



ALTOGETHER ARCHAEOLOGY
MODULE 9-D REPORT

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**NENTHEAD LEAD MINES,
NENTHEAD, CUMBRIA**

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NENTHEAD LEAD MINES, NENTHEAD, CUMBRIA
COMMUNITY ARCHAEOLOGY PROJECT

SUMMARY

Northern Archaeological Associates Ltd (NAA) were commissioned by North Pennines Area of Outstanding Natural Beauty (AONB) Partnership to undertake a community archaeology project as part of the Altogether Archaeology project at Nenthead Mines, Nenthead, Cumbria (NGR NY 7865 4325). The project was undertaken in order to further understand the position, function, and flow paths of the water management systems at the mines, and to inform on the management plan for the site. The survey aimed to identify threats to known archaeological remains, and its results used to establish mitigation measures for their preservation. The project area comprised a lead mining area and Scheduled Monument covering 48 hectares.

The movement of water across the site raised concern with regard to the known archaeological remains in the area. Both man-made channels and natural run-off channels flow across the site into the main watercourses. Water flow had caused damage to the surviving structures, and had also caused potentially toxic material to enter into the natural watercourses, as indicated by the growth of rare metallophytes in the River Tyne.

The project was undertaken as part of a scheme of works being carried out by volunteers from the Altogether Archaeology project. Altogether Archaeology, largely funded by the Heritage Lottery Fund, is the North Pennines AONB Partnership's community archaeology project. It enables volunteers to undertake practical archaeological projects with appropriate professional supervision and training. As well as raising the capacity of local groups to undertake research, the project makes a genuine contribution to our understanding of the North Pennines historic environment, thus contributing to future landscape management.

The history of lead mining at Nenthead is long and complex, with the site changing ownership numerous times. The first documented mining activity on Alston Moor dates from the 12th century, when the first systematic exploitation of Alston Moor began. By the 13th century, Alston Moor fell within Scottish territory, and the mine came into the ownership of the Kings of Scotland. Smelting disappeared from Alston Moor during the 13th century, as the number of trees available for fuel diminished. During the 14th to the early 17th century there is very little evidence for lead mining in the area. It is likely, however, that limited small scale exploitation of the surface workings by shallow pits occurred. By 1692 work on Rampgill vein, the first vein known to have been exploited at the mine, had begun. The site at Nenthead has since been involved with the mining and processing of lead ore up until the 1900s when the smelt mill and other buildings were put out of use. It was subsequently a focus for zinc mining and later reprocessing.

The water management system formed the heart of the mine workings. It powered machinery involved in the extraction and processing of lead ore at the site, and was also utilised to drain levels which would often flood. Through a complex series of leats, culverts and sluices, water was collected in numerous reservoirs and then fed into different areas of the mining complex.

A full survey of the watercourses, and how they interact with each other, was undertaken. The survey highlighted areas where the water management system was not fully understood, for example, around Dowgang Hush, specifically with regard to the stream to the west of the site. Little was known of this area; it was thought to be the site of a dam, or similar workings, associated with hushing (see Section 6.2).

The results of the survey revealed numerous areas of vulnerability. These were targeted by a phase of trial trenching, carried out by the Altogether Archaeology team, which allowed for investigation of the vulnerable areas identified during the survey phase of this project. As a result it was possible to clear blockages and evaluate any future water management issues.

Both the survey and trial trenching phases of work highlighted numerous potential threats to the archaeological resource in the area. The greatest area of vulnerability was the trackside leat and culvert to the south of Handsome Mea. This report discusses all of the threats observed through the survey and excavation of the site, and offers solutions to these issues, which limit the future disturbance of the current archaeological resource.

Further proposed action in the area include a further phase of trial trenching and recording and/or more targeted specialised consolidation work similar to that was undertaken as part of the Nenthead Conservation Plan.

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NENTHEAD LEAD MINES, NENTHEAD, CUMBRIA, COMMUNITY ARCHAEOLOGY PROJECT

1.0 INTRODUCTION

- 1.1 Northern Archaeological Associates Ltd (NAA) was commissioned by the North Pennines Area of Outstanding Natural Beauty (AONB) Partnership to undertake a community archaeology project as part of the Altogether Archaeology project at Nenthead Mines, Nenthead, Cumbria (NGR NY 7865 4325), Figure 1. The project was undertaken to further understand the position, function and flow paths of the water management systems at the mines, and to inform a future management plan for the site. The survey aimed to identify threats to the known archaeological remains, and its results used to establish mitigation measures for their preservation. The project area comprises a lead mining area and Scheduled Monument covering 48 hectares.
- 1.2 Feature and context catalogues can be found in Appendices A and B, respectively.

2.0 ALTOGETHER ARCHAEOLOGY

- 2.1 Altogether Archaeology, largely funded by the Heritage Lottery Fund, is the North Pennines AONB Partnership's community archaeology project. It enables volunteers to undertake practical archaeological projects with appropriate professional supervision and training. As well as raising the capacity of local groups to undertake research, the project makes a genuine contribution to our understanding of the North Pennines historic environment, thus contributing to future landscape management.
- 2.2 Altogether Archaeology Fieldwork Module 9c at Nenthead was split into two sections. The first section comprised a survey of the watercourses at the mines, and the second focussed on the excavation of numerous trial trenches, which were a direct result of the survey phase. The module offered volunteers the chance to learn advanced archaeological survey techniques, and the opportunity to make a genuine contribution to research, that would, in turn, be crucial to future landscape conservation (Frodsham and Town 2014a). Further to training in surveying techniques, the module also offered volunteers the chance to develop their excavation skills on a number of small self-contained excavations. Volunteers were trained in all stages of excavation, from laying out of trenches to recording, with appropriate levels of professional supervision (Frodsham and Town 2014b).
- 2.3 The current Altogether Archaeology programme runs from September 2012 – September 2015. It involves a range of professional and academic partners, and participation is open to all. Work is arranged according to ten themes, ranging chronologically from early farming to post-medieval industrial archaeology (Frodsham and Town 2014a).

3.0 NENTHEAD MINES: HISTORY

- 3.1 The history of lead mining at Nenthead is long and complex, with the site changing ownership

numerous times. The first documented mining activity on Alston Moor dates from the 12th century, when the first systematic exploitation of Alston Moor began. By the 13th century, Alston Moor fell within Scottish territory, and the mine came into the ownership of the Kings of Scotland. Smelting disappeared from Alston Moor during the 13th century, as the number of trees available for fuel diminished. During the 14th to the early 17th century there is very little evidence for lead mining in the area. It is likely, however, that limited small scale exploitation of the surface workings by shallow pits occurred, but there are no surviving records of specific mines at this time. The first systematic exploitation of Alston Moor commenced in the early 17th century, when the estate passed to Sir Francis Radcliffe, Earl of Derwentwater, in 1618. The mines were reported as exhausted, and the Radcliffes encouraged their systematic development, with an increase in production from the late 17th century; the first vein known to have been exploited at Nenthead was the Rampgill Vein, from 1692 (BHWB 1995).

- 3.2 In 1716, Sir James Radcliffe was beheaded for his part in the Jacobite uprising in the previous year, and the estate passed to the Crown. In 1735 the Alston Moor estate was granted to the Royal Hospital for Seamen at Greenwich in London. Greenwich Hospital leased out mines on the moor, with one of the major lease-holders being George Liddle, who began working at Nenthead from 1736, and built the first smelt mill. In 1745, the leases were taken on by the London Lead Company (as it was known colloquially) which successfully developed and modernised the mines and became the largest employer in the area. The greatest period of production was between 1780 and 1820, but by the early 19th century, cheaper foreign imports began to damage the industry, leading to the ultimate end of lead mining at Nenthead by the early 20th century.
- 3.3 The London Lead Company gave up its leases in 1882. Between 1882 and 1896, the mines were run by the Nenthead and Tynedale Lead and Zinc Company, who struggled in an increasingly volatile market. From 1896, Vielle Montagne Zinc Company of Belgium took up the Nenthead leases for 42 years, concentrating on producing concentrates of zinc and lead from both mined ore and the reprocessing of spoil dumps. The company were very successful, and further modernised the mines, using traction engines and locomotives for haulage, and improving the washing floors. The miners used rock-drilling equipment powered by hydraulic compressors, and acetylene torches replaced candles. In the Second World War, the mines were cut off from their head office by the Nazi occupation of Belgium, and the works were requisitioned by the Ministry of Supply. Following the war, the mines were worked by the Anglo-Austral Mining company (from 1949), and then by a series of small concerns, who were mainly interested in the reprocessing of spoil heaps rather than undertaking further mining. By the 1970s, activity at the site had largely ceased, and the smelt mill and other buildings were systematically destroyed (Frodsham and Town 2014a).

4.0 PREVIOUS WORK

- 4.1 The Nenthead Mines have been subject to a number of archaeological excavations over the last three decades. The first excavations at the site were undertaken by David Cranstone in 1987 and 1988, at the site of an 18th century water-powered stamp mill to the southeast of the current car park

(Cranstone 1988a and 1988b).

- 4.2 The North Pennines Heritage Trust (NPHT) was set up in 1987 and became actively engaged in the conservation and interpretation of the Nenthead site. Works progressed in that period from small-scale emergency repairs with limited recording, to a full-scale conservation programme. Some of the buildings on the site, particularly those related to the later phases of activity, were in a good state of preservation and survived as roofed structures; others, such as the former mine compound buildings at Rampgill (adjacent to the car park), required some repair work. Most of the mineshafts and level entrances were in a reasonable condition, although many were fenced off or gated for reasons of public safety. As a direct result of the conservation programme, significant data was accrued concerning the phased development of several of the standing buildings on the site.
- 4.3 In 1994, the first major conservation works were undertaken on the Rampgill compound, and all the buildings were investigated. An archaeological watching brief also recorded a number of structures and culverts within service trenches, some of which may form part of a wider water management system (Hedley and Cranstone 1995).
- 4.4 In 2005, a field school, the Nent Valley Archaeological Project, was set up at the mines. The Smallcleugh Project, which formed part of it, was undertaken in 2006 and 2007, focussing on the Smallcleugh and Middlecleugh mines. The works comprised the recording and consolidation primarily of mine shops and other buildings (the 2006 season is reported in Sowerby 2006).
- 4.5 The Nenthead Mines have also benefited from a number of detailed surveys, commissioned either by the NPHT, the Countryside Commission, English Heritage and/or Cumbria County Council. Archaeological works began in 1985, when detailed, non-intrusive, ground surveys were carried out by Liverpool University's Environmental Advisory Unit (LUEAU nd) and subsequently in 1993, by the Royal Commission on the Historical Monuments of England (RCHME 1993). Both surveys mapped or planned all surface features at a variety of scales and produced a gazetteer of site components and features. The RCHME report contains basic textual descriptions of the components and collates, as far as possible, all existing survey work.
- 4.6 Cumbria County Council's Economic Development Unit also undertook a detailed 1:500 scale contour survey of the site in the same year. In 1995, Barton Howe Warren Blackledge (BHWB 1995) was commissioned by NPHT to produce a draft management plan for the lead mining complex at Nenthead, which also mapped the surface archaeology in detail. The survey undertaken by BHWB was supplemented by further survey work in 1997, by the Lancaster University Archaeological Unit (LUAU 1997). This examined two defined areas of landscape (an area to the south-east of the main smelt mill complex and the Dowgang Burn and Hush) and identified a further 22 features in those areas.
- 4.7 In 2008, English Heritage commenced the Miner Farmer Landscapes Project, an innovative, multi-disciplinary research initiative begun with the intention of furthering the understanding, conservation and public enjoyment of the historic environment within the North Pennines AONB. The project was

undertaken with support from the AONB partnership, local experts and volunteers, universities and other government agencies (Frodsham and Town 2014a).

5.0 PROJECT BACKGROUND

- 5.1 This project arose through a number of factors, primarily related to the movement of water across the site, from within both man-made channels and natural run-off channels, into the main watercourses.
- 5.2 The River Nent, the principal water-course within the study area, lies at the base of an incised glacial valley, at approximately 440m AOD, and flows north-westwards towards the village of Nenthead. The river is fed by a series of meltwater channels and small streams. At the head of the valley, the Long Cleugh Burn, the Middle Cleugh Burn and Old Carr's Burn combine to form the main tributaries, with the Rampgill Burn contributing to this river in the vicinity of the smelt mill complex. The Dowgang Burn and Dowgang Hush, the latter a deep steep-sided valley formed by mining, lie immediately west of the car park. The Dowgang Burn flows into the valley from the moorland to the south and flows into the Nent close to the village. It is from the sides of the tributaries and valley that levels were driven, with the floor of the Nent Valley containing extensive lead mining remains, comprising ruined structures associated with ore processing, such as stamp and smelt mills, condensers, compressors, tramways and dressing floors, as well as numerous mining features such as communication routes, spoil tips, reservoirs, watercourses and lodging shops. Many of these features, although legally protected within the Nenthead Scheduled Monument, are now at risk of damage or destruction by flowing water that is no longer constrained within artificial channels; for this reason, English Heritage was keen to see the completion of this Altogether Archaeology survey.
- 5.3 The Environment Agency and Natural England had also identified the need to map the watercourses at Nenthead, for differing reasons. The Environment Agency was concerned that the movement of water off the site was pulling material, primarily tailings from ore processing, into the main watercourses, which was having an effect on the River Tyne, through the deposition of heavy metals into that water body. However, it was the movement of these deposits, and their subsequent deposition along the watercourses as they move towards the Tyne, which had also encouraged the growth of rare metallophytes (lead tolerating plants). A solution to the problem of movement of spoil from the site was not, therefore, a simple one. The first identified stage of the understanding of spoil movement and erosion was to accurately map the position of the natural and man-made channels within the study area (Frodsham and Town 2014a).

6.0 WATER: POWER AND PROCESS

- 6.1 Water, and the harnessing of water, was immensely important for mining for a wide number of reasons. Within the deeper mine workings themselves, water was a nuisance, as it limited the depth to which mines could be worked; drainage from mine workings was therefore of paramount importance. At Nenthead, most of the mining was undertaken from levels, a tunnel (usually driven into a hillside) in order to give access to a mine, which could also be used for drainage or the hauling of broken ore. Most of these survive as beautiful stone-lined structures and were built by the

London Lead Company from the 18th century.

