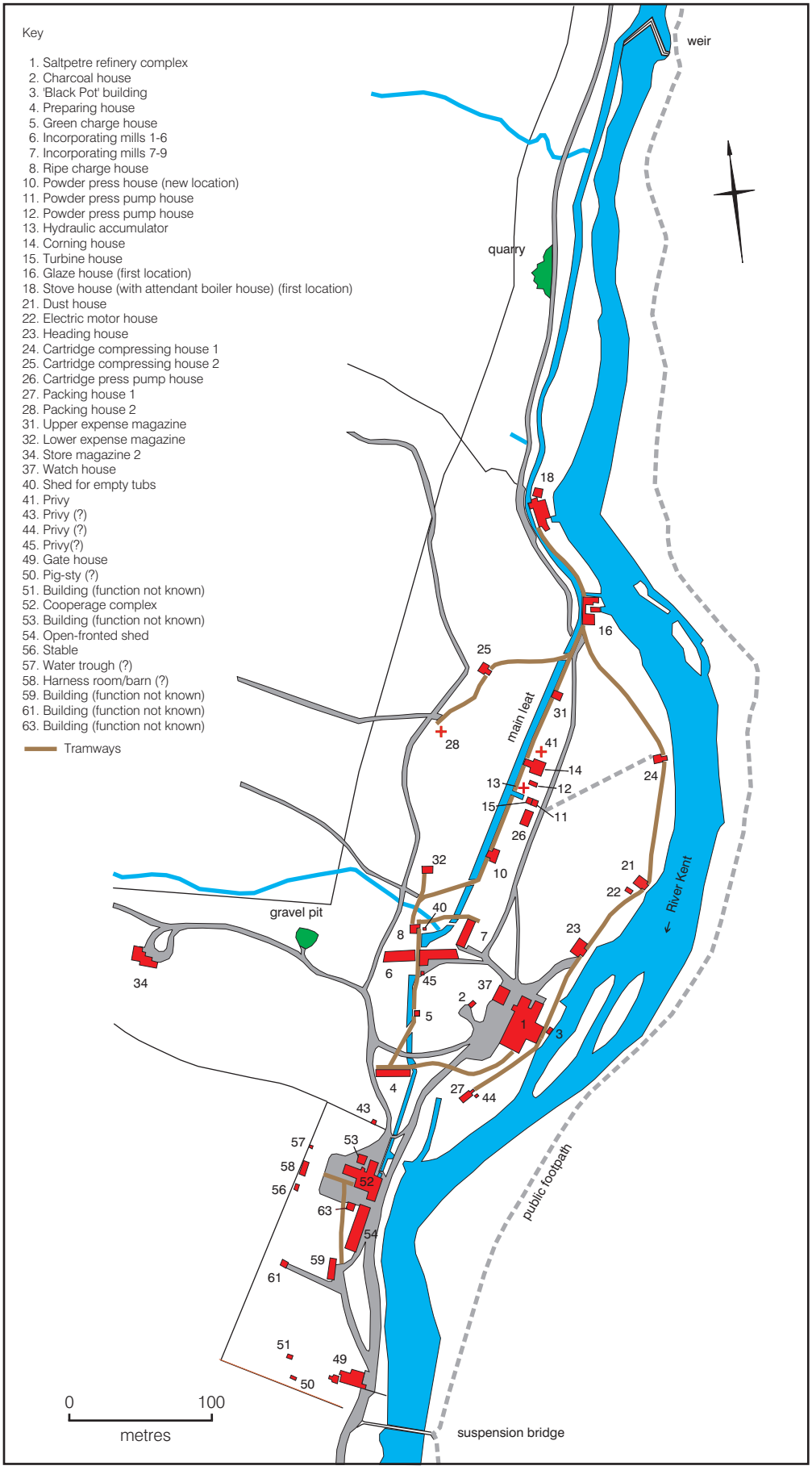

Figure 60.
Plan of the works at the end of 1900

1869). Explosions at the incorporating mills were not infrequent but a particularly damaging one also occurred in 1889, when all nine mills exploded. The increased incorporating capacity at New Sedgwick brought about by erecting mills 7-9 is likely to have had an effect on other buildings at the works. Perhaps the need to process more powder (especially sporting powders which required reeling) contributed to the expansion at the first glaze house location where the original glaze house was replaced by a larger building and a second compartment had been added by 1896.

It was probably during the second part of the 1860s or early 1870s that the new company installed two tramways at the works. One, a very short affair, served the cooperage area while the other was a much more extensive system and serviced the whole of the manufacturing part of the works within the licensed area. This second tramway has been described in some detail in section 6.2.10 and it is suffice to say here that it commenced at the saltpetre refinery complex and then went to the preparing house from where it proceeded in a northerly direction to link up the other processing buildings and expense magazines. There is a reference in a newspaper article to the laying in 1874 of the section that served the ripe charge house, the lower expense magazine and the new powder press house (*Westmorland Gazette*, 7 August 1875). Installing a tramway within a works where the buildings were already erected could not have been the easiest of tasks and in some cases it may have led to buildings being demolished in order to provide a suitable route. A close inspection of the depiction of the green charge house on the first and second editions of the OS mapping indicates that sometime between 1857 and 1896 it was demolished and rebuilt slightly further to the south. There is no recorded explosion at this building during the period concerned to account for this change and in terms of safety the original building was already a satisfactory distance from both the preparing house and incorporating mills, so this consideration would not have figured in the rebuilding. A more likely explanation is that the green charge house was moved so that there was sufficient space for the tramway to pass between it and the edge of the main leat on its way to the incorporating mills. The early range of the latter lay on the route of the new tramway and to have moved and rebuilt them would have been a very expensive undertaking. Instead the tramway was literally taken through the mills by utilising the space above the main leat which at the mills ran between mill 3 and the waterwheel house. It is possible that the southern compartment of the original glaze house was also moved and rebuilt at this time, partly to facilitate the insertion of the tramway.