- 6.2 In contrast to the deep mining, where water needed removal, surface mining made a lot of use of water, and its collection and redistribution was more important. The technique of hushing was used to prospect and exploit the upper sections of lead. Hushing involved utilising a flow of water to aid the extraction process, exposing ore and perhaps assisting in releasing and sorting the ore by washing away waste. Water to serve the hushes was collected via leats or gutters, often utilising rainwater and captured in dams or reservoirs close by the hush ready to be used when required. These frequently survive as earthworks located close to the hush remains. Dowgang Hush is the largest, and most famous, hush at Nenthead, but there are numerous examples across the survey area.
- 6.3 Water was the main source of power for the miners at Nenthead, and was used widely in districts where the topography and the high rainfall enabled extensive use of waterwheels for pumping and draining mines, hoisting ore and spoil to the surface, and to power crushing mills, dressing floors and their associated processes. Leats and reservoirs were constructed and, along with the wheel pits, survive as evidence of these installations. There are many reservoirs at Nenthead, the largest being Handsome Mea and Perry's Dam, though there are numerous small ponds and water catch-pits across the landscape. The network of leats which served the reservoirs, known as feeder or contour leats, extend for many miles following the contours of the hill, to collect as much rainwater as possible. At Nenthead, the makeup of these leats varies: most within the vicinity of the main workings are stone-lined and have flagged caps, and sometimes timber or stone bases, whilst elsewhere some leats are entirely of timber construction, or are just earthworks.
- 6.4 The leat network encompasses sluice-gates to control the water and divert it to different parts of the site as needed. There are numerous water wheels within the study area – for example, within the dressing floor at Smallcleugh which was used to power crushers in the dressing mill, and another water wheel in the centre of the smelt mill, to power bellows to provide air blast to the furnaces. Perhaps the most famous form of wheel pit is the Stagg Condenser wheel pit (Plate 1), a massive wheel which powered a large condenser built to condense any lead fume in the gases leaving the furnaces, invented and patented by Joseph Stagg in 1842.
- 6.5 Water was key to lead dressing (Plate 2), and was widely used on dressing floors, from simple buddles (water filled pits used to separate (by sedimentation) minerals from lighter rock dust in crushed ore) through to the complex industrial-scale processes. All lead ores required cleaning and sorting to some degree. After manual picking, the essential processes for the dressing of lead are; washing, classifying, reducing (i.e. crushing) and concentrating using gravity, sieving and, later, flotation techniques.



Plate 1: The Stagg Condenser wheel pit in 1975 (© NMCS archive).

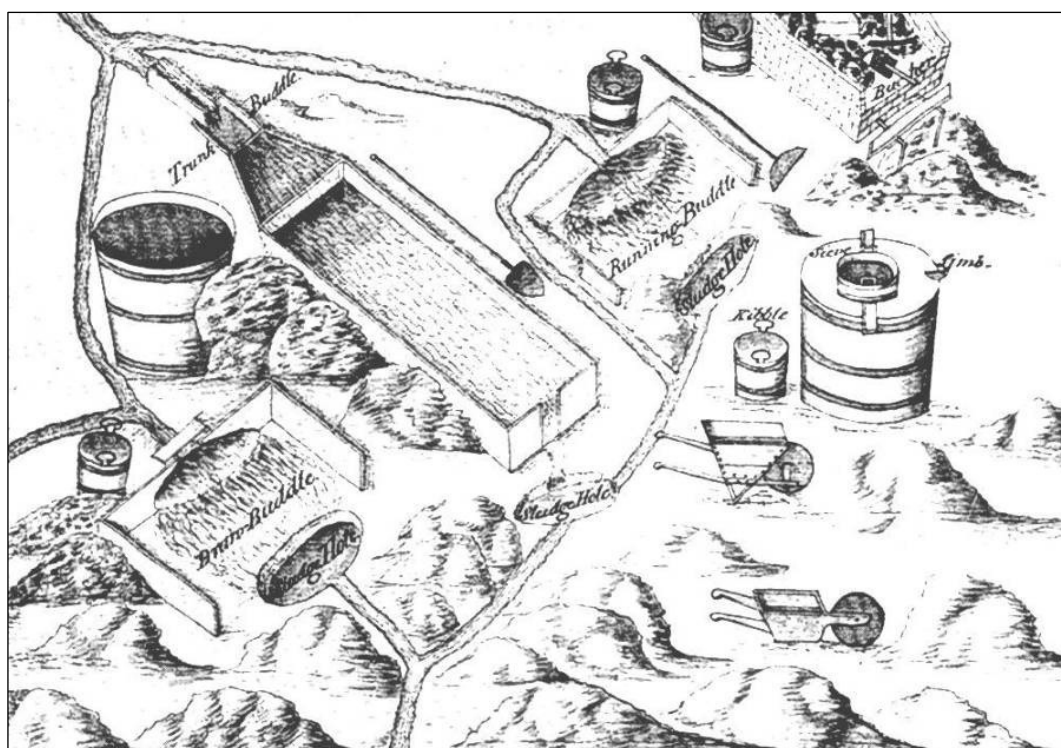


Plate 2: Equipment used for washing lead ore at the end of the 18th century (after Hunt 1970).

- 6.6 Crushing could be carried out by hand using flat-faced hammers known as 'buckers'. From the 19th century, crushing rollers, powered by water wheels, were introduced to Alston Moor; they were installed at the Rampgill and Smallcleugh dressing mills. Stamping mills, mechanically-powered stamps for pulverising ore, were used infrequently at lead mines; however, a stamp mill, dated to the 18th century, was excavated at Nenthead, near to the Power of Water exhibit, in the 1980s.
- 6.7 Ore was concentrated or washed using a variety of gravity and sieving methods, which relied on a disparity in the relative density between the valuable ores and the unwanted gangue minerals. The most significant gravity method of dressing lead ore was the buddle. Early buddles comprised rectangular stone or timber-lined, inclined troughs, though by the 19th century circular buddles were used. Hand methods such as hotching tubs and jiggers, concentrating devices used to separate the lead ore from the gangue material by repeated suspension and settling in water, are unlikely to have left much specific archaeological evidence, although the areas in which these operations took place, known as washing floors, often survive as artificially levelled terraces, with stone or part timber surfaces.



Plate 3: The machinery room at the base of Brewery Shaft - the tools and machinery survive as left nearly 100 years ago. A Pelton wheel is visible right of centre of the photograph.

- 6.8 From the later 19th century, the main focus of mining at Nenthead switched from mining lead to zinc, and the reprocessing of heaps for materials which had been left behind by earlier miners. The Vielle Montagne Zinc Company used the water to generate electricity on the site, and this, in turn, was used to power fixed air compressors, which powered rock drills. The company installed a network of pipes across the landscape, connected to the reservoirs, which carried water to Pelton wheels (impulse turbines), which were turned by high pressure jets of water, to generate electricity.

Pelton wheels still survive at Nenthead, in the machine room at the base of Brewery Shaft, a 100m deep shaft. The company built a tower over the top of this shaft and channelled water up and over the top of the shaft, before letting it drop down pipes to the machinery at the base (Plate 3).

- 6.9 Today, the same reservoirs are used by the Nent Hydro Company to power two water turbines, housed in a purpose-built building just north of the smelt mill complex (Frodsham and Town 2014a).

7.0 AIMS AND OBJECTIVES

- 7.1 The aim of this project was to produce, via survey and excavation, evidence and data that could be used to develop informed water management systems at the Cumbria County Council landholding at Nenthead Mines that minimise impact on the natural environment and on the significant archaeological remains.
- 7.2 A better understanding of the position and function of the man-made watercourses, as well as the flow-paths of natural watercourses was one key objective; a comprehensive map of these was produced to inform wider studies related to sediment movement and pollution.
- 7.3 Another objective of the survey was to identify water blockages, so that these could be cleared.
- 7.4 Results contributed to the English Heritage Miner Farmer Landscape Project (MFLP), enhancing the existing Miner Farmer Landscape Survey database with more detailed information on the position and composition of the recorded watercourses. Enhancement of the MFLP was an important component to this project; it exists as a framework for future survey, with the ability to absorb further information as future surveys are undertaken.
- 7.5 One primary objective of this project was to raise awareness and appreciation of the rich cultural heritage in the local landscape. A group of local volunteers learnt the techniques of archaeological field survey, excavation, and recording; equipping them with the skills and experience to carry out further work beyond the life of this project. By focussing on these skills, the project has resulted in a legacy of skilled field surveyors enabled to carry out further archaeological and historical research in the area.
- 7.6 The results of this work represent a key stage in the study of Nenthead Mines, providing a basis for future conservation, interpretation and research. This report includes a brief assessment of the potential for further work, and observations and suggestions for future site management.

8.0 METHODOLOGY

Survey Methodology

- 8.1 The on-site survey work was undertaken in accordance with the procedures set out in *Understanding the Archaeology of Landscapes; A Guide to Good Recording Practice* (EH 2007). The study area was subdivided into discrete blocks (1km, or smaller, squares, as appropriate) which were systematically examined by teams of volunteers.
- 8.2 A site reconnaissance survey was carried out based upon the results of the orthophotographic and

LIDAR transcriptions of the study area undertaken as part of the Miner Farmer Landscape Project. The field teams examined the orthorectified photographic images, digital surface model (DSM) LIDAR, digital terrain model (DTM) LIDAR, and digital Ordnance Survey data. This was undertaken in order to validate the results of the transcription process, and to identify clearly the position of the recorded watercourses and water management features examined.

- 8.3 Once the reconnaissance survey was completed, additional textual information was recorded for each feature on pro-forma recording sheets based on the Miner Farmer Landscapes Project Recording Form. A selective photographic record was made of features of exceptional form, alongside a representative photographic record of features of repetitive form. The purpose of this exercise was to check and enhance the information on water-management features derived from the Miner Farmer Landscapes Project GIS data, and to identify additional sites not previously recorded. It was specifically recorded if a watercourse was currently carrying water, whether there were any obstructions (and if so, where), and if there was evidence of overflow (along with a note of any related erosion). Special consideration was given to water management features deemed to be under immediate threat; the nature of that threat, and its likely severity, was recorded.

Excavation Methodology

- 8.4 Following the survey, a phase of trial trenching was carried out in order to investigate areas of failure within the water management system with a view to provide recommendations for their future conservation.
- 8.5 Trenches were excavated by hand to either the top of archaeological deposits, or the natural substrate, whichever was observed first. Trenches were subsequently cleaned and all features investigated and recorded as deemed appropriate by the Project Director.
- 8.6 All excavated contexts were recorded in plan and section and recorded on stratigraphic matrices. Plans and sections were drawn at appropriate scales (generally either 1:10 or 1:20). The excavations were tied into the OS national grid and accurately levelled, relative to OS datum, using traditional survey techniques.
- 8.7 During fieldwork, turf, soil and stone was stored in separate piles adjacent to the trenches but not impinging on the areas to be excavated.
- 8.8 A comprehensive digital photographic record of the excavation, including 'people shots' of excavations in progress as well as standard shots, was made. All such images have been accessioned into the site archive, with an appropriate selection included within this project report.

9.0 OVERVIEW OF RESULTS

- 9.1 The following sections discuss the water management features previously identified by the MFLP and the results of the trial trenching informed by the Altogether Archaeology survey. During the survey and trial trenching phases several new sites were identified, and these were added to the MFLP database.

- 9.2 The features discussed below have been split up into separate areas relating to their usage and purpose. Each section will discuss the results of the Altogether Archaeology survey, followed by the maintenance issues identified during the survey. Following the results of the survey, a summary of the trial trenching results will be discussed and any further maintenance identified during this phase of work has been included in the conclusion.
- 9.3 The second phase of the project saw trial trenching in areas of vulnerability identified by the Altogether Archaeology survey. In total, 15 areas were highlighted by the survey phase at points of failure within the water management system and Scheduled Monument Consent was granted for all 15 areas to be investigated. Of the 15 areas only 10 were fully investigated, due to weather, access and time restraints.

10.0 HANDSOME MEA, FEEDER LEATS AND TRACKSIDE LEAT

History

- 10.1 Handsome Mea reservoir, also known as 'Smallcleugh Reservoir' was built in 1820 (Plate 4). Measuring 219m by 75m, the reservoir is located in the centre of the landholding at Nenthead, and formed the heart of the water management system at the mines. Its function was to supply water to the Nenthead mine complex, in particular Smallcleugh dressing floor, the Brewery Shaft and the Smelt Mill complex.
- 10.2 On the southwest side of the reservoir a small valve housing (2627) controlled the flow of water towards Smallcleugh dressing floor. Water from the reservoir was carried via an aqueduct to the southwest and directly to Smallcleugh dressing floor.
- 10.3 Water from Handsome Mea was later utilised, through pipeline (2442), by Vielle Montagne to power the hydro-electric and compressed air system and mechanised drills at Brewery Shaft.
- 10.4 The reservoir itself is fed from two feeder leats, one in the north, leat (0029), which originates from around Firestone Level and Rampgill Burn. A second feeder leat (0010), on the south side of Handsome Mea, brings water from Dowgang to Middlecleugh and Old Carr's Burn and into the reservoir.

Surveyed Features

- 10.5 The surveyed features within the Handsome Mea have been separated into four sections. The first section discusses the reservoir and associated structures, such as the valve housing and pipelines. The next section discusses all surveyed features associated with the northern feeder leat for the reservoir, including associated overflows. The features associated with the southern feeder leat have been separated out to also include its overflows. The final section discusses the trackside leat and all associated structures, which are being fed by both the northern and southern feeder leats for the reservoir.

Handsome Mea

Reservoir (0338)



Plate 4: Handsome Mea reservoir (0338).

- 10.6 Handsome Mea is split into two key components. The first of these components is an earthwork bank, forming the dam of the reservoir. BHWB (1995) described it as "*a massive flat topped bank c.4m wide on the west side, with an inner face formed by a sloping stone lining of roughly coursed squared stone rubble, which appears to be of two phases. It is supported by a crude timber revetment in places. The dam itself is grassed over and well defined*".
- 10.7 The RCHME have previously described this feature as "*Drystone wall incorporating timbers that appear to lace it into the dam structure*" (RCHME 1993).
- 10.8 The second component is the northern most sluice (2578) and culvert (2579), previously described by the LUEAU as "*Northern sluice of Smallcleugh Dam. Iron rail, sluice grill*" (LUEAU nd). The culvert is built of squared stone rubble brought to courses and has a flagstone roof. It has a well laid floor of stone cobbles revetted with timbers at regular intervals; the cobbles are replaced by flagstones as the culvert nears the western aperture (BHWB 1995). All of the features discussed above were re-examined by the Altogether Archaeology team as part of the survey of the site, and were found to be as previously described in earlier surveys.