A more centrally placed watch house near the saltpetre refinery complex was probably also erected during the late 1860s to which the mill men could retire after having set the incorporating mills in motion; it either supplemented, or more likely, replaced the 1859 watch house at the saw mill. The works' fire engine, which is known to have been on site by 1869, was also housed in the new watch house (see section 6.2.7 above) and in 1871 changing facilities, where employees could change into the special clothes provided by the company for working in the danger buildings, were added. These clothes lacked pockets to discourage matches and pipes being brought into processing buildings. However, in the early 1870s New Sedgwick still lacked a specific rule banning pockets, despite this being

a recommendation of the Explosives Inspectorate. This was clearly an area in need of tightening up because a newspaper report of an inquest into an explosion at the works in 1875 states that 'it was certain that some of the men had pockets, one of which contained a steel-clasped purse' (W*estmorland Gazette*, 7 August 1875). Before entering a powder building, workers had to remove their footwear and change into leather slippers as a further safety measure (*Westmorland Gazette and Kendal Advertiser*, 5 June 1869). Boots worn at the works apparently had soles attached with copper (and not iron) nails to prevent sparks (the remains of one of these boots, complete with copper nails, was found in the licensed area by EH during the survey and passed on to the National Trust).

In addition to the changing facilities at the watch house, newspaper sources indicate that the company continued with their building programme through the first half of the 1870s, to some extent this was due to necessity rather than by design. It is also clear that during these years there was an on-going discussion taking place between the company and the Explosives Inspectorate (*Westmorland Gazette*, 7 August 1875); it is tempting, therefore, to see some of these changes foreshadowing and anticipating the 1875 Explosives Act. In 1871, an explosion that destroyed both the corning house and the powder press house (Phase diagram Fig 59) and also killed at least two men took place. Both buildings were rebuilt at their original locations but the decision was now taken to look for a new site for the powder press house, one that was well away from the corning house. This was not a simple matter and the site initially chosen was converted into an expense magazine completed by 1875 (the lower expense magazine). This led to the demolition of an earlier expense magazine (the one built after 1857 by the Sedgwick Gunpowder Company Ltd. (Phase diagram Fig 59)) and the new powder press house being erected on its site instead. In 1875, while the new powder press house was being constructed, the existing powder press house (itself rebuilt after the 1871 explosion) and the corning house blew up with a loss of five lives (*Westmorland Gazette*, 18 July 1875). The corning house, which had also exploded in 1874, was rebuilt once again. Other building work completed at this time includes the heading house (1873) and new dust house (1874). The ripe charge house was also in existence by this time because there is a newspaper reference to the laying of a tramway from it to the lower expense magazine in 1874 (*Westmorland Gazette*, 7 August 1875). A shed for empty tubs had been erected to the east of the ripe charge house by 1896 but had gone by 1912. Perhaps during the late 1860s or 1870s (but definitely by 1896) store magazine 2 was erected and its predecessor (store magazine 1, built by the original company) demolished. The new magazine was situated slightly further away from the main part of the works at a location where the natural topography afforded much better blast protection than that provided for the first store magazine.

A pair of blast banks flanked the new powder press house that was being built in 1875 and were aimed at giving protection to and from the incorporating mills and the corning house. The southern bank had been extended by 1912, possibly to give extra protection to the incorporating mills as a consequence of an explosion in 1906 during which burning debris from the powder press house also reached one of the incorporating mills (Explosives Inspectorate 1906, 4). It is uncertain how the presses at the first powder press house

location were initially powered, but the press in the new powder press house was certainly a hydraulic one and by the end of the 19th century (if not before) power was provided by pumps housed in a pair of small buildings, one of which was attached to the turbine house that powered the corning machine. This last pump house was in existence by at least the middle of the 1870s because an extended turbine house is visible on one of the 1873-1875 photographs. This relationship indicates that the turbine must also have powered the powder press pumps. In addition the latter also shared a hydraulic accumulator (erected by 1900 on the site of the first powder press house) with the cartridge press pump house.

The company also had to contend with natural disasters that temporarily halted production during the early 1870s. In 1872 the main leat burst and the whole workforce was put to repairing it. It was damaged once again in October 1874 when the river flooded. The location of at least one of these incidents may have been close to the first stove house location where map evidence indicates that here part of the main leat was rebuilt sometime between 1857 and 1896. The original stove house and its attendant boiler house were also rebuilt during this period, perhaps as a consequence of the problems with the main leat. The repositioned boiler house whose original site lay on the path of the realigned leat (see section 6.2.3 above) provides support for this suggestion. The 1874 flood also swept away the weir at the northern end of the gunpowder works together with the wooden footbridge just outside the southern entrance. The weir that was destroyed was probably the straight one constructed by the original company (shown on the 1858 OS map) with the new one built after the flood being the more efficient 'V'-shaped weir depicted on later maps (see section 6.2.1 above). An elegant suspension footbridge, which still survives, was erected as a replacement for the wooden footbridge (see section 6.2.9 above).

The 1875 Explosives Act made the filling of blasting cartridges illegal except at a licensed establishment. Cartridge production at New Sedgwick commenced in 1880 following the issue of an amending license which allowed the expense magazine near the river (the one on the 1857 map) to be converted into a cartridge compressing house (cartridge compressing house 1). The upper expense magazine may well have been erected at this time in order to provide a replacement magazine for this end of the works. Cartridge compressing house 1 was rebuilt following an explosion in April 1883 that killed three workers (Explosives Inspectorate 1883, 8). An additional cartridge compressing house was also erected between 1883 and 1896 in a newly excavated deep cutting on the west side of the leat. This cutting was presumably designed to give good blast protection and also to provide an easy route for the spur that was laid out from the main tramway to serve this building (cartridge compressing house 2). Power for the hydraulic presses in both these compressing houses came from pumps located in a purpose-built cartridge press pump house situated on the east side of the main leat between the new powder press house and the corning house. The cartridges were packed in packing houses 1-2. Packing house 1 was erected between March 1880 and April 1883 and lay beyond the saltpetre refinery complex at the southern end of the site (see section 6.2.4 above). This was supplemented by packing house 2 which was built in an extension of the deep cutting (which contained cartridge compressing house 2) between 1896 and 1900 but had a short life as it had gone by 1912. The women who worked in

packing house 1 appear to have had a dedicated privy built for them adjacent to the packing house (see section 6.2.7 above).

Changes also took place in that part of the licensed area where the raw materials were housed. Additions were made to the saltpetre refinery complex and the 'Black Pot' building (possibly the graphite store) had been erected by the mid 1870s. In 1884 the charcoal store burnt down and a new one was built north-west of the saltpetre refinery complex, possibly on the site of the one which ignited. It has been claimed that charcoal production in retorts ceased at New Sedgwick after the fire with charcoal subsequently being bought in from away (Tyler 2002, 204). In the unlicensed area the open-fronted shed near the cooperage had been extended by 1896.