Valve Housing (2627)

- 10.9 Housing for a valve is located to the southwest of Handsome Mea at NY 78660 43087. The site has been previously described by the LUEAU as "*Ruined, but hut floor visible, south west end of Smallcleugh reservoir*" (LUEAU nd) and by BHWB as "*Rectangular structure with walls of neat squared stone rubble standing up to 0.4m in height. The valve control survives as a cast iron frame with a vertical threaded bolt running through it, joined to another bolt just visible above ground surface. The component is partially grassed over and in poor condition*" (BHWB 1995).
- 10.10 This feature is likely to be 19th century in date and was probably constructed around the time of the crushing mill at Smallcleugh dressing floor to control the flow of water from Handsome Mea.
- 10.11 Sometime in the 1980s the valve housing failed and flooded the area to the southwest of Handsome Mea (Jackson, *pers com*). The valve housing was re examined by the Altogether Archaeology team; the structure itself was found to be in the same condition as described by earlier surveys. In addition to the structure, a large linear depression can be seen running to the south and continuing past the track way to the dressing floor.

Pipeline (2442)

- 10.12 Pipeline (2442) originally extended from Handsome Mea reservoir (338) to the Brewery Shaft (324). It is probably later than or contemporary to the reworking of spoil heaps (2443).
- 10.13 The pipe is, for the most part, encased in a rubble bank, which is turfed over in places. It crosses Rampgill Burn on stone piers (2444) and is not visible beyond this point towards the Brewery Shaft (324).
- 10.14 The pipe originally ran to the top of a 27m high tower positioned over the shaft and formed part of the hydraulic system, gradually introduced between 1903 and 1915 by Vielle Montagne to power mechanised drills. The pipeline was re-examined during the survey and found to be as described in previous surveys of the site.

Surveyed Features: Northern Feeder Leat (Figure 4)

- 10.15 The northern feeder leat for Handsome Mea is a long and complex structure made up of many different components. The following section discusses all of the components of the northern feeder leat surveyed by the Altogether Archaeology team. Each feature is discussed in order of its appearance, from the northern end of the feeder leat at Firestone Level down to its southern exit at Handsome Mea.
- 10.16 Figure 4 is a detailed map of all surveyed features that make up the northern feeder leat.

Leat (2615)

- 10.17 Leat (2615) exits directly out of Firestone Level and only travels a short distance to Firestone spoil

heap where it seems to terminate.

- 10.18 This feature has gone unrecorded in previous surveys of the site. Although unclear, it is unlikely that this structure forms part of the wider water management system on site given its short length and unusual brick construction. It is clear that this structure is a much later insertion (possibly by NPHT) in an attempt to divert water away from leat (0029, Plate 5) and presumably away from launder base (0030). As a result it is likely that the insertion of leat (2615) and the diversion of leat (0029) are contemporary with each other.

Leat (0029)

- 10.19 The northern feeder leat for Handsome Mea starts at Firestone Level in the form of leat (0029). Leat (0029) appears in the side of feature (2615) and takes water out of Firestone Level. The leat exists at this point as a stone lined and capped culvert for approximately 10m as it runs between the mouth of Firestone Level and launder base (0030, Plate 6). It is constructed of roughly faced limestone blocks in a random coursing pattern, capped by limestone slabs.



Plate 5: Start of leat (0029) in the side of leat (2615) at the entrance to Firestone Level facing southeast.

Launder Base (0030)

- 10.20 Launder base (0030) consists of two opposing stone piers aligned roughly northwest-southeast and are constructed of roughly coursed, squared stone rubble; these are now partly grassed over. Water would have flowed through leat (0029) over the launder (0030) and across the other side. At this point leat (0029) is no longer stone built and takes the form of a well defined earthwork contour leat, which then winds its way around the northern edge of Rampgill Burn for roughly 150m until it reaches weir (0031). To the north of launder base (0030) a previous water course (2435) can be traced, which runs parallel to (0029). This likely represents an earlier watercourse carrying water out of Firestone Level.



Plate 6: Both launder bases (0030) with continuation of leat (0029) on far bank and earlier watercourse (2435) to the left of the launder base.

Weir (0031)

- 10.21 Weir (0031) is stone-built and comprises multiple squared timbers set transversally across the burn which retain about 22 rows of stone setts. It has two retaining walls above the weir on the north and south sides. These are constructed of randomly coursed square rubble with a max height of 2m. On the east side of weir (0031) there is a timber box sluice connecting Rampgill Burn to the modern

pipeline, which feeds leat (0029).

- 10.22 As the water exits weir (0031) on the south side of Rampgill Burn, leat (0029) becomes timber lined. This section of mostly collapsed timber lining was re-excavated in 2005 as part of NMHS and a modern pipe was inserted (0049, Plate 7). Water is taken through this pipe and up to the brow of the hill where it re-enters leat (0029). At this point leat (0029) is stone lined and capped and becomes culverted in a similar fashion as the exit between Firestone Level and launder base (0030). This culverted section of leat (0029) exists for roughly 130m until it meets overflow sluice (0032, Plate 8) roughly 20m to the northeast of Handsome Mea. At its midpoint, leat (0029) is crossed by the smelt mill flue (0427) where the leat is flagged over for a short distance.



Plate 7: Water from pipe (0049) exiting the brow of the hill and into leat (0029) with Handsome Mea in the background.

Overflow (0032)

- 10.23 Overflow (0032) diverts water to the southwest away from Handsome Mea and into culvert (2462) through culvert (2440, Plate 9). The overflow comprises a 0.8m deep stone channel in the centre of a semi-circular paved area with retaining wall on one edge and is capped by a series of eight concrete blocks. The sluice gate is new, but the original grooved posts still survive.



Plate 8: Overflow (0032) to the right of the image with the continuation of leat (0029) into the reservoir.

Culvert (2440)

- 10.24 Once water flows through overflow (0032) it enters culvert (2440). Culvert (2440) runs for 20m and is constructed of roughly coursed sandstone blocks with a flagged base and partially capped. Water flowing through culvert (2440) would exit into culvert (2439) that extended from sluice (2578) which controlled the water level inside the reservoir.

Sluice (2578)

- 10.25 This feature is located at the northern edge of Handsome Mea and acts as a sluice gate to control the water levels inside of the reservoir. Water from this point would be directed into culvert (2439) and away into the trackside leat through a series of culverts and sluices.



Plate 9: Exit of culvert (2440).

Culvert (2439)

- 10.26 Culvert (2439) runs for 85m to the southwest until it dips underground and becomes culvert (2462). The culvert extends from sluice (2578) and is constructed of roughly coursed squared stone rubble with retaining wall either side, which is largely grassed over. To the southwest it feeds into a natural water course and into culvert (2462).

Culvert (2462)

- 10.27 Culvert (2462) is vaulted with a wooden plank base and flows underneath an area of mining waste adjacent to the track way. Water from culvert (2462) enters sluice (2619) which can then be diverted towards the Stagg wheel pit or down into the River Nent to the southwest.
- 10.28 It is interesting that culvert (2462) is plank lined, unlike other culverts onsite which tend to be cobbled or flagged. This is likely to be because the culvert sits on top of a large area of mine waste which is highly vulnerable to water erosion. Planks would limit the amount of water seeping downwards and potentially undercutting the structure. Because of this it is likely that the surrounding spoil heaps predate the construction of the planked section of culvert (2462).

Identified Issues: Northern Feeder Leat

- 10.29 The following section will discuss each area of vulnerability identified during the survey, running from the top end of the feeder leat at Firestone Level down to the exit of the feeder leat at the north of Handsome Mea.

Leat (0029): Firestone Level

- 10.30 The first area of vulnerability within leat (0029) was identified directly to the east of Firestone Level, where the feeder leat (0029) crosses the burn over launder base (0030). Water was seen running down the hill at right angles to the leat and was pooling in large quantities at the base of the spoil heap associated with Firestone Level. Although not causing any immediate risk to the surrounding structures, if this area was left to pool it is likely to undercut the bottom of the spoil heap and wash material away into the burn. This area of pooling is also being fed at the exit of feature (2615).

Leat (0029): Flue Crossing

- 10.31 A second major area of vulnerability was located either side of the flue line (0427) as it crossed feeder leat (0029). The leat is failing at two points in this location and is causing water to flow down the hillside and pool against the track way, from here it is carried by modern soakaway pipes into Rampgill Burn to the north of the Stagg Wheel Pit. The second failure to the south of the flue is also causing water to pool in large quantities to the west. If both of these areas are left to pool, it is likely that toxic dumped material will be dragged into the burn.

Leat (2615)

- 10.32 Two vulnerabilities were noted along the length of leat (2615, Plate 10). The entire length of the structure was overgrown and choked by long grass. The section towards the mouth of Firestone Level had collapsed completely blocking the line of the leat.
- 10.33 The exit of the leat, adjacent to the spoil heap, was causing water to wash down the hill and pool in large quantities at the bottom, similarly to leat (0029) in this location. This is carrying spoil from the Firestone Level into the burn, which, whilst probably not toxic, could block culverts further to the west, dragging more toxic material at this point.



Plate 10: Water pooling at base of hill from leat (2615), to the left of the image, and water from leat (0029) at the centre of the image.

Culvert (2440)

- 10.34 Culvert (2440) is in a fairly ruinous state and has become heavily choked by long grass at its outflow, causing water to pool and wash away the side and retaining walls of the culvert outfall. This has subsequently caused a major collapse of the retaining walls which have blocked the line of culvert (2439, Plate 11).

Culvert (2439)

- 10.35 Culvert (2439) has numerous areas of vulnerability across its entire length. The structure is now heavily choked by long grass and weeds and is blocked by rubble from culvert (2440) all along its length. Some of the rubble probably relates to the later construction of pipeline (2442) used to feed the plant in Brewery Shaft from Handsome Mea, which cuts across this feature and was carried over a bridge.



Plate 11: Water flowing from culvert (2439) down to culvert (2462).



Plate 12: Collapsed section of culvert (2462). Note large void behind collapse.

Culvert (2462)

- 10.36 The majority culvert (2462, Plates 11 and 12) is in good condition however, towards sluice gate (2619), the vaulting of the culvert has collapsed (Plate 12). The wooden base of the culvert has also been washed away at this point causing water to pool. This pooling has caused the surrounding gravel deposits to slowly wash away and undercut the supporting walls of the arch. As a result the collapse of the vaulting had created a significant blockage causing water to pool further up the line of the culvert. If left unattended this will cause further collapses of the vaulting.

Trenching Results: Northern Feeder Leat (Figure 5)

Leat (0029): Trench 1

- 10.37 Trench 1, Plate 13, was located to the southeast of Firestone Level entrance at NY 78755 43496, and was excavated to investigate water flowing out the side of leat (0029), down the hill towards the burn. The trench measured 2.00m by 2.00m and was approximately 0.45m deep. The location of this trench is shown on Figure 5.



Plate 13: Trench 1 showing leat (0029) diversion facing northeast.

- 10.38 The trench showed that leat (0029) had been deliberately diverted away from its original course along where the launder would have spanned the gap across the burn. The leat joined the ditch leading to the launder and has been deliberately blocked by the placement of capping stones on edge in the ditch. This has caused the water to be diverted down the hill.
- 10.39 The purpose of this diversion is uncertain, but was probably done to stop water flowing over the

surviving launder base (**0030**), potentially by the North Pennines Heritage Trust (NPHT).

- 10.40 The water flowing out of leat (**0029**) at this location is not currently causing any damage to existing structures, but is pooling in large quantities at the base of the slope. This is causing the area beneath to become waterlogged. A potential solution to this problem could be the reinstatement of a timber launder across the burn, so that water can return into leat (**0029**) and then pool into a soakaway.
- 10.41 There are no blockages within the line of the leat exposed by Trench 1. No further work is recommended on this section of leat.

*Leat (**2615**): Trenches 2-4*

- 10.42 Trench 2, Plate 14, was located at the end of leat (**2615**) at NY 78742 43491. It was investigated to examine the water flow coming down the hillside to the southeast of Firestone spoil heap in addition to the water flowing down the hill at Trench 1. It was also excavated to examine the structure of the leat at its presumed exit. The trench measured 0.40m by 0.60m and the location of this Trench is shown on Figure 5.
- 10.43 The trench was excavated across this section of the leat to investigate what looked like an outfall. It is unclear where the water flowing out of this leat would have originally flowed, but at the time of excavation it was flowing directly down the hillside and joining up with the water spilling out of the diversion of leat (**0029**).



Plate 14: Trench 2 showing exit of leat (**2615**) facing northwest.

- 10.44 Not much of the original leat structure survived within this trench. Water exiting at this point has washed away the end of the structure and further erosion is highly likely. It is recommended that the

structure at the end of leat (2615) is reconsolidated to prevent further erosion. If further erosion occurs it is likely that the water will start bringing debris from Firestone spoil heap down the side of the burn and into the natural watercourse.

- 10.45 Trench 3, Plate 15, was located at the entrance of Firestone Level at NY 78743 43497. It was investigated to examine water pooling at the mouth of the level. The trench measured 1.00m by 0.50m and the location of this Trench is shown on Figure 5.
- 10.46 Trench 3 was excavated down to reveal the capstones of leat (2615). The side walls of leat (2615) had washed away on the southeast side. This had caused the limestone capstones to fall in and subsequently have blocked the leat causing water to pool.
- 10.47 It is recommended that reconsolidation work is carried out along this section of leat to rebuild the sidewalls that hold up the capstones. It was unclear why the side walls have washed away, so further investigation is required to understand the cause of the erosion.



Plate 15: Trench 3 showing leat (2615) facing southwest.

- 10.48 Trench 4, Plate 16, was located at NY 78742 43496 to investigate the flow of leat (2615) coming out of Firestone Level. The trench measured 0.40m by 0.60m and the location of this Trench is shown on Figure 5.



Plate 16: Trench 4 showing leat (2615) facing southeast.



Plate 17: Culvert (2440) facing southwest showing collapsed retaining walls.

Culvert (2440): Trench 5

- 10.49 Culvert (2440, Plate 17) is located to the north of Handsome Mea and incorporates the area around overflow (0032). Trench 5 was put in across culvert (2440) as it came off overflow (0032) feeding

into culvert (2439) at NY 78727 43262. The culvert had partially collapsed at the end and had become almost completely silted up at the mouth where it exits into culvert (2439). The location of this feature is shown on Figure 4.

- 10.50 Trench 5 was excavated to examine the structure of culvert (2440) and to clear a significant blockage. The trench measured 3.00m by 0.4m and 0.70m deep.
- 10.51 The blockage in the culvert comprised soil and fallen stonework. This was cleared by hand as far as practicably possible. It was noted that culvert (2440) is blocked further upstream towards (0032). A significant patch of long grass was not removed at the mouth of culvert (2440) due to its density and is subsequently causing a blockage.
- 10.52 Two retaining walls have been built in a similar manner to the overflow leat at its mouth. These walls have collapsed into culvert (2439) and are causing a significant blockage.
- 10.53 It is recommended that further work is needed around culvert (2440). Large amounts of debris from the collapse of the retaining walls needs to be cleared to allow water from the reservoir to flow freely. Currently the overflow from the reservoir is washing over the wing wall debris and is further washing the bank away from culvert (2440). In time this will cause the leat to collapse. It is further recommended that culvert (2440) is reconsolidated after the debris is cleared to reinstate both retaining walls.
- 10.54 No features of further archaeological interest were uncovered during the excavation of Trench 5 across culvert (2440).

Culvert (2462): Trench 6

- 10.55 Culvert (2462, Plate 18) is located to the west of Handsome Mea adjacent to the modern track way, where it joins the trackside leat (2460). Trench 6 was excavated to investigate a collapse in the culvert, which was forcing water to flow northwest, creating a void in the overlying deposits. The location of culvert (2462) is shown on Figure 4.
- 10.56 Trench 6 was excavated down to the top of the culvert arch, to investigate the collapse. Water has been flowing through the culvert to an area where the plank lining stops. This was causing the water to pool and gradually washing away the surrounding gravel creating a large void. The pooling water has subsequently washed away the side wall, causing the arch to collapse and block the culvert.
- 10.57 During the excavation, safety concerns over the size of the void made the trench unworkable. A JCB, with a toothless ditching bucket, was used to make the trench safe by machining the gravel above the void, and battering the sides. The trench was then fenced off and no further work was undertaken.



Plate 18: Culvert (2462) facing northeast.

Surveyed Features: Southern Feeder Leat (Figure 6)

- 10.58 The following section discusses all of the survey features which make up the southern feeder leat of Handsome Mea. The southern feeder leat originates on the west side of the Nent Valley at Dowgang Hush in the form of an earthen contour leat (0742). It then makes its way through a complex series of sluices at Old Carr's Burn and the Compressor House where it joins leat (0010), with its earlier overflow at (2617) and later overflow at (2580), which was utilised to divert the feeder leat into the trackside leat and away from the reservoir, probably at times of excess water flow. Figure 6 is a detailed map of all surveyed features that make up the southern feeder leat.

Contour Leat (0742)

- 10.59 The southern feeder leat for Handsome Mea is a very long and complex structure. The leat originates at Dowgang Hush in the form of a very long earthwork contour leat (0742), which runs east to west across the contour of the fell from Dowgang Burn to Middlecleugh. The remains of stone lining can be seen in places, but this was highly fragmented. The leat has seen a number of modern re-cuts and a modern wooden lining has been inserted in places. The leat was noted to have a small embankment on the north-east side in numerous locations.

Sluice Gate (2593)

- 10.60 As the leat approached the Compressor House, it connects to a sluice gate (2593). This wooden sluice takes water from the southern feeder leat (0742) and diverts it eastwards towards the Compressor House. Leat (0742) winds its way around the Compressor House through a series of complex sluices (2592) and (2591). As leat (0742) leaves the Compressor House area it enters leat (0010). Leat (0010) runs broadly north-south and extends from the north bank of Old Carr's Burn to the south end of Handsome Mea.

Leat (0010)

- 10.61 The leat (0010, Plate 19) itself is constructed of randomly coursed limestone blocks with a flagged base in places, but mostly cobbled overall. A good portion of the leat is capped by large slabs, but there are some open sections noted during the survey. Leat (0010) runs for roughly 350m until it meets the junctions of leat (0020) and overflow (2617). It then continues westward through the junction until it meets overflow (2580). Overflow (2580) diverts water from (0010) away from Handsome Mea and into trackside leat (2460). Feeder leat (0010) continues for a short distance and feeds into the southern end of Handsome Mea.



Plate 19: Leat (0010) feeding into the south end of Handsome Mea. Overflow (2580) at the top end of the leat.

Leat (0020)

- 10.62 Leat (0020) begins approximately 250m east of Handsome Mea beneath the line of the flue. It begins as an earthen contour leat and becomes a stone lined and capped culvert until it meets leat (0010) to the east of Handsome Mea. This leat is not widely understood as the area has seen a lot of water erosion, particularly up towards the flue, but appears to have been inserted to feed additional water into the system.



Plate 20: Overflow (2617) with the continuation of leat (0010) to the right of the image.

Overflow (2617)

- 10.63 Overflow (2617, Plate 20) is located at the junction between leats (0010) and (0020) and was in a ruinous state. The structure survived up to four courses high of randomly coursed limestone blocks for approximately 10m after which the structure appears to have been robbed out.
- 10.64 The overflow served to take water out of the southern feeder leat and diverting water away from the reservoir and into the trackside leat.
- 10.65 The connection between overflow (2617) and the trackside leat is now lost. At some stage an attempt had been made to re-establish the water flow out of (2617) in the form of ditch (2618) which looks to have joined to ditch (2616) at the end of the trackside leat (2460). Most of the evidence has now been lost due to the partial construction of a car park at the junction between the two features (*Jackson, pers com*).

Overflow (2580)

- 10.66 Overflow (2580, Plates 19 and 21) is located immediately to the south of Handsome Mea and diverts water from the southern feeder leat into the trackside leat (2460). This feature is of very similar construction to overflow (0032) and serves the exact same purpose. Under closer examination it seems overflow (2580) has been inserted into the side of leat (0010) (Plate 19), supporting the fact that overflow (2580) is a later replacement of overflow (2617).



Plate 21: Overflow (2580).

Overflow (0017)

- 10.67 Overflow (0017, Plate 22) is located adjacent to the track way to the north west of the Compressor House at NY 78852 42810 and served to divert water into Old Carr's Burn from leat (0010) probably during periods of heavy rainfall. The structure consists of six courses of randomly coursed limestone blocks up to 0.40m high with large limestone capstones and a flagged base. The sluice gate at the junction with leat (0010) is mostly rotten and has been recently repaired. A small masonry overflow exists at the base of the overflow and slots can be seen either side, which likely represents the position of the original sluice gate.



Plate 22: Overflow (0017) facing northwest.

Identified Issues: Southern Feeder Leat

- 10.68 The following section will discuss each issue identified during the survey, running from the western end of the feeder leat at Dowgang Hush to the exit of the feeder leat at the southern end of Handsome Mea.

Contour Leat (0742)

- 10.69 This long section of leat is badly degraded in sections causing water to leak out. In places, patches of the original stone structure can be seen, but this is highly fragmentary. The entire length of this feature has been extensively modified with modern re-cuts and timber linings placed along its length.
- 10.70 Towards Dowgang Hush, it was noted that a series of drainage grips cut directly across the line of leat (0742) and these direct water down the hill towards the River Nent.

Leat (0010)

- 10.71 Sections of the stone lining of leat (0010) are severely bulging, particularly around NY 78773 43014. This is caused by the pressure of the surrounding earth, which is poorly vegetated and at risk of slippage. It was noted that water at this point was fairly fast flowing at the time of survey, adding to the risk of collapse.
- 10.72 Another section of leat (0010) at NY 7879 43006, similarly to the previous area of vulnerability, is under pressure from the surrounding deposits causing the side walls to bulge inwards. Water is also passing along the base of a heap of rock at this point, which is exerting further pressure on the north

wall of the leat. If left this could potentially cause the collapse of the northern wall creating a significant blockage.

- 10.73 Following a period of heavy rainfall it was noted that leat (0010) was overflowing in the section between overflows (2580) and (2617). This was causing water to pool to the south, which if left unchecked could cause damage to the trackside leat.
- 10.74 A general loss of capstones has been noted across the length of the leat. Although not an immediate problem, the replacement of these missing capstones would help to limit the amount of debris falling into the leat.



Plate 23: Leat (0010) struggling to cope with amount of water flowing through it. Notice water flowing out of the leat to the left of the image.

Trenching Results: Southern Feeder Leat

- 10.75 A series of trenches were located around the southern feeder leat for Handsome Mea. These pits were initially investigated to examine a large boggy area at the end of leat (2460) and the cause of water poaching through the retaining wall for the track. Further trenches were located along the line of ditch (2618) coming off of overflow (2617). This was done to trace the line of the ditch as it was thought to join up to the end of the trackside leat (2460). The location of a number of the trenches within this area is shown on Figure 7, and the position of all features surveyed along the southern feeder leat is shown on Figure 6.

Overflow (2617) and Ditch (2618): Trenches 7 and 8 (Figure 7)

- 10.76 Trenches 7 and 8 were positioned across a depression in the ground where overflow leat (2617) ended, and a ditch, similar to ditch (2616), commenced and ran down the hill. It was revealed that the stone structure of the leat is still present in both trenches approximately 0.20m below the surface, but now only survives as a single course of badly abraded limestone blocks. Above the leat structure a ditch (2618) had been cut to allow water to flow down the hill, but this is now mostly silted up. The ditch was presumably cut in an effort to re establish the flow of water coming out of leat (2617).

Ditch (2618): Trenches 9, 10 and 11 (Figure 7)

- 10.77 Trenches 9, 10 and 11 were located to the west of trenches 7 and 8 at NY78776 42996. The trenches were excavated to further investigate the line of the ditch (2618) coming off of leat (2617). Trench 9 measured 1.70m by 0.60m and 0.50m deep, Trench 10 measured 1.5m by 0.64m and 0.70m deep and Trench 11 measured 1.5m by 0.64m and 0.70m deep. The locations of all three trenches are shown on Figure 7.
- 10.78 The trenches further revealed the line of ditch (2618) coming down the hill towards the track way. The remains of leat (2617) were not present within the three trenches. It was noted that the line of the ditch snakes down the hill in an irregular fashion, where presumably the leat would have been cut straight. It is likely that the line of the ditch no longer follows the line of the leat at this point.

Trench 12

- 10.79 Trench 12, Plate 24, was located directly adjacent to the track way to the west of Trenches 7 to 11 at NY 78756 42996. The trench measured 1.00m by 1.50m and 0.30m deep.
- 10.80 This trench was excavated to investigate a boggy area next to the track way, which was suspected as being the cause of flooding coming out of the retaining wall to the southeast of the track way. It was noted that the trench was filled by large angular stones and was acting as a soakaway (Plate 24). This allowed water to drain through the south-western retaining wall for the track way, causing significant damage.
- 10.81 No features of archaeological interest were found in Trench 12 as the area had been disturbed by the partial construction of the car park adjacent to Handsome Mea.



Plate 24: Trench 12 to investigate boggy area of ground.

Surveyed Features: Trackside Leat (Figure 8)

Trackside leat (2460)

- 10.82 The trackside leat (**2460**, Plates 25 and 26) is located to the south west of Handsome Mea and runs northwest-southeast through the centre of the mining complex. It forms the backbone of the water management system helping to feed numerous areas of the mining complex, around the smelt mill and dressing floors. A detailed map of all surveyed features along trackside leat (**2460**) can be found in Figure 8.
- 10.83 Leat (**2460**) is fed by overflow (**2580**) that extends west from Handsome Mea at its southern end and culvert (**2462**) at the northern end of the reservoir. The leat itself is made up of randomly coursed blocks with a flagged base in parts and cobbled in others. It is partially capped by stone slabs with a small section of the leat capped by planking. A large section of the leat is uncapped with a modern launder inserted into the base to carry water.
- 10.84 At its north-western end leat (**2460**) enters sluice (**2619**, Plate 26) and runs into culvert (**2574**) which is carried across a modern launder (**2573**) towards the Stagg Condenser wheel pit. The exit of leat (**2460**) as it enters sluice gate (**2619**), has been partially blocked off and is currently heavily silted up. It is likely this was meant to act as an overflow to limit the amount of water entering the sluice gate from leat (**2460**), but has now become too silted up to function correctly. At its south-eastern end leat (**2460**) turns into a poorly defined earthen ditch (**2616**) which runs for a short distance before it

runs into an area of modern disturbance and is lost.



Plate 25: Looking down the length of trackside leat (2460) facing northwest.



Plate 26: North-western exit of leat (2460) as it enters sluice gate (2619).

Leat (2620)

- 10.85 Leat (2620, Plate 27) was identified coming off of trackside leat (2460) at NY 78581 43176 and flowing underneath the track way for approximately 50m to the southwest where it terminated suddenly before it reaches the Nent.
- 10.86 The junction between leats (2460) and (2620) is fairly confused and has likely seen numerous alterations during its lifetime. Leat (2620) likely represented an earlier overflow for leat (2460) which fell out of use and was moved to the northwest possibly in an effort to divert water towards the Stag Condenser Wheel Pit. If this theory is correct then leat (2620) predates the construction of the wheel pit.



Plate 27: Leat (2620) to the left of the scale bar, facing southwest. Continuation of trackside leat (2460) appears to the right of the scale bar and continues to the northwest.

Ditch (2616)

- 10.87 Ditch (2616) commences at the south-eastern end of leat (2460), directly beneath Handsome Mea. It runs to the south east and follows the line of the modern track way. Its path is uncertain to the north of Smallcleugh Level due to the partial construction of a car park (*Jackson, pers com*).
- 10.88 This feature does not appear on previous surveys and is thought to join up to ditch (2618) given the similar profiles. It is possible the line of this ditch represents an earlier robbed out leat that diverted water away from Handsome Mea.

Culvert (2574)

- 10.89 Culvert (2573, Plate 28) starts in the side of sluice gate (2619) and runs to the northwest over a modern launder (2574). It runs underneath spoil heap (2457) and continues beyond the launder as culvert (2575) towards the Stagg Condenser wheel pit. The culvert is made up of two side walls approximately 0.40m high made up of randomly coursed limestone blocks with a vaulted arch spanning both walls made from thin sections of limestone voussoirs. The base of the culvert was partially covered by gravel and fallen debris. The entrance to the culvert, shown in Plate 28, has partially collapsed, but is largely clear of debris.