It was probably during the last two decades of the 19th century, in the aftermath of the 1875 Explosives Act, that many of the blast banks on the site were built. Indeed it has been suggested in section 6.2.4 above that some of the material dug out of the deep cutting in which cartridge compressing house 2 was located, was used in the pair of blast banks that flanked the tramway south of the first glaze house. The cutting was later extended to house packing house 2 and the excavated spoil must be the origin of the large earthen blast mound between this packing house and the corning house. The blast banks associated with packing house 1 and the upper expense magazine were probably also heaped up at the same time as these two buildings were erected. There was once a blast bank between the first stove and first glaze house locations which was erected to comply with Amending Licence No. 254 issued some time after 1883 (Explosives Inspectorate 1903, 3).

An electric motor house had been erected by the end of 1900 beside the dust house to provide power for the mechanical separator housed in the latter. The electricity was probably produced by the dynamo, which was installed at this time, in the cartridge press pump house. The remodelling of the latter had also taken place before the end of 1900, perhaps as a consequence of electricity production. The dynamo is likely to have provided power for a number of other installations at New Sedgwick including the electric lights outside the windows of the incorporating mills.

7.2.3 Into the 20th century (1901-17) (Phase diagram Fig 61)

A terrible explosion in March 1903 marred the beginning of the new century at New Sedgwick. It started at the first glaze house location (Phase diagram Fig 60) but spread or caused damage to other buildings in the vicinity and killed two employees. The glaze and corning houses were destroyed, the upper expense magazine, cartridge compressing house 2, and the stove house at the first stove house location (Phase diagram Fig 60) were all damaged. Apparently 'the other powder buildings escaped with little damage other than broken glass' (Explosives Inspectorate 1903, 5). The rebuilding which followed (much of it probably in 1903) led to the complete reorganisation of the northern end of the works. A new glaze house consisting of two compartments and a waterwheel house was erected a short distance to the north west of the first glaze house and, as part of the site preparations for it, the blast bank referred to in Amending Licence No. 254 was levelled. But the new glaze house,

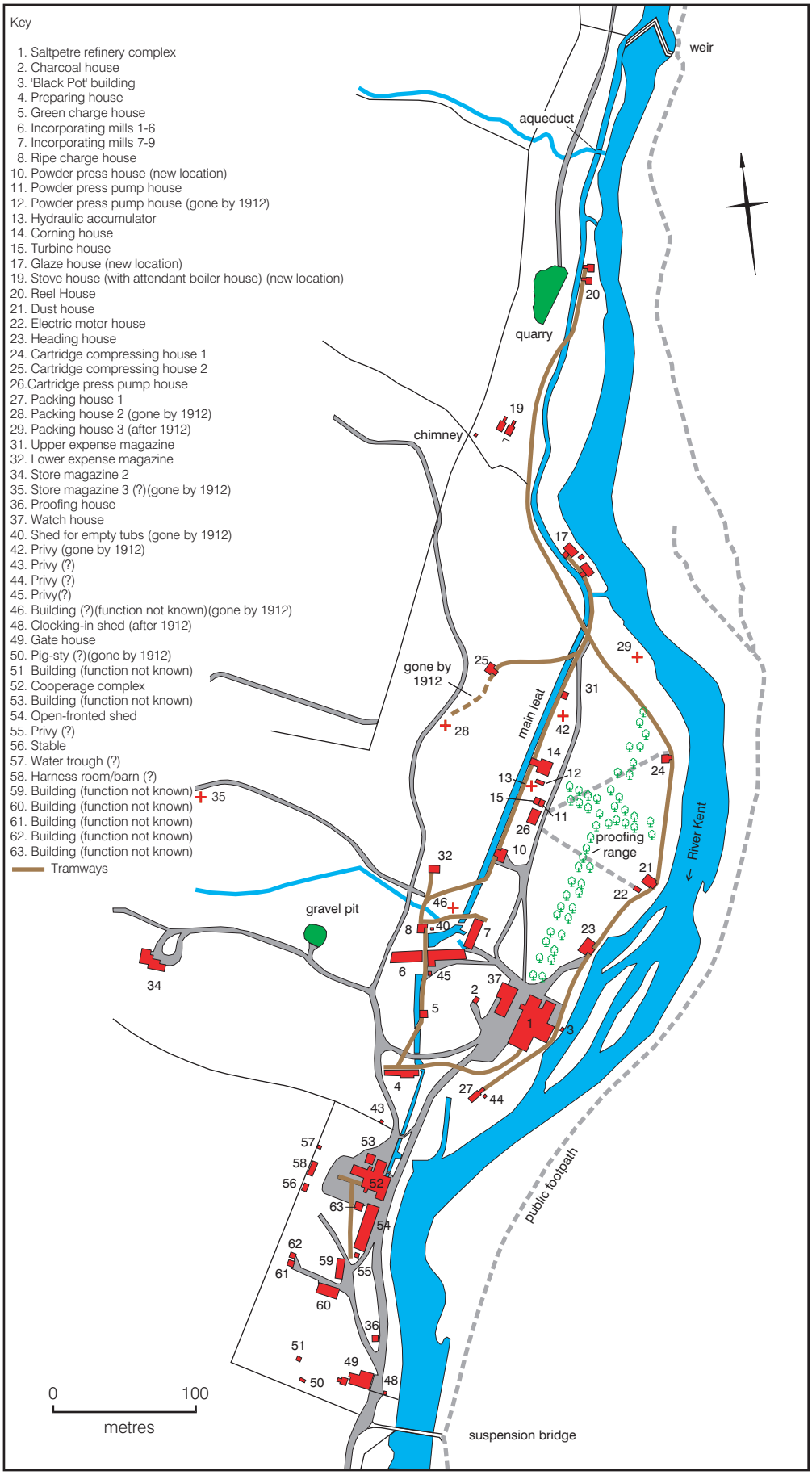

Figure 61.
Plan of the works during the early 20th century (after 1903)

although provided with a pair of blast banks, was much too close to the original stove house location for safety with the result that the stove house and its attendant boiler house also had to be demolished. Their replacements were built over 80m away from the new glaze house on the opposite (west) side of the main leat. The new stove house consisted of two buildings, separated by a blast wall, erected on the floor of a large rectangular depression cut into the side of the valley. One building was for drying loose powders and the other for blasting cartridges; the boiler house was located underground immediately to the south (see section 6.2.3 above). Prior to the 1903 explosion, reeling had been carried out in the glaze house and it was while tightening a key on a reel shaft that the explosion occurred. It is thus not surprising that on rebuilding this process was moved to a new purpose-built reel house located towards the northern end of the licensed area well away from other powder buildings; it was sited close to the river on the eastern side of the main leat. It is possible that a small aqueduct, which crosses the main leat near the north end of the site, was installed at this time so that the northern stream could discharge directly into the river. Perhaps it was thought that if the stream's lime-rich water continued to flow into the main leat, it might clog up the turbine at the reel house (see section 6.2.1 above). The tramway also had to be extended in order to link the new stove and reel houses with the rest of the network in the licensed area. The replacement for the corning house was constructed on the same site as all previous corning houses; it is possible that as part of this building activity a privy, which had formerly stood outside the corning house to the north, was moved closer to the upper expense magazine (see section 6.2.7 above). Much of the stone used in this building programme may have come from the quarry situated on the western bank of the near river the northern end of the site (see section 6.2.8 above).

Further building work had to take place at New Sedgwick in 1906 as a consequence of lightening strikes which destroyed the new powder press house (despite it being provided with a lightning conductor) and caused four of the incorporating mills to explode. The proofing range (with its surviving avenues of trees), together with the laboratory, may also date to the first part of the 20th century. Neither is shown on the OS map revised in 1896 but both are depicted in 1912. It is not known where the gunpowder was tested in the 19th century but a separate bank to the east and near to the southern end of the long avenue might be the remains of an earlier range (see section 6.2.6 above). Store magazine 3, a possible temporary store for gunpowder, also appears to have been erected and subsequently demolished between 1903 and 1912 (see section 6.2.5 above). Additions to the works after 1912 include a third probable cartridge packing house and the clocking-in shed. They have been included in this section but it is equally possible that they were not installed until after 1917. The clocking-in shed was erected just inside the main southern entrance while packing house 3 was built on the riverbank between cartridge compressing house 1 and the first glaze house location.

7.2.4 The final years and closure (1917-35) (Phase diagram Fig 61)

After World War 1 the demand for Cumbrian gunpowder fell dramatically and in 1917 New Sedgwick ceased to be a family concern, finally becoming part of ICI in 1926 (see section 4.2 above). During this period the chief sources of information are Thomas Faulkner's

notebook and the manufacturing method book (MMB) for New Sedgwick. These sources are more concerned with manufacturing processes and the contents of individual buildings rather than with structural and evolutionary aspects of the works at this time. However the MMB provides some evidence for decline during the final years: the reel house, for example, was no longer being used because reeling at the works had ceased. When Faulkner compiled his notebook two cartridge packing houses were still required but by the time of the MMB they had been reduced to one. Another source of information for this period is David Willacy's collection of photographs, which show a few of the powder buildings in the late 1920s. As well as indicating what these buildings looked like towards the end they also confirm the earlier newspaper accounts and official accident reports that the processing buildings were often lightly constructed using materials such as corrugated iron, timber and roofing felt. Irrespective of whether or not these buildings exploded, such materials would still have required periodic maintenance and renewal during the final years in order to keep the contents of the buildings dry. Regarding explosions, these continued to take place at the incorporating mills especially between 1928 and 1931 (Patterson 1986, 29) although they appear not to have caused fatalities. At times it appears that safety measures were still not always being followed: a handwritten note in the Patterson Collection (NMRC, Swindon) refers to a 'millman' who on the 20th November 1925 'was attending to the boiler fire without having changed into the special clothes provided, when his clothing caught fire. He escaped serious injury by jumping into a tank of water'. It is possible that under ICI the synthetic sodium nitrate that was being refined in the saltpetre complex was also being produced for industries other than gunpowder. The MMB (page 2) states that this form of saltpetre was used for blasting explosives and, interestingly, also for dyestuffs.

In May 1935 the works finally closed and the powder buildings were demolished. Section 4.2 above contains some very interesting recollections from James Guy about how demolition took place including blowing up the edge-runners in the incorporating mills with gelignite. The latter is probably the explanation for the large piece of iron edge-runner which lies on the ground to the south of the waterwheel house of the early range of incorporating mills. The buildings in the unlicensed area, because they had not been used for powder manufacture or storage, were not demolished and in 1938 the whole of the gate house was converted for residential use.

7.3 World War II and New Sedgwick (Phase diagram Fig 62)

New Sedgwick was requisitioned by the army during World War II to serve as a munitions depot (see section 6.3 above). It is interesting that the archaeological evidence indicates that the arrangement of the depot appears to have mirrored that of the gunpowder works with the former licensed area being used for the explosives (munitions) and the unlicensed area reserved for the service and ancillary buildings. The southern entrance of the former gunpowder works remained the principal entry point into the depot and just outside it a timber guard house was erected. It no longer survives apart from the shuttered concrete pillars that supported its base but fortunately photographs of it exist. Within the unlicensed area temporary huts (barracks, showers, mess room, etc.) were erected which, apart from their concrete bases, no longer survive. Still extant though is a timber-framed garage clad