Plate 28: Culvert (2573) as it crosses launder (2574) to meet culvert (2575).

Launder (2574)

- 10.90 This launder is a modern reconstruction of the original launder which would have carried water across this area towards the Stagg Condenser wheel pit. It was noted during the survey that the northern end of the launder where it joins to culvert (2575) is in a poor state of repair and is leaning heavily.

Sluice gate (2619)

- 10.91 Sluice gate (2619, Plate 29) controlled the flow of water from culvert (2462) and leat (2460) and directed into culvert (2574). This is presumably contemporary with the construction of the Stagg Wheel Pit. The current sluice gates are modern timber replacements and are currently set up to divert

water away from culvert (2574).



Plate 29: Sluice gate (2619) and culvert (2462) facing north-east.



Plate 30: Collapse of leat (2460) adjacent to valve housing.

Identified Issues: Trackside Leat

Trackside Leat (2460): Valve Housing

- 10.92 Significant issues were noted across the entire length of the trackside leat (2460, Plate 30), the most serious of which occurs to the south of valve housing (2627). The leat at this point had become severely choked by rubble and long grass. The blockage was created by the collapsed side walls of the leat causing the capstones to fall inward.

Trackside Leat (2460): Retaining Walls

- 10.93 Numerous issues were also noted along the retaining wall for the track way at either end of trackside leat (2460). Water at the north-western end of the leat is joined by water from the track way and from beneath launder (2573). It then washes over the top of the retaining wall, which is slowly causing the wall to collapse (Plate 31).
- 10.94 At the south eastern end of the trackside leat, directly beneath Handsome Mea, water was poaching through the base of the retaining wall from a soakaway created during the partial construction of the car park to the south of Handsome Mea, see Plate 31. This water was then flowing down slope to the southwest. Although unproven, this area of land is thought to be the location of a dressing floor and any water cutting across this area could potentially drag dressing waste into the natural watercourse. If left unattended water poaching through the wall could either completely undercut the structure causing it to collapse, or potential dressing waste could be dragged into the natural watercourse to the southwest.



Plate 31: Water poaching through base of retaining wall and heading down slope to the southwest.

Trackside Leat (2460): Capping Stones

- 10.95 A general loss of capstones was noted across the entire length of leat (2460). Washed in debris had partially blocked all open sections of the leat. This was most notable around the junction between leat (2620) and (2460) where a significant amount of debris had washed in causing a small blockage.
- 10.96 The position of leat (2460), directly adjacent to the track, means that it is highly vulnerable to quarry and pedestrian traffic. The close proximity of this traffic had put a great deal of pressure on the leat which have caused sections of capstones to fall inward. The replacement of these capping stones would greatly limit the amount of debris that falls into the leat.

Trackside Leat (2460): Side walls

- 10.97 Numerous issues with the side walls of leat (2460) were identified during the survey. Various sections had begun to bulge along the north-eastern wall. This was probably caused by the pressure of the spoil heaps pressing up against the walls. Some of these sections had collapsed causing blockage issues and other sections were bulging inward slightly (Plate 32).



Plate 32: Collapsed section of side wall.

Leat (2620)

- 10.98 It was not possible to fully investigate leat (2620, Plate 33) due to its proximity to the quarry track. As a result this feature is not well understood. Although no specific issues were identified, this area warrants further investigation to fully understand the structure as it likely forms part of an earlier overflow for leat (2460). Interestingly it seems that the section of leat (2620), which heads

underneath the track way has been repaired with brick at some stage and is shown in Plate 33.



Plate 33: Brickwork repair to leat (2620).

Trenching Results: Trackside Leat (Figures 9 and 10)

Trackside leat (2460): Trenches 13-17

- 10.99 Five trenches were located along the length of trackside leat (2460). Trench 13 was located at the junction between leats (2460), (2462) and (2620) to clear a small blockage and investigate a complex junction between numerous leats. Trench 14 was located further southeast across a waterlogged area thought to be caused by a collapse in the underlying leat. Trench 15 was located further down the line of the leat to the southeast, adjacent to the valve housing for Handsome Mea. A pipe burst at the valve house had required a trench to be cut across leat (2460) to install a new pipe to carry water downhill. This had caused leat (2460) to collapse which resulted in water pooling at this location. Trench 16 was located further southeast around a minor capstone collapse caused by traffic on the track. The final trench, Trench 17, was located at the south-eastern limit of trackside leat (2460) to examine a large waterlogged area.

Trackside leat (2460): Trench 13

- 10.100 Trench 13 was located between the junctions of leats (2460) and (2620) at NY 78581 43176, Plate 34. It was investigated to examine the junction of these two leats and to clear a series of blockages causing water to pool at this point. The trench measured 9.00m by 0.75m and 0.55m deep and the location of this feature is shown in Figure 8.



Plate 34: Trench 13 showing leats (2460) and (2620), facing southeast.

- 10.101 The trench was excavated to the top of the cobbled surface of leat (2460) and as far as practicably possible around the junction between (2460) and (2620). Due to the width of the leat it was not possible to clear the entire blockage. It was noted that leat (2620) is significantly blocked towards the southwest. A square inspection hatch was visible between the junctions of the two leats. The capstone for the inspection hatch had been removed and was allowing debris to fall into the leat. This stone was replaced to stop further material falling in.
- 10.102 Sections of arching within the leat were also investigated. It was not possible to fully excavate around each section of arching due to the width of the leat. It is assumed that the sections of arching represent the line of numerous leats which have been blocked up (Plate 35).



Plate 35: Trench 13, facing south showing section of blocked arching.



Plate 36: Trench 13 showing leat (2460) with section of bulging wall to left of scale.

- 10.103 This area has undergone numerous phases of building work, the first being the blockage of the arches and the second the insertion of the inspection hatch (Plate 35).
- 10.104 It was noted that the northeast side wall of leat (2460) is bulging inwards slightly (Plate 36). This is due to the pressure created by the nearby spoil heap pressing against the wall. There are numerous

other examples of the northeast side wall of leat (2460) bulging all along the length of the leat. In places the wall has collapsed causing drainage issues (Plate 32).

- 10.105 To the southwest of the inspection hatch for leat (2460) a brick-lined structure was observed. This feature was not fully investigated because of its proximity to the track; its position makes it highly vulnerable to passing quarry traffic.

Trackside leat (2460): Trench 14

- 10.106 Trench 14 was dug across a section of leat (2460, Plate 37) at NY 78114 43125 to investigate a number of blockages. The trench measured 9.00m by 0.75m by 0.30m deep; the location of this feature is shown in Figure 8.



Plate 37: Trench 14 showing leat (2460) facing southeast.

- 10.107 The trench revealed a large section of *in situ* stone capping. A number of capping stones had cracked and fallen into the leat causing a blockage. This is possibly a result of quarry traffic, but is uncertain.
- 10.108 Sections of wooden planking can be seen directly underneath the stone capping that are not part of the wooden launder. These are thought to have been put in place in an attempt to stop water leaking into Smallcleugh level (*Jackson, pers com*).

- 10.109 The leat slopes down fairly sharply to the northwest of the trench. This made it difficult to look up the line of the leat to identify any blockages. A series of small blockages can be seen through the spaces in the stone capping, but it was difficult to fully assess any blockage issues within the trench.

Trackside leat (2460): Trench 15 (Figure 9)

- 10.110 Trench 15 was excavated across a section of collapsed track side leat (2460, Plate 38). It was placed in this location to examine the cause of a significant blockage, and also to examine the structure of the leat. The trench measured 3.00m by 0.55m and 0.40m deep.
- 10.111 At the north-western end of the trench a modern pipe trench cuts the line of the leat at a right angle. The north-eastern wall, taken out by the pipe trench, has been partially rebuilt (this can be seen at the half metre mark on the ranging pole in Plate 38). However, the stone base was not re-established and was causing water to pool and wash out both sides of the leat. If left unattended this will cause the walls to collapse and block the leat further.



Plate 38: Trench 15 showing leat (2460), facing southeast.

Trackside leat (2460): Trench 16

- 10.112 Trench 16 was located to the South of Handsome Mea along a section of leat (2460) at NY 78718 43028 in order to examine the cause of a blockage. The trench measured 1.20m by 0.75m and

0.50m deep and the location of this feature is shown in Figure 8.

- 10.113 A section of capstone had collapsed into the leat, probably caused by the proximity of quarry traffic on the adjacent track way. No further blockages were detected up or downstream. It is recommended that these fallen capstones are replaced to stop material washing in from the nearby spoil heap or from the track way.

Trackside leat (2460): Trench 17 (Figure 10)

- 10.114 Trench 17 was located directly to the south of Handsome Mea and was placed to look at the junction between culvert (2580) feeding leat (2460) from Handsome Mea and the junction between (2460) where it turns into ditch (2616) and runs along the side of the track way.



Plate 39: Trench 17 showing junction between culvert (2580) and leat (2460)

- 10.115 Trench 17 was initially placed to investigate a boggy area of long grass where the line of leat (2460) was thought to have been. The trench revealed that leat (2460) is no longer a stone lined and capped leat past this point, but becomes a ditch. The trench was then extended to the northwest to find the junction between the ditch and the stone lined leat. No blockages were found down the length of the stone lined leat to the northwest, but a junction with the culvert from Handsome Mea (2580) was observed.

11.0 STAGG CONDENSER WHEEL PIT

- 11.1 In 1842, Joseph Dickinson Stagg (1815-1851) was appointed as the '*manager of the mills, washing floors and counting houses*' (Almond 1977, 39) after a promising early career as an assistant to his

father Joseph Stagg, who was a Superintendent for the London Lead Company at Eggleston Mill. Perhaps his greatest achievement at Nenthead was the creation of the Stagg Condenser, a fume condenser which he patented in 1843. The condenser represents one of the earliest and most important forms of condenser constructed, and the example at Nenthead is the best surviving example (Town 2014a).

Surveyed Features: Stagg Condenser Wheel Pit and Smelt mill (Figure 11)

- 11.2 The following section is a brief summary of each of the surveyed features. The survey area at the Stagg wheel pit encompassed a fenced off area to the east of the wheel pit and a section of culvert (2575) up until launder (2573). A detailed map of all surveyed features within the Stagg Condenser wheel pit and smelt mill area is shown in Figure 11.

Culvert (2575)

- 11.3 The main feature of the water management system within the Stagg wheel pit area is culvert (2575). The culvert originates from the trackside leat (2460) as it crosses the modern timber launder (2574) and runs broadly north-south for 100m until it turns westward towards the Stagg wheel pit. An inspection hatch (2445) and two sluice gates (2628) and (2629) were observed along the length of culvert (2575). The culvert was likely carried over a wooden launder and down into the wheel pit to power the wheel at the junction between culvert (2575) and sluice gate (2629).



Plate 40: Looking down into inspection hatch (2445).

Inspection Hatch (2445)

- 11.4 This inspection hatch (2445, Plate 40) is located roughly 60m to the northwest of modern timber launder (2573). Currently the inspection hatch is covered by railway sleepers and has been cordoned off as it has been previously misidentified as a mineshaft due to the circular outer profile. Closer inspection of the hatch was not possible during the survey.

Sluice Gate (2628)

- 11.5 Sluice gate (2628, Plate 41) is located at NY 78538 43365 and is described by the RCHME as '*a timber frame for a sluice gate at the junction of numerous channels with an overflow that leads downhill to the southwest*' (RCHME 1993). It is further described as being formed by two grooved posts connected to a horizontal cross timber by iron straps. The frame is 1.2m high and is well preserved (BHWP 1995).
- 11.6 Sluice gate (2628) controls the flow of water through culvert (2575) and diverts it through a modern pipe (2525).



Plate 41: Sluice gate (2628) with pipe (2525) entering the sluice to the left of the image.

Pipeline (2525)

- 11.7 Pipeline (2525, Plates 41 and 42) appears in the side of sluice gate (2628) and runs to the southwest for roughly 90m where the line of it is lost beneath the rubble of the smelt mill flue. The line of pipe

(2525) to the north can be traced as far as Rampgill Burn where it then becomes unclear. It is possible that the pipe originates further to the north around reservoir (0599), used for hushing at Longcleugh, but this is uncertain.



Plate 42: Pipeline (2525) headed down towards the smelt mill area.

- 11.8 This feature has been previously described by the RCHME as a *"Curving scarp, possibly associated with 457, which it parallels for a short distance, forming a bank and appears to overlie 186"* (RCHME 1993). It is further described as "c1m in height. Its relationship with surrounding components is unclear. It is within a fenced off area, is grassed over and moderately defined. The component may have been thrown up by the excavation of the overflow channel" (BHWB 1995).). This was inserted by the Vielle Montagne Zinc Company, probably as a feed to the Rozan House.

Sump (2621)

- 11.9 Sump (2621, Plate 43) lies parallel to pipe (2525) to the southeast at NY78534 43358. It was first recorded by the RCHME as a *"timber and stone structure containing iron pipes; water filled, 0.5m deep inspection pit?"* (RCHME 1993). It is also mentioned by S. Richardson during a BHWB site visit as 1.5m long by 0.8m wide. It has sides of roughly coursed squared stone rubble with timber barks around the top. One iron pipe is visible in the interior, which is water filled. It is within a fenced off area and is partially grassed over and in poor condition (BHWB 1995).
- 11.10 The purpose of this sump (2621) is not immediately apparent, but it is thought to relate to pipeline (2525) given its alignment and proximity.



Plate 43: Sump (2621) heavily choked by long grass and weeds.

Sluice Gate (2628)

- 11.11 Sluice gate (2628, Plate 44) appears at the junction between leat (2572) and culvert (2575). The sluice gates purpose was to divert water away from the wooden launder, which fed the wheel pit, and take water down leat (2572), bypassing the wheel altogether. Currently the sluice gate only exists as a small channel which would have held the gate in place with the remnants of a wooden post to one side.



Plate 44: Sluice gate (2629) with the start of leat (2572) at the top of the image.

Leat (2572)

- 11.12 Leat (2572, Plate 45) is located at NY 78468 43369 and is made up of roughly coursed stone with a stone slab base and roof. It heads to the west and down into a timber frame and into wheel pit at its base. The leat enters the wheel pit at the base, meaning that it was likely constructed as an overflow system as it entered the wheel pit too low to power the wheel.



Plate 45: Exit of leat (2572) into Stagg wheel pit.

Launder Base (2630)

- 11.13 Launder base (2630, Plate 46) is located to the west of sluice gate (2629) and consists of one large stone slab. This would have been used to support a wooden launder carrying water to the west to power the Stagg wheel pit.