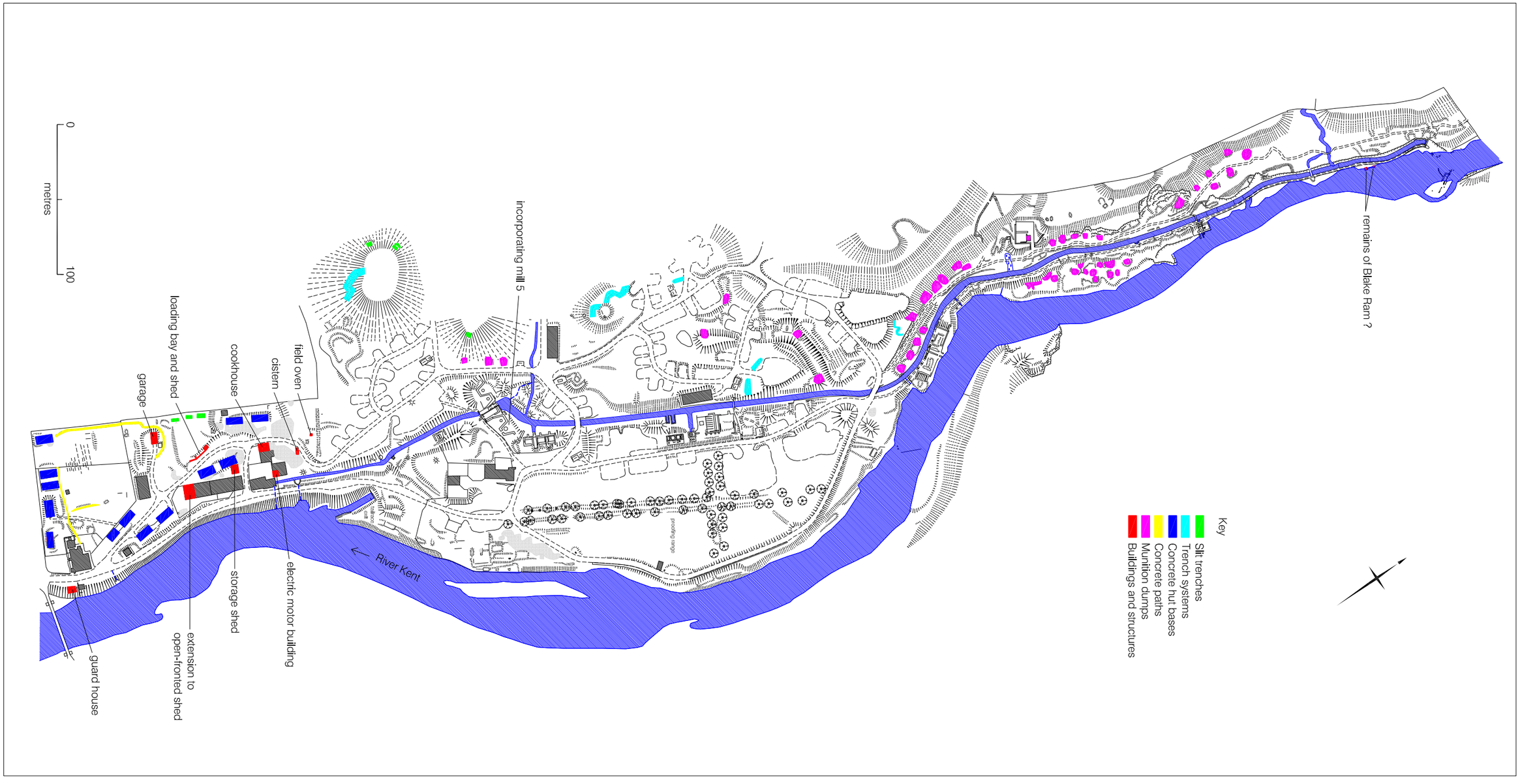

Figure 62. *Plan of World War II features at New Sedgwick*

in corrugated iron with an inspection pit in its floor. Some of the former gunpowder buildings and structures that were not demolished when the works closed were also used by the military. According to local information the gate house was probably used by the officers while in the cooperage, a room was created to house an electrically-powered motor which drove a line shaft down to the saw mill and old machine shop. This indicates that these buildings and their machines were still being used, perhaps to produce items such as wooden boxes in which to pack the smaller munitions. The machine shop at the western end of the saw mill was converted into a cookhouse and the cast-iron range which was installed still survives as does a notice board on the back of the door. Outside it is a cistern, chiefly made of concrete, together with the remains of a field oven, near which is a broken plate bearing the NAAFI insignia.

Within the licensed area of the former works the EH survey has found evidence of some fifty stances on which the munitions were probably stored. They survive either as platforms or hollows and were clearly positioned in areas where the topography and tree canopy would help to hide them from being observed by enemy air reconnaissance. A number utilised the deep cutting that was initially excavated for cartridge compressing house 2 and, towards the northern end of the site, even the bottom of an abandoned quarry was used. It is quite possible that either part of the old tramway survived into the war years or was re-laid to assist with the movement of munitions around the northern end of the depot (see section 6.2.10 above). The new stove house buildings were destroyed in 1935 when the gunpowder works closed, but the hollow in which they were situated (together with the blast wall that separated them) still provided excellent protection and was used during the war for the storage of phosphorous grenades (they exploded on at least one occasion - see section 6.3.2 above). The compartments belonging to the incorporating mills also appear to have been used by the army, hence the shuttered concrete-lined gap that was cut through the rear wall of mill 5. The central hole in the interior of this mill was also plugged with concrete. Slit trenches, together with more extensive trench systems, were also recorded by EH with the former occurring in both licensed and unlicensed areas. These features were presumably part of the depot's defence system and were supplemented no doubt by barbed wire fencing. The latter, now very rusty, is still visible in several areas of the site, especially where multiple strands hang from tree trunks. A good example of this is present at the northern end of the site, on the west side of the main leat, where there are also slight earthworks - possibly the remnants of a former checkpoint (see section 6.2.7 above).

8. SURVEY METHODOLOGY

The archaeological measured survey was carried out using a Leica TC805 electronic theodolite with Electromagnetic Distance Measurement (total station) to establish a series of interlinked traverses. Observations from each station were taken to set out a network of temporary control points marked by a combination of plastic pegs and degradable paint marks across the site and to directly record 'hard detail' such as buildings and walls. Total station data was processed and plotted using Key TERRA-FIRMA software. The archaeological detail was then plotted by hand using a plane table and Leica RK-1 self-reducing alidade (a particularly effective approach when the vegetation had started to sprout) and conventional graphical methods of tapeline and offset. The buildings were measured with hand tapes and drawn digitally using Microstation software.

Site photography for archival purposes was undertaken mainly on medium format roll film cameras, using perspective control lenses and portable electronic flash lighting equipment. All photographs were taken in colour.

9. ACKNOWLEDGEMENTS

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EH is most grateful for all the help and information which it has received from a large number of individuals and organisations. In particular thanks are due to the National Trust (Fiona Clarke, Brian Fereday and Robert Maxwell) for permission to survey the site and for kindly providing background information, David and James Willacy for passing on their considerable knowledge about the works (David also allowed EH to copy some of the images in his collection of old photographs for the NMR), Mike Davies-Shiel who very generously shared his archive material and ideas with EH and supplied copies of photographs, plans and a typescript of Thomas Faulkner's notebook, Cliff Brown for his local knowledge about the site, Janet Thompson for information about the history of Sedgwick, Alan Crocker and Kenneth Major for sharing their knowledge (especially about the turbines), ICI (Peter Cartwright) for information on archive material held at Ardeer, Glyn and June Davies for allowing access to the caravan park during the caravaning season and the farmer at Bradley Farm for permission to visit the gunpowder warehouse at Hincaster Junction. Last, but by no means least, EH is extremely grateful to the assistance so readily given by staff at the Local Studies Library and the Cumbria Record Office, both in Kendal.

The National Trust (Robert Maxwell), ICI plc (Peter Cartwright), the Cumbria Record Office in Kendal (Richard Hall) and David Willacy have also kindly allowed EH to reproduce plans or photographs from their collections in this report.

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WD/CAT/A1951 Working drawings by Richard C Shaw, architect, of buildings at Sedgwick Gunpowder Works, 1859

WD/NT/40 Plan of the Sedgwick Gunpowder Works by John Banks of Kendal, no date (but internal evidence suggests 1903-12)

WDB/22/68.4 Map of Low Sizergh in the occupation of Chr. Garnett, *c*1850 (but more likely to be later and *c*1857)

WDB/22/68.5 Estate map *c*1850

WDB/35/564 Map showing closure of footpath from Hawes Bridge to Sedgwick, 1860

WDB/35/779 Draft deposited plan, footpath and footbridge through gunpowder works at Hawes Bridge (Helsington), no date

WQ/A/H/15 Documents and map accompanying stopping up of footpath at Sedgwick, 1859

WQ/O/15 Kendal Order Book 1839-76

2. Davies-Shiel Archive, Windermere (in private possession, Mike Davies-Shiel):

No details, but extracts supplied for this report to EH include colour photographs, notes, annotated plans and a transcription of Thomas Faulkner's notebook of *c*1925

3. Imperial Chemical Industries (ICI), Ardeer:

Copy of plan entitled 'Plan of the Sedgwick Gunpowder Works' accompanying Amending License No. 910, drawn October 1900 and signed by JH Thomson, Captain, HM Chief Inspector of Explosives, 2 November 1900

4. Kendal Reference Library:

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Westmorland Gazette, 3 July 1875

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Westmorland Gazette, 7 August 1875

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Westmorland Gazette, 30 June 1906

Westmorland Gazette, 8 June 1935

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5. National Monuments Record, Swindon:

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Transcript of an interview with James Willacy in 2001 (to be catalogued)

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6. National Trust, Grasmere:

Structural survey of the incorporating mills and coopers yard at New Sedgwick carried out in 1992. Comprises a typed report and plans at I:100 scale

Collection of black and white photographs of the works taken in 1977

Typescript of an interview with James Guy in 1995

7. Strickland Archive, Sizergh Castle (private collection):

Hornyold-Strickland, H 1931-71, *Sizergh Estate. Improvements and Alterations from 1931*, manuscript

8. Willacy Collection, Sedgwick (in private possession, David Willacy):

Two photographs of New Sedgwick Gunpowder Works by J H Hogg of Kendal (undated but probably taken between1873 and 1875). In addition there are a number of family-type photographs relating to Thomas Faulkner which show features at the New Sedgwick Works (undated but probably late 1920s), together with several group photographs of people involved in the wider Cumbrian gunpowder industry. Some of the above have been copied for the NMR

Appendix 1: List of recorded explosions at New Sedgwick

As a consequence of the 1875 Explosives Act, the reporting of fires and accidents involving explosives at gunpowder works became a statutory requirement (Cocroft 2000, 99). As a result, major accidents after 1875 are described and analysed (to try and identify the causes) at length in a series of special reports by HM Inspectors of Explosives. Before this date local newspapers are the chief source of information for such events, but their reporters tended to concentrate on the more spectacular explosions and coroner's inquests. A number of local newspapers have been consulted by EH, often as a follow-up to references gleaned from secondary sources, and Table I has been compiled from both these newspapers and the special reports from the HM Inspectors. Tyler (2002, 204) briefly describes an explosion on April 15th 1885, allegedly in one of the incorporating mills at New Sedgwick that was caused by a lightning strike and led to a fatality. It has not been included in Table I because no other reference to this incident has been found in the literature and sources consulted for this report. Perhaps confusion has crept in and the explosion actually took place at another site such as the one that occurred in similar circumstances on June 15th 1883 at the near-by Basingill Works where one man later died from the injuries he sustained (Hunt and Goodall 2002, 52). It might be possible to produce a fuller list of accidents for New Sedgwick by systematic scrutiny of all contemporary local newspapers, but this task is beyond the remit of the present report.

From 1876, minor explosions not resulting in fatalities were noted briefly in the Explosives Inspectorate's annual reports. It has not been possible to consult all this series at first hand, but Patterson (1986, 29) has compiled a list of explosions from them which occurred in incorporating mills whilst in motion. Details for New Sedgwick have been extracted from this list and form Table II. Patterson's list does not include explosions caused by removing trod (hard compacted powder which accumulated on the bed plate and edge-runners during incorporation) from stationary mills. However, hand-written notes referring to such incidents form part of the Patterson Collection and have also been included in Table II with an asterisk against them.

The tables show that at New Sedgwick, as at other gunpowder manufactories, explosions at the incorporating mills were common place. Fortunately they did not often result in fatalities because the dangerous nature of the process was appreciated, and the mill men were able to retire to the safety of the watch house whilst the mills were in motion. Many explosions at gunpowder works also took place at the corning house and the one at New Sedgwick proved to be no exception. Unfortunately until 1875 the powder press house was located so close to it that when one exploded the other often went up as well. No powder processing building was immune from being a possible candidate for an explosion as is demonstrated at New Sedgwick by the explosions which wrecked cartridge compressing house 1 in 1883 and completely destroyed the glaze house in 1903. This last explosion also shows how easy it was for air-borne debris, which were on fire to spread conflagration and explosions to other powder buildings in the vicinity. Some explosions were due purely

to natural causes such as the lightning strikes of June 1906 that caused damage to the incorporating mills and destroyed the powder press house.

Table I: Major explosions

Date	Location	Cause	Damage	Casualties	Reference
1859, 20 September	Incorporating mills	Not known	One mill and its machinery damaged. Blast broke a few panes of glass in the saltpetre refinery	None	*Westmorland Gazette and Kendal Advertiser,* 24 September 1859
1869, 15 May	Incorporating mills	Not known	Started in either mill 7 or 8 and then spread to all the other mills. Blast broke every window in the saltpetre refinery complex and forced open the doors of the preparing house. Estimated cost £600	1 killed	*Westmorland Gazette and Kendal Advertiser,* 5 June 1869
1871, 22 October	Corning house and powder press house	Repairs to corning house roof	Both buildings destroyed	At least 2 and possibly as many as 3 or 4 killed	*Westmorland Gazette and Kendal Advertiser,* 28 October 1871; *Westmorland Gazette,* 25 April 1874
1872, 29 August	Incorporating mills	Not known	One mill damaged	None	*Westmorland Gazette,* 31 August 1872
1874, 24 April	Corning house	Not known	Corning house destroyed	2 men severely burnt	*Westmorland Gazette,* 25 April 1874
1875, 30 June	Corning and powder press houses	Not known	Both buildings destroyed. Estimated cost £300-£500	5 killed	*Westmorland Gazette,* 3 July 1875; 7 August 1875
1883, 12 April	Cartridge compressing house 1	Probably friction in the press	Building wrecked	3 killed	*Westmorland Gazette,* 14 April 1883; Explosives Inspectorate 1883
1903, 30 March	Glaze and corning houses	Tightening a key on a reel shaft	Glaze and corning houses destroyed. Blast or flying (burning) debris also caused damage to the stove house, upper expense magazine and cartridge compressing house 2. Estimated cost £4000	2 killed and 4 men injured	*Westmorland Gazette,* 4 April 1903; Explosives Inspectorate 1903
1906, 23 June	Incorporating mills and powder press house	Lightning	Mills 1, 4, 8 and 9 exploded. The powder press house was also destroyed. Estimated cost £500-£1000	None	*Westmorland Gazette,* 30 June 1906; Explosives Inspectorate 1906