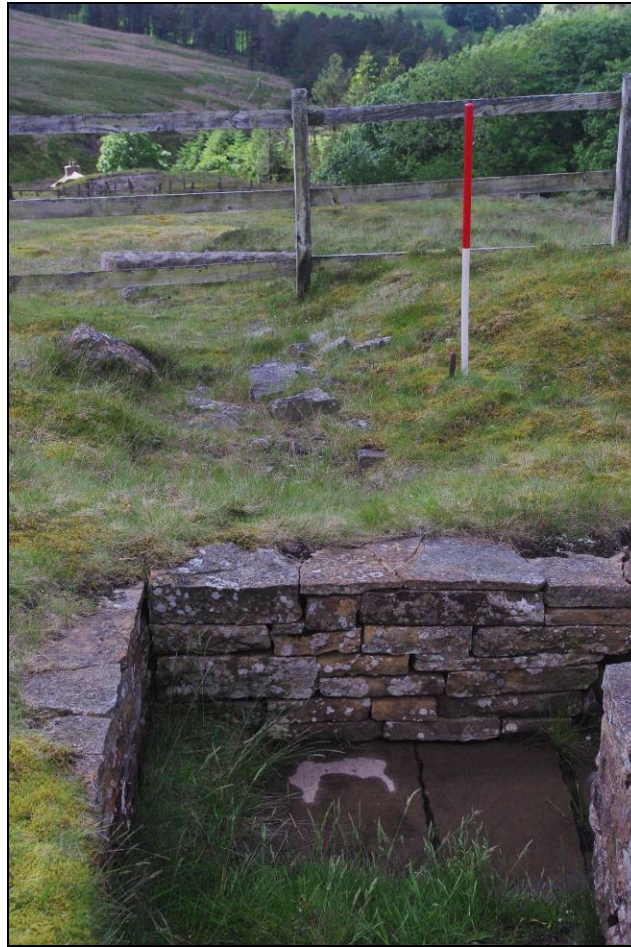


Plate 46: Launder base (2630) behind fence with sluice gate (2629) to the right of the image.

Identified Issues: Stagg Condenser Wheel Pit

Culvert (2575) and Inspection Hatch (2445)

- 11.14 Numerous small areas of debris were observed along the length of culvert (2575). The major areas of concern were around sluice gate (2628) where a large amount of debris had built up in the base of the culvert. A second area of debris was noted around sluice gate (2629) this had been caused by a build up of plant material and was blocked the flow of water down through leat (2572).
- 11.15 The inspection hatch was blocked by a series of railway sleepers. This made it difficult to fully assess any problems associated with this structure and it is recommended that further work is carried out here to remove the sleepers and inspect the underlying structure.

Trenching Results: Stagg Condenser Wheel Pit

- 11.16 A series of trenches were located to the east of the Stagg Condenser Wheel Pit. Although the structures within this area are not under threat of imminent collapse, it was decided to put in trenches to further understand these features.

Sump (2621): Trench 18

- 11.17 Trench 18 was located to the southern end of the fenced area to investigate a large square depression in the ground at NY 78526 43351. The trench measured 1.30m by 0.80m and 0.55m deep and the location of this feature is shown on Figure 11.
- 11.18 The trench revealed a timber lined sump (2621). The structure is made up of timber planking with vertical timber uprights in each corner and a timber base with an inlet pipe at the eastern side, and a narrower outlet on the western side. Two wooden beams ran down the length of the structure at the north and south sides. On top of these beams ran a single course of limestone blocks. The weight of these blocks, and the placement of the fence, has subsequently caused the wooden beam support on the south side to snap (Plate 47).



Plate 47: Mid-excavation shot of collapsed support beam.

- 11.19 It is unclear what the purpose of this sump (2621) was as it doesn't seem to tie into any of the structures associated with the wheel-pit.
- 11.20 Due to the alignment of the sump it could be related to trench (2525), which runs parallel to the sump to the northwest. It is also possible that this feature is related to the condenser flue which cuts across this area. A series of settling tanks would have been placed along the line of the flue to catch fume for reprocessing.

Pipe Trench (2525): Trenches 19 and 20

- 11.21 Trenches 19 and 20 were located to the northeast of sump (2621) to investigate pipe trench (2525) that is shown in the side of culvert (2575) at NY 78527 43358. The trenches measured 1.00m by 0.65m and 1.00m deep and the location of this feature is shown in Figure 11.
- 11.22 The trenches were excavated down to the top of the pipe that appears in the side of culvert (2575), the exit of which forms a sluice gate acting as an overflow diverting water downhill towards the smelt mill complex.
- 11.23 The extent of trench (2525) was not traceable to the southwest as it becomes obscured where it joins the flue rubble further down the hill. No features of further archaeological interest were uncovered within these trenches. It is not recommended that further work be carried out around pipe trench (2525).

12.0 DOWGANG HUSH

- 12.1 Dowgang Hush is one of the most prominent landmarks in the Nent Valley and extends for approximately 1.2km. The hush itself follows the Brigal Burn and Dowgang veins. The early history of the hush is unknown but a reference to Bacons Level suggests that the Brigal Burn vein may have been worked from the second half of the 16th century.
- 12.2 Hushing involved the use of an artificial torrent of water released from a turf dam built near the crest of a hill slope. When enough water had collected, the dam was broken and the resulting surge of water down the slope tore up and removed surface soil and broken rock along its path.

Surveyed Features: Dowgang Hush (Figure 12)

- 12.3 The main feature within the Dowgang Hush area is reservoir (0201), which is fed from leats (2587) and (2588). Further upstream of (2588) a possible dam (2625) was noted during the survey.
- 12.4 The water management system at Dowgang Hush is fairly confused due to the poor survival of the leats and gullies feeding the reservoir (0201). The first archaeological survey of the water management features was conducted by BHWB in 1995, where a series of leats to the southeast, south and southwest of the reservoir were identified. They were previously described as shallow gullies 0.5m wide by 0.5m deep bringing water from the moorland to the south into the reservoir. A detailed map of all surveyed features within Dowgang Hush can be found in Figure 12.

Dam (2625)

- 12.5 This feature lies outside the boundaries of previous surveys conducted by the LUEAU and RCHME (BHWB 1995). The vicinity of this area is discussed briefly in BHWB however no fragmentary dam or features of a similar nature were identified during the previous survey.
- 12.6 The survey identified a small flat area adjacent to Dowgang Burn likely to house a fragmentary dam. A series of linear mounds were observed at right angles to each other and are thought to represent

walls of a structure (BHWP 1995).



Plate 48: Remains of fragmentary dam (2625).

Possible Track Way (2631)

- 12.7 This feature lies to the northwest of fragmentary dam (2625) and runs roughly parallel to the existing boundary wall. It is thought that this layer represents either a standing/working surface or a possible trackway.
- 12.8 Evidence for a possible trackway can be seen in earlier 1st edition OS mapping of the area as a linear feature running parallel to the burn.

Leat (2587) and Leat (2588)

- 12.9 Leat (2587) was surveyed at NY 78262 43297, to the east of Dowgang Reservoir, and takes the form of an earthen leat that forms the eastern feed for reservoir (0201) and would have brought water in from the moorland to the south, but is now inactive. The leat is built with a downhill bank preventing water leaking out of its northern edge towards the River Nent. This feature does not appear on previous surveys of the site.
- 12.10 Leat (2588) forms the western feed for reservoir (0201) and is located at NY 77974 43408. The leat runs northeast to southwest for roughly 80m where it joins the reservoir. Currently the leat is highly fragmentary and has been mostly lost to land slippage, which has become blocked it in most places.

It is now disused and no water flows through the leat at all.

- 12.11 This feature appears on the previous survey of the site (BHWB 1995); however, no further information is given. It seems likely that this leat would have brought water into Dowgang reservoir from the burn to the southwest, but the relationship between the leat and the burn has been lost through natural erosion.

Reservoir (0201)

- 12.12 Reservoir (0201) is located at NY 78088 43460 and is fed by leat (2588) on its western side and leat (2587) on its eastern side. It is constructed from a flat topped steep sided earthen bank with a stone built sluice on its western side.
- 12.13 The survey conducted by BHWB (BHWB 1995) identified a feeder leat on the southern edge of the reservoir in between leats (2587) and (2588). Similarly to leat (2587) it is thought that this feature brought water from the moorland to the south and was also fed by a natural gully on its eastern edge. This feature was not identified during the Altogether Archaeology survey of the site probably due to the poor condition of the surviving features.

Paving (2589)

- 12.14 Further upstream of reservoir (0201) a section of paving still survives at NY 77876 43309. The paving runs for 10m of irregularly coursed sandstone blocks. It is most likely that this paving represents an attempt to water proof the levels beneath to stop water leaking in from the burn.

Identified Issues: Dowgang Hush

Fragmentary Dam (2625)

- 12.15 The Dowgang Burn runs parallel to the suspected site of the fragmentary dam. The burn itself is fairly fast flowing and the immediate area around the burn is in danger of eroding away as a consequence.

Reservoir (0201)

- 12.16 The failure of the sluice gate and pipe at the reservoir was noted as causing water to poach through to the north. This is potentially a very serious problem for the integrity of the dam structure. If water is allowed to poach through the bank it could cause a burst in the future.

Leat (2587) and Leat (2588)

- 12.17 Currently both of these features are in a ruinous state and have been partially blocked by land slippages. No water currently flows through these leats, but it is recommended that further work be carried out to consolidate these features so they are not totally lost by further slippages.

Trenching Results: Dowgang Hush (Figure 13)

- 12.18 A series of trenches were located at north-eastern end of Dowgang Hush where the previous survey phase had identified a possible fragmentary dam (2625) that was subsequently being eroded by the river flowing through Dowgang Hush, and will likely be washed away by future burst. The trenches placed within the area were targeted to identify any structures still present. The location of the trenches within this area is shown on Figure 13 and the position of all features discussed in this area can be found on Figure 12.

Possible Track Way (2631): Trench 21

- 12.19 Trench 21, Plate 49, picked up the remains of a possible track way (2631) at a depth of 0.05m. The feature consisted of a flat area of metallised stones running broadly parallel to the existing boundary wall. The full extent of the possible track way was not established during the train trenching phase, but it is likely that it does not extend further towards the burn at this location.



Plate 49: Trench 21 showing part of working surface (2631)

Dam (2625): Trenches 22-25 (Figure 13)

- 12.20 The remaining four trenches were placed on a patch of land adjacent to Dowgang Burn thought to be the location of a fragmentary dam related to the hushing activity in the area. Trenches 22-25 were unable to pick up any trace of a dam within them. The line of a possible wall was picked up in Trenches 22 and 23 however, this is inconclusive.



Plate 50: Trench 22 showing possible wall facing southwest

13.0 AREAS OMITTED FROM TRENCHING (FIGURE 14).

13.1 In total ten of the fifteen areas were investigated, two of which (Areas 11 and 12) fell under the remit of a previous scheme of consolidation undertaken as part of the Nenthead Conservation Plan, monitored by NAA (Countryside Consultants 2013). Due to access arrangements Area 13, located next to the Barracks (Smelt Mill Complex), was not investigated. The final area (Area 14) was not fully investigated due to weather and time restrictions.

Area 11

13.2 Area 11 was located to the north of Smallcleugh level and was targeted to investigate underlying deposits in an attempt to identify and mitigate against any future water runoff coming from the surrounding system of leats and culverts. This area was omitted from the trial trenching phase as it would interfere with ongoing conservation and reconsolidation work carried out as part of the Nenthead Conservation Plan (Countryside Consultants 2013).

Area 12

13.3 Area 12 was located to the west of Smallcleugh dressing floor to investigate water flow coming over wall (2478). This area was omitted from the trenching phase as it fell under the remit of a recent previous scheme of consolidation carried out as part of the Nenthead Conservation Plan (Countryside Consultants 2013).

Area 13

13.4 Area 13 was located directly adjacent to the Barracks within the Smelt Mill Complex. It was targeted

to investigate problems with the drainage next to the Barracks. This area was omitted from the trenching phase due to significant access issues with digging a trench across the car park. The location of Area 13 is shown on Figure 14.

Area 14

13.5 Area 14 was located at Dowgang Dam to the northeast of Area 15. This area was picked up during the survey phase and was targeted to investigate the failure of a sluice gate and pipeline which was causing an area of the dam to collapse and causing water to poach out from the north. The location of Area 14 is shown in Figure 14.

13.6 This area was omitted from the trenching phase because Nenthead had experienced a large amount of rainfall during the two week period of the trial trenching, which had caused the water levels of the dam to rise considerably. This made it impossible to investigate the area fully.

14.0 CONCLUSION AND RECOMMENDATIONS

14.1 The survey and trial trenching phases of this project has further reinforced our understanding of the position, function and flow paths of the man-made water management systems at Nenthead. A series of maintenance issues and recommendations have been brought forward as a direct result of the archaeological investigation of these areas.

Trackside leat (2460)

Trench 13

14.2 It is recommended that this area is subject to further archaeological investigation to fully understand the phasing of the structures around the inspection hatch (Plate 34). Further Investigation of leat (2620) would be warranted as this structure is not well understood. It is not clear if any water flows through leat (2620), but any blockages found should be cleared as a matter of course. Monitoring of the bulging side walls within leat (2460) is also recommended at this location. These objectives could be achieved by.

- Lifting stones around inspection hatch to facilitate access for full clearing of blockages.
- Further archaeological survey and recording of arched sections to trace original alignment.
- Investigate leat (2620) heading under track way to discover direction of flow and potential exit of leat.
- Monitoring of bulging section of side wall (Plate 36).

Trench 14

14.3 It is recommended that further work is carried out around this section of leat (2460) to lift the large capstones and clear any blockages present. This will involve the removal of a significant amount of

spoil around both sides of the leat and further down slope towards the start of the modern wooden launder.

- Excavate soil around leat (**2460**) by machine to expose stone capping. Too much to reasonably hand dig.
- Lift capping the inspect leat for blockages.
- Inspect condition of wooden launder.

Trench 15

14.4 Both walls at the north-western end of Trench 15 are in need of consolidation. The pipe from the valve housing has cut through both walls and slate bedding and has been partially rebuilt to a poor standard. This is causing water to pool around this area and will cause future collapses if left unattended.

- Reconsolidate structure exposed, especially area effected by pipe trench.
- Reinstate fallen capstones. These have been kept to one side next to the trench.
- Reinstate bed of the leat. This has been destroyed by the pipe trench and is causing water to pool and wash away sections of the leat.