Table II: Incorporating mill explosions after 1875 and not included in Table I (NB. * indicates explosions at stationary mills)

Year	Number of explosions	Year	Number of explosions	Year	Number of explosions
1877	1	1900	1	1928	1
1878	2	1904	1	1929	1
1879	1	1912	2	1930	3
1882	2	1915	2	1931	3
1889*	1	1917	1		
1894	1	1918	2		
1898	1	1919*	1		

Appendix 2: The archive and photographic record

A survey archive consisting of the field plans and supportive background information such as the project design, has been deposited in the NMR (NMRC, Swindon), under Collections reference AF 00088, where it is available for public consultation upon request. The digital plan is currently retained at the EH York office and is also publicly available on request.

Site photographs (taken by Bob Skingle in January 2001) are held at the NMRC, Swindon, together with photographs copied by him from the Willacy Collection (with the kind permission of David Willacy). Also held are photographs by Christopher Dunn of features in the saltpetre refinery floor (taken in May 2003) and the gunpowder warehouse at Hincaster Junction (photographed in June 2002). All these photographs are listed below with their NMR numbers and are publicly available on request

Site photographs by Bob Skingle

NMR number	Subject
AA012831	Suspension bridge from the north east
AA012832	Suspension bridge from east
AA012833	Clocking-in shed from north west
AA012834	Gate house cottages from north east
AA012835	Gate house cottages from south east
AA012836	Gate house cottages from the north north west
AA012837	World War II garage to north west of gate house
AA012838	Huts in field to the west of gate house
AA012839	Modern timber store shed with World War II garage beyond, from east
AA012840	World War II loading platform and hut to rear of open-fronted shed from the south south east
AA012841	World War II concrete hut near loading platform
AA012842	Remains of workbench from cooperage
AA012843	Machinery by 'Marshall Sons &....' originally in the cooperage
AA012844	Detail of machine by 'Prentice Bros Worcester MA88' originally in the cooperage
AA012845	General view of machinery removed from cooperage
AA012846	View of slit trenches to west of cooperage
AA012847	Small stable to the west of the cooperage, from north east
AA012848	Open-fronted shed from the south south east
AA012849	Interior of open-fronted shed showing graffiti dated 1940/1943
AA012850	Interior of open-fronted shed, north end
AA012851	New saw mill and watch house from south
AA012852	New saw mill, watch house and turbine house from north east
AA012853	Detail of new saw mill showing arched opening from the main leat into the turbine house serving cooperage, from north east

AA012854 Interior of turbine house serving cooperage
AA012881 Incorporating mill 3, detail of north-east corner
AA012882 General view of incorporating mills Nos 7-9 and north side of waterwheel house (between mills 3 and 4) and headrace
AA012883 North side of waterwheel house showing entrance for race
AA012884 Incorporating mills 1-3 from the west
AA012885 View into waterwheel pit from south
AA012886 Detail of iron fittings and roofing
AA012887 Incorporating mill 4 from south
AA012888 Incorporating mill 4, detail of chamber below lost incorporating mill machine
AA012889 Incorporating mill 4, remnant of cement floor
AA012890 Waterwheel pit (between mills 3 and 6) from the north east
AA012891 Entrance to drive alley east side of waterwheel house
AA012892 Rear view (west side) of incorporating mills 7-9 from south west
AA012893 Waterwheel chamber between incorporating mills 7 and 8 from east
AA012894 Waterwheel house and incorporating mill 8, general view from south east
AA012895 Incorporating mill 8 from east
AA012896 Incorporating mill 9 from north-east
AA012897 Incorporating mill 9, machine bed below ground level showing shaft alley from north
AA012898 Rear view (west wall) of incorporating mill 8, detail
AA012899 Rear view (west wall) of incorporating mills 8 and 9
AA012900 Main leat and incorporating mills from the north north east
AA012901 Old boiler to west of cooperage (possibly re-used in World War II)
AA012902 Clocking-in shed, interior
AA012903 Detail of stone arch at end of main tailrace from incorporating mills etc.
AA012904 Cartridge press pump house and near-by blast banks from north east
AA012905 General view of sluices and cartridge press pump house from the south west
AA012906 Turbine house (for corning and powder press pumps) from south west
AA012907 View up River Kent to weir from south
AA012908 Weir on River Kent from south west
AA012909 Sluice gate machinery at northern end of main leat near weir
AA012910 Entrance to new stove house from the east
AA012911 Interior of new stove house, south-eastern compartment
AA012912 Interior of new stove house, north-western compartment
AA012913 General view of new stove house from north-east
AA012914 Cartridge press pump house with turbine house (for corning machine) in background, from south
AA012915 Turbine house and turbine pit that served corning house and powder press pumps
AA012916 Blast bank between first powder press house and corning house, from the south east

AA012917 View up deep cutting (utilised by tramway) to site of cartridge compressing house 2, from north-east
AA012918 New glaze house (southern part) from north west
AA012919 New glaze house (northern part and headrace to waterwheel house) from south east
AA012920 New glaze house (northern part) from south
AA012921 Remains of the tramway crossing over the main leat between the new stove house and the reel house, from the north
AA012922 End of the short headrace to the reel house, from south west
AA012923 Aqueduct across main leat at north end of site, looking south
AA012924 Boiler house which served the new stove house, from south east
AA012925 Remains of flue from boiler house at new stove house
AA012926 Tramway cutting (south west of new glaze house) heading towards the new stove house, from south east
AA012927 Electric motor house from west
AA012928 Avenue of trees (proofing range), from south
AA012929 Stone tank (beside 'Black Pot' building) near River Kent at south end of site
AA012930 Site of saltpetre refinery complex
AA012931 Inspection pit in World War II garage
AA012932 Ground floor of new saw mill
AA012933 First floor of new saw mill
AA012934 Hoist wheel, first floor of new saw mill
AA012935 Interior of machine shop from south west showing drive shaft
AA012936 Interior of machine shop from south west
AA012937 Interior of machine shop from north east
AA012938 Cooks' duty roster board in World War II cookhouse
AA012939 Oven range in World War II cookhouse
AA012940 Forge in smithy created in original cooper's shop
AA012941 Electric motor in room created in south-west corner of smithy
AA012942 Workbenches against east wall of smithy

Photographs copied from the Willacy Collection

NMR Number Subject

AA022282 View from the east showing the saltpetre refinery complex and other buildings in the main part of the works, by J H Hogg
AA022283 View from the north east across the unlicensed area, by J H Hogg
AA035268 Portrait of James Willacy who worked in the office at New Sedgwick from 1916
AA035269 Thomas Faulkner and three ladies having tea outside gate house, from the west
AA035270 The gate house from the south

AA035271 Thomas Faulkner at New Sedgwick with fishing tackle
AA035272 Front of gate house (east wall) from the north
AA035273 Gate house from the west
AA035274 Thomas Faulkner fishing with the new glaze house in the background, from the north
AA035275 Cartridge compressing house 2 and the tramway, from the east
AA035276 Western end of the corning house from the south west
AA035277 Footbridge across the main leat north-west of the new glaze house, from the south
AA035278 Suspension footbridge across the River Kent from the south east
AA035279 River Kent with gunpowder works weir in background, from the south
AA035280 River Kent with gunpowder works weir in background, from the south
AA035281 The ruins of the glaze house after the explosion in 1903, from the east

Photographs supplied by Christopher Dunn

NMR Number Subject

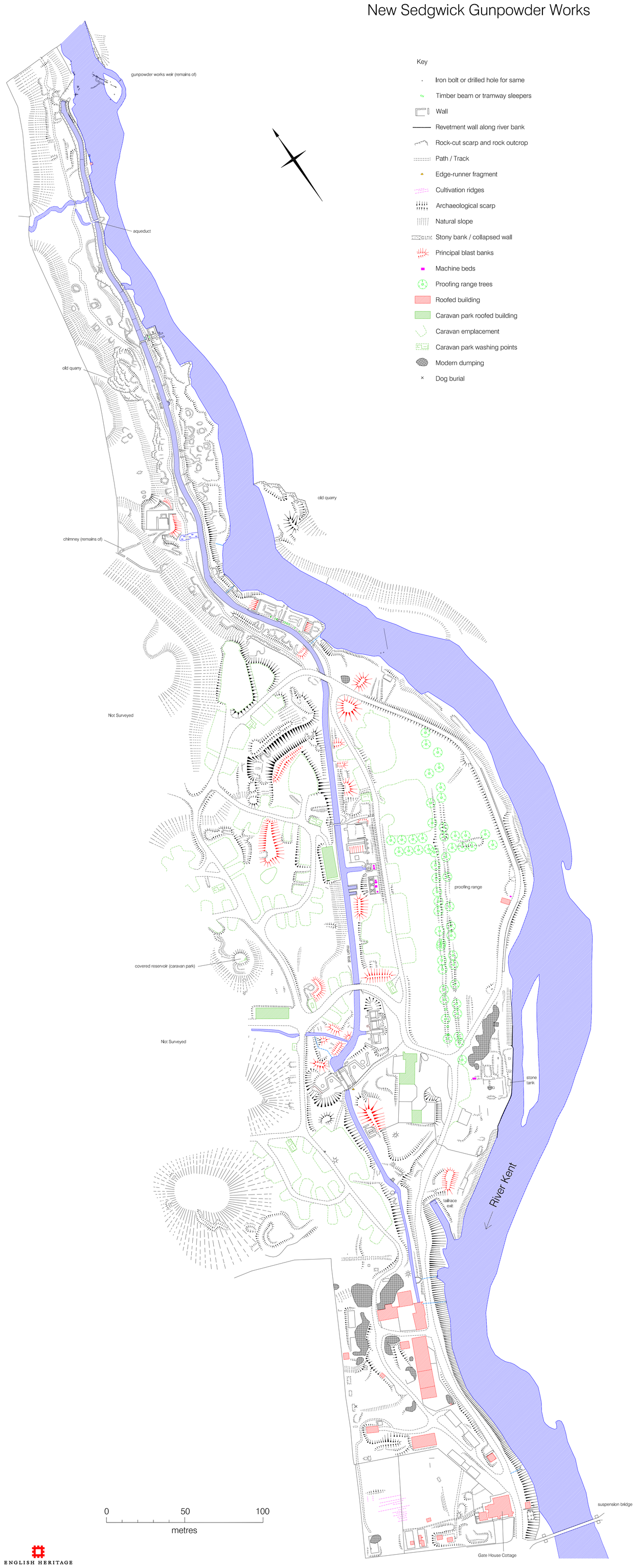
DP001578 Tank and iron basins in the floor of the saltpetre refinery at New Sedgwick, from the south east
DP001579 Iron basins and tank in the floor of the saltpetre refinery, from the west
DP001580 Tank and iron basins in the floor of the saltpetre refinery, from the south east
DP001581 Gunpowder warehouse at Hincaster Junction, from the south
DP001582 Gunpowder warehouse from the south east
DP001583 Detail of loading bay from the east
DP001584 Gunpowder warehouse from the east

Appendix 3: List of NMR numbers linked to the survey

SITE NAME	COUNTY	DISTRICT	PARISH
New Sedgwick Gunpowder Works	Cumbria	South Lakeland	Helsington

SITE NAME	NGR	NMR No
New Sedgwick Gunpowder Works	SD 5098 8814	SD 58 NW 33
Munitions depot	SD 5085 8765	SD 58 NW 37
Suspension bridge	SD 5087 8752	SD 58 NW 38
Early weir (pre-gunpowder works)	SD 5106 8801	SD 58 NW 81

New Sedgwick Gunpowder Works



Key

- Iron bolt or drilled hole for same
- Timber beam or tramway sleepers
- Wall
- Revetment wall along river bank
- Rock-cut scarp and rock outcrop
- Path / Track
- Edge-runner fragment
- Cultivation ridges
- Archaeological scarp
- Natural slope
- Stony bank / collapsed wall
- Principal blast banks
- Machine beds
- Proofing range trees
- Roofed building
- Caravan park roofed building
- Caravan emplacement
- Caravan park washing points
- Modern dumping
- × Dog burial

Figure 10. *English Heritage earthwork plan of the New Sedgwick Gunpowder Works, reproduced at 1:1000 scale*