Trench 17

14.5 Although the structures within Trench 17 are not under any threat of flooding or collapse it is recommended that work be carried out on ditch (**2618**). The ditch has silted up and is heavily choked by long grass and reeds and needs clearing to allow water to flow freely again.

- Clear out ditch (**2616**) running from leat (**2460**). This is currently choked by reeds and causing drainage issues.

Culvert (2462)

14.6 It is recommended that this area is subject to significant further work and reconsolidation. At present the trench across culvert (**2462**) has been left open and fenced off, as it was impractical to backfill.

14.7 It is recommended that a series of wooden formers are inserted on either end of the culvert to facilitate further work around the collapse, and help to prevent the culvert from collapsing further. The gravel either side of the culvert collapse should be removed by machine to expose the collapse fully. Once this is done the collapsed section should then be dismantled by hand and rebuilt around a wooden former.

14.8 It is likely that the lack of wooden lining, present in the rest of the culvert, is the cause of the water pooling and eroding the sides away. It is further recommended that this wooden lining be re-instated along this section to prevent further erosion. A summary of all of the recommendations for this

feature are listed below.

- Install a series of formers around the collapsed area of culvert (**2462**) to prevent further collapse.
- Machine gravel deposits away on either side of collapse under archaeological supervision.
- Record structure still standing.
- Dismantle vaulting by hand and rebuild.
- Install a wooden lining similar to the rest of culvert (**2462**) to prevent further wash out of surrounding deposits.

Sluice Gate (2619)

- 14.9 Once water exits culvert (**2462**) it enters into an area of sluice gates. The current set up of these sluice gates (Plates 51 and 52) allows water to travel down culvert (**2462**) where it turns to northwest (Plate 53) and disappears underground and emerges at culvert (**2609**).



*Plate 51: Water flowing from culvert (**2462**) to series of sluice gates and changing course to the northwest.*



Plate 52: Sluice gates controlling flow of water from culvert (2462).



Plate 53: Water diverted into leat (2462) from sluice gates. Note water pooling on surface and flowing into leat at bottom of image.

14.10 It is recommended that the setup of the sluice gates shown in Plate 52 is swapped. This would divert water away from culvert (2462) and across the modern launder that carries water into culvert (2575). A summary of all of the recommendations for this feature are listed below.

- Swap setup of sluice gates to divert water into Stagg Condenser wheel pit (Plate 52).
- Examine flow of water from sluice gate (2619) to inspection hatch at (2445) across modern launder.
- General clearance of culvert (2462) between trackside leat (2460) and culvert (2440) to the northeast.
- The section of culvert (2462), particularly around pipeline (2442), is fragmentary and it is recommended further targeted clearance is carried out along this long stretch also.

Retaining Wall

14.11 Sections of the retaining wall of the quarry track have numerous significant localised problems as a result of various drainage issues arising from culvert (2464) and a modern soakaway to the south of Handsome Mea discussed in previous sections. The problems relating to the north western section of retaining wall would be solved through the diversion of water from culvert (2462) through sluice gate (2619) as discussed earlier.

14.12 The south-eastern section of retaining wall to the south of Handsome Mea would require a more substantial intervention in the form of the removal of the entirety of the modern soakaway created during the partial car park construction adjacent to Handsome Mea.

Handsome Mea: Southern Feeder Leat

Overflow (2617)

14.13 Water does not currently flow through leat (2617, Plate 54) as the flow has been diverted to the northwest through leat (0010). As a result leat (2617) does not pose any flooding issues to the surrounding area.

14.14 It is recommended, however, that the stone lined section of leat (2617) is reconsolidated. The structure is in a very poor condition at the present time and is vulnerable to collapse. If the junction between overflow (2617) and leat (0010) were to collapse, it would lead to a significant amount of water washing down toward the quarry track and bypassing the reservoir completely.



Plate 54: Disused overflow leat (2617), facing east. Ditch can be traced joining road at bottom of image.

- Reconsolidation of overflow leat (2617). This is currently in poor condition and vulnerable to collapse through natural erosion.

Contour Leat (0742)

14.15 Contour leat (0742) is a very long and sinuous structure that has seen numerous re-cuts during its lifetime. Although the structure is sound for the time being it is recommended that this structure is monitored to ensure any failures in the structure are dealt with swiftly.

14.16 It was observed, particularly around the mid section of the structure, that a great deal of drainage grips cut the feature. These grips are aligned broadly north south and could potentially direct water from leat (0742) downhill towards the River Nent. A list of recommendations for this feature are listed below.

- Further survey along the entire length of contour leat to assess vulnerabilities in the structure.
- Monitoring of the effects of modern drainage grips directing water down slope towards the Nent.

Leat (0010)

14.17 It is recommended that leat (0010) is monitored closely particularly in periods of heavy rainfall. It was noted that water is very fast flowing at the south of Handsome Mea along leat (0010) and the

leat struggles to contain the amount of water flowing through it.

- 14.18 Structurally leat (0010) is in a good condition overall with no blockages observed and the majority of the capping still survives. Recommendations for this feature are listed below.

- Monitoring of water particularly in between overflow (2617) and reservoir intake. During substantial amounts of rainfall this area struggles to cope with the amount of water and it spills downhill towards the track.

Handsome Mea: Northern Feeder Leat

Leat (2615)

- 14.19 Leat (2615) runs directly out of Firestone Level and exits down the hillside adjacent to Firestone spoil heap. There are significant blockages all along this leat, which is causing sections of the leat to wash away. It is recommended that leat (2615) is cleared of debris to prevent any further loss.

- 14.20 The end of leat (2615) is under greater threat as water is fairly free flowing at this point causing further damage to the structure. Water from this point is flowing downhill and pooling in large quantities. Given the close proximity to Firestone spoil heap, this could potentially drag toxic material down with it and into the burn at the bottom. A summary of the recommendations for this feature are listed below.

- Clearance of material from leat (2615) flowing out of Firestone Level.
- Reconsolidation of leat at entrance to Firestone and at the exit of leat (2615)
- Monitoring of waterlogged area at the base of Firestone spoil heap. This could potentially cause material to erode out of the spoil heap and into the natural watercourse below.

Leat (0029)

- 14.21 Although water from leat (0029) has been deliberately diverted away from launder base (0030) down the hillside, it is not recommended that any further work is undertaken on this section of the leat. The structure of the leat itself is sound and no collapses or blockages were identified. It is recommended however that the water pooling at the bottom of leat (0029) is monitored as it is creating a large waterlogged area at the base of Firestone spoil heap. This could cause material from the spoil heap to erode away into the natural water course.

- 14.22 Two significant leaks were identified within leat (0029) where the leat crosses the flue. These two leaks are causing water to pool to the west and run off into the burn. This could potentially cause toxic material to be dragged into the burn. A summary of the recommendations for this feature are listed below.

- Further archaeological investigation of leat (0029) around where the flue crosses the leat. Two areas of the leat are leaking either side of the flue and further investigation would be required to

pinpoint the problem.

- Monitoring of waterlogged area at the base of Firestone spoil heap being fed by leat (0029).

Culvert (2440)

- 14.23 Culvert (2440) only stretches for a short distance between overflow leat (0032) and culvert (2439). The structure itself is mainly sound except for the junction between culvert (2439). A large collapse of culvert (2440) has fallen into culvert (2439), which has caused a substantial blockage to the overflow of the reservoir.
- 14.24 To the east, sluice gate (2578, Plates 55 and 56) controls water from the reservoir into culvert (2439) and prevents the reservoir from draining into the trackside leat. During heavy amounts of rainfall the reservoir quickly fills up and water can often flow over the top of the sluice gate and down into (2439).



Plate 55: Sluice gate (2578) after a heavy period of rain. Note wooden sluice is in the down position.



Plate 56: Water from sluice (2578) flowing through the junction between culvert (2440) and culvert (2439).

- 14.25 As a result, water from sluice (2578) washes over the collapsed section of culvert (2440) further eroding the bank. If left unattended this will cause culvert (2440) to collapse further and create a significant blockage. A summary of the recommendations for this feature are listed below.
- Clear substantial amounts of debris and rubble out of overflow from Handsome Mea. This will probably have to be done by machine.
 - Rebuild retaining walls.

Leat (2575) towards the Smelt Mill Complex

- 14.26 A significant area of flooding, identified during the survey phase of the project, occurs along the fork in quarry track to the southeast of the smelt mill complex. This water is travelling down slope and making its way into the smelt mill complex. This is a significant cause for concern, as this could potentially cause damage to the smelt mill features. To avoid this situation, water from the quarry track can be diverted into the existing water management system through culvert (2575) via inspection hatch (2445) (discussed in greater depth below).
- 14.27 Water from culvert (2575) originates from the junction between culvert (2462) and sluice gate (2619) (as discussed earlier in the recommendations for culvert (2462)). It is recommended that water from culvert (2462) is diverted through the sluice gate at (2619) and towards culvert (2575) across launder (2573). This would divert water away from the track way adjacent to Carr's Level and eliminate the flooding issue around this area highlighted during the survey.

- 14.28 Once water enters (2575) it then makes its way towards the Stagg Wheel Pit through sluices (2628) and (2629) and into leat (2572). Water from leat (2572) flows into the bottom of the wheel pit through tailrace culvert (2577) and connects to (2576) junction at the south end.

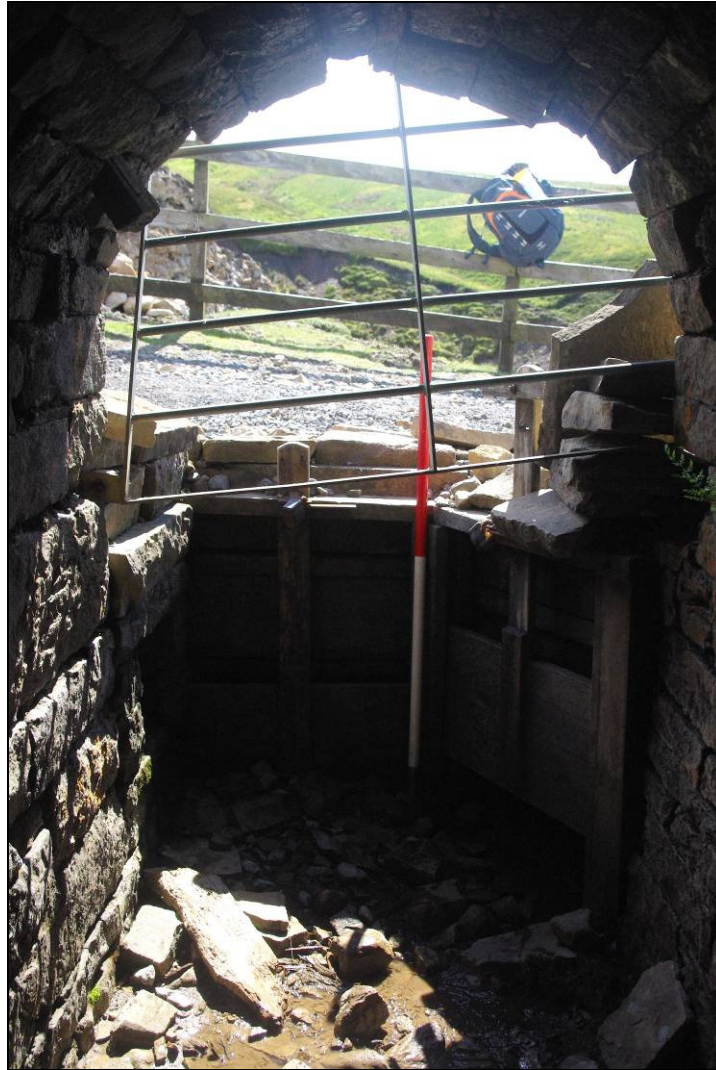


Plate 57: Junction from tailrace culvert (2577) to launder for smelt mill complex.

- 14.29 At this point the water from the Stagg Wheel Pit has three potential outlets. The first runs directly over the launder (2576) feeding the Smelt Mill (Plates 57 and 58), down the smelt mill wheel pit and through into the natural watercourse exiting from conduit sluice (2604) (Plate 59). If this course was taken extreme care would need to be taken so that water coming through the smelt mill is not causing issues elsewhere within the complex.

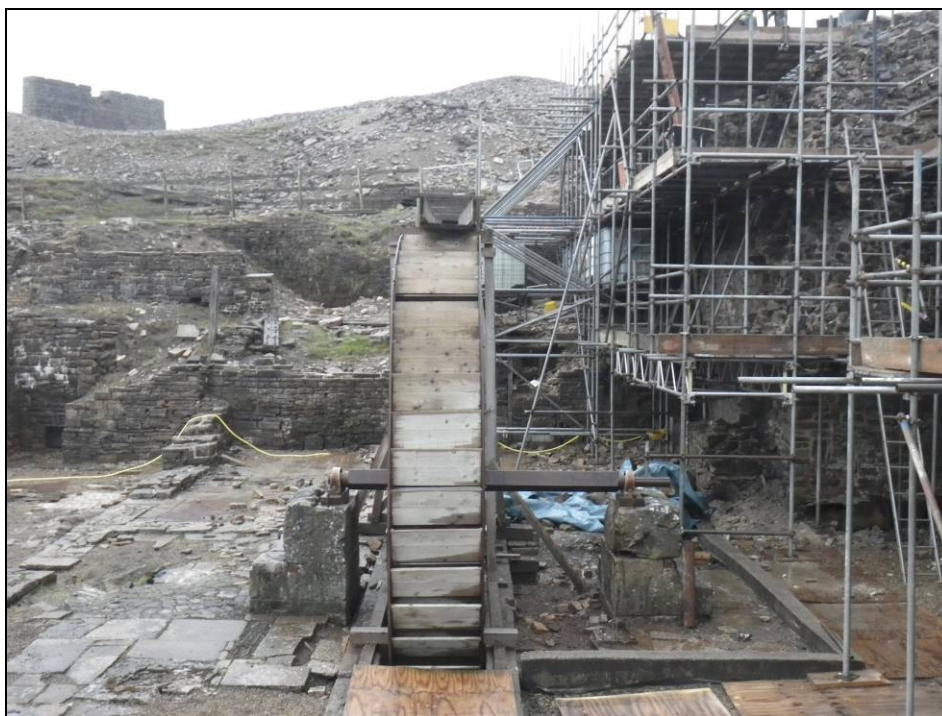


Plate 58: Launder running from (2576) into Smelt Mill wheel pit.

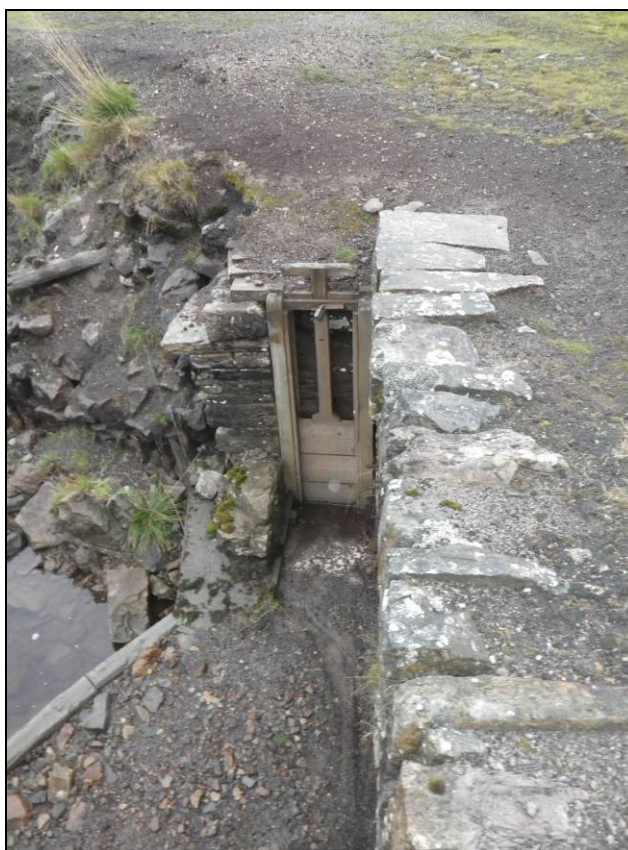


Plate 59: Conduit sluice (2604) outlet from Smelt Mill wheel-pit.

- 14.30 The second potential outlet runs northwest from (2576) along (2623) and out of a large opening (2624) (Plate 60) directly adjacent to the Assay House. Of the three potential courses for water from

the wheel pit to flow this is the least desirable. This would cause a large amount of water to pool inside of the smelt mill complex and adjacent to the assay house, causing damage to both structures.



Plate 60: Exit (2624) adjacent to Assay House.

- 14.31 The third, and most preferable, outlet for water coming off the Stagg wheel pit is directly along leat (2623) avoiding outlet (2624) and out of exit (2603) (Plate 61). This would eliminate any potential danger to the smelt mill complex. Further work would need to be done around the pathway junction to ascertain the flow of (2623) as it is not currently clear how the two join.



Plate 61: Exit (2603) alongside track way.

- 14.32 Water around **(2603)** is currently being diverted, by a line of limestone blocks, away from a collapse to the retaining wall supporting the track way (Plate 62).



Plate 62: Main flow of water diverted away from collapsed section of retaining wall.

- 14.33 Further work to consolidate the retaining wall collapse (Plate 59) would allow water exiting **(2603)** to flow freely. Alternatively the wall diverting the main flow of water away from the collapse could be moved further downstream to catch the water exiting **(2603)**. A summary of all the recommendations for this area are listed below.
- Divert water from culvert **(2462)** and sluice **(2619)** through into culvert **(2575)** (discussed in the recommendations for culvert **(2462)**).
 - Monitor length of culvert **(2575)** from sluice gate **(2619)** up to Stagg Wheel Pit to ensure no further blockages.
 - Monitor water from leat **(2572)** as it enters tailrace culvert at the Stagg wheel pit.
 - Investigate junction at **(2576)** between leats **(2577)** and **(2623)** to examine flow and direction of water from wheel pit into smelt mill complex.
 - Investigate flow and direction of water around Smelt Mill wheel-pit towards conduit leat exit **(2604)**.
 - Investigate flow and direction of water from leat **(2623)** towards launder exit at **(2603)** into natural watercourse. This may involve a further trench at the junction of pathways adjacent to house to establish relationships between leats.

Inspection Hatch (2445)

- 14.34 Previously, feature (2445, Plate 63) was recorded as a mineshaft due to the profile of the earthwork mound around the outside (BHWB 1995). Further investigation during the survey, revealed that feature (2445) is in fact an inspection hatch for culvert (2575).



Plate 63: Railway sleeper removed at (2445) to reveal inspection hatch for (2575).

- 14.35 It is recommended that water directly to the west of (2445) that is flowing freely down the modern track is diverted into the inspection hatch (2445). This could be achieved by blocking the flow of the track runoff heading south and digging a channel into (2445) on its western side. Water would then flow into leat (2575) and into the series of leats within Area 10 and down towards the wheel pit.
- Clear debris inside inspection hatch.
 - Block flow of roadside gully causing flooding in the smelt mill complex.
 - Excavate channel through to the side of inspection hatch (2445) which will take existing flow into leat (2575)
 - Install a grate or mesh on top of inspection hatch (2445) to prevent injury and accumulation of debris.

Sump (2621)

- 14.36 Currently sump (2621) is sufficiently waterlogged to prevent the timber of the structure from degrading further, but care would need to be taken to make sure the structure doesn't dry out in

warmer weather. The fence immediately to the south of the structure is putting pressure on the timber side panels and could possibly cause further damage. It is recommended that the fence be moved back slightly, to the south, to prevent any further collapse. A summary of the recommendation for this feature are listed below.

- Move southern side of the fence away from sump (2621). This will take pressure off the sides, which will likely cause the sump to collapse if the structure dries out.
- Rebury or cover over the sump to prevent it from drying out.

Culvert (2575)

14.37 Culvert (2575) is a fairly long feature with a series of inspection hatches and sluices along its length. As a result of this complexity a number of maintenance issues arose from the excavation and survey of the feature.

14.38 The stretch of culvert between inspection hatch (2445) and launder (2573) was not fully investigated for blockages due to the fact it is mostly capped. It is recommended that this stretch is examined properly as culvert (2575) plays an important role in helping to divert water from the track and potentially from culvert (2462).

- Investigate flow of water from leat (2575) to wheel pit and out of tailrace culvert (2577).

Dowgang Hush

Fragmentary Dam (2625)

14.39 Although the trial trenching of the fragmentary dam did not prove or disprove the presence of a dam at this location, it is recommended that further work be carried out in this location in the form of a more substantial phase of trail trench. The area surrounding the potential dam is highly vulnerable from the adjacent stream and in time this area will erode away entirely. A summary of the recommendation for this feature are listed below.

- Further targeted trenching at site of fragmentary dam (2625). No conclusive evidence either way was established for the existence of a structure at this location.

Reservoir (0201)

14.40 This area was not fully investigated during the trenching phase of the project due to the height of the water within the reservoir after a sustained period of rainfall. The reservoir itself is still highly vulnerable due to water poaching out on its northern face as a result of the failure of the sluice gate. A summary of the recommendations for this feature are listed below.

- Excavate a series of trenches to examine the cause of water leakage. These could be located around the sluice gate and around the northern edge of the dam around the leak.

- Further survey to find the southern feeder leat for reservoir (0201) identified during the BHWB survey of the area.

Conclusion

- 14.41 Both the survey and trial trenching phase of this project have been hugely successful in helping to further our understanding of the water management system at Nenthead and has provided us with a series of future recommendations for the continued upkeep and preservation of the site as a whole. As well as improving our understanding of the issues surrounding the future conservation of the site, the project has also helped our understanding of the ecological impact the site is having on the natural watercourses and how the continued conservation of the site will help limit these factors.
- 14.42 An important aspect of this project was the continued enhancement of the Miner Farmer Landscape Project database with information relating to the site to be used as a framework for future survey work. As well as enhancing existing records on the database the survey and trial trenching of the site has helped to add a wealth of additional information for the key components of the water management system.
- 14.43 The project has also been hugely successful in helping to engage local volunteers from the Altogether Archaeology project in both the survey and excavation phases of this project. As a direct result of this the project has helped to equip local volunteers with techniques of archaeological excavation and recording, which has resulted in a legacy of skilled field surveyors able to continue further work beyond the life of this project.

15.0 REFERENCES

- Almond, JK (1977) *The Nenthead and Tynedale Lead and Zinc Company Limited, 1882-1896, British Mining vol. 5, 22-40.*
- Barton Howe Warren Blackledge (BHWB) (1995) *Draft Management Plan, Nenthead Lead Mining Complex, Alston, Cumbria, unpublished document.*
- Countryside Consultants (2013) *A Management Plan for the conservation of Scheduled Monument No. 28906: Lead Mines, Ore Works and Smelt mill at Nenthead, Cumbria, unpublished report.*
- Cranstone, D (1988a) *Nenthead Excavations 1987: an interim report, unpublished report.*
- Cranstone, D (1988b) *Nenthead Excavations 1988: an interim report, unpublished report.*
- English Heritage (2007) *Understanding the Archaeology of the Landscape – A guide to good recording practices.*
- Hedley, I, and Cranstone, D (1995) *Rampgill Workshops, Nenthead: Archaeological Recording and Building Survey 1994, unpublished report.*
- Hunt, CJ (1970) *The Lead Mines of the Northern Pennines in the Eighteenth and Nineteenth Centuries, Manchester.* The University Press.
- LUAU (1997) *Nenthead Lead Mines, Cumbria: Report on Archaeological Recording, Lancaster University Archaeological Unit, Unpublished Report.*
- Liverpool University Environmental Advisory Unit (nd) *An Historical and Archaeological Survey of the Nenthead Mining Area, Cumbria, unpublished report*
- RCHME (1993) *Nenthead Lead Mines, Alston Moor, Cumbria, unpublished report.*
- Sowerby, M (2006), *North Pennines Heritage Trust Archaeological Field School 2006: The Smallcleugh Project, NPA Ltd CP230/06 unpublished report.*
- Town, M (2014a) *Nenthead Lead Mines, Nenthead, Cumbria: Archaeological Survey.* Northern Archaeological Associates. Report 13-130.

Town, M (2014b) *Nenthead Lead Mines, Nenthead, Cumbria: Archaeological Monitoring - Written Scheme of Investigation*. Northern Archaeological Associates. Report 14-27.

Town, M and Frodsham, P (2014a). *Altogether Archaeology Theme 9 - Industrial Archaeology Fieldwork Module 9c, Nenthead Lead Mines watercourse survey phase 2 - Excavation Project Design*.

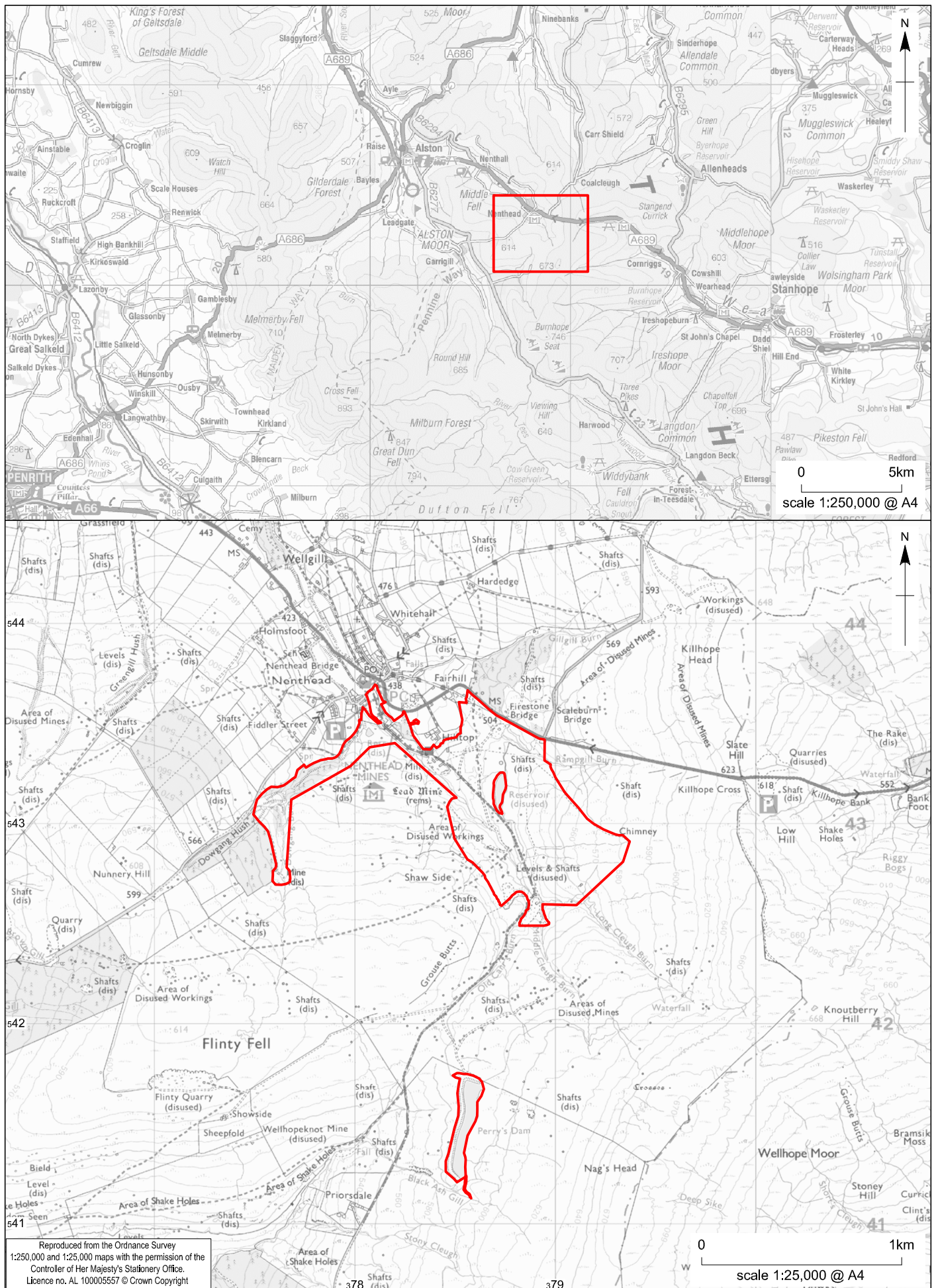
Town, M and Frodsham, P (2014b). *Altogether Archaeology Theme 9 - Industrial Archaeology Fieldwork Module 9c, Nenthead Lead Mines watercourse survey - Project Design*.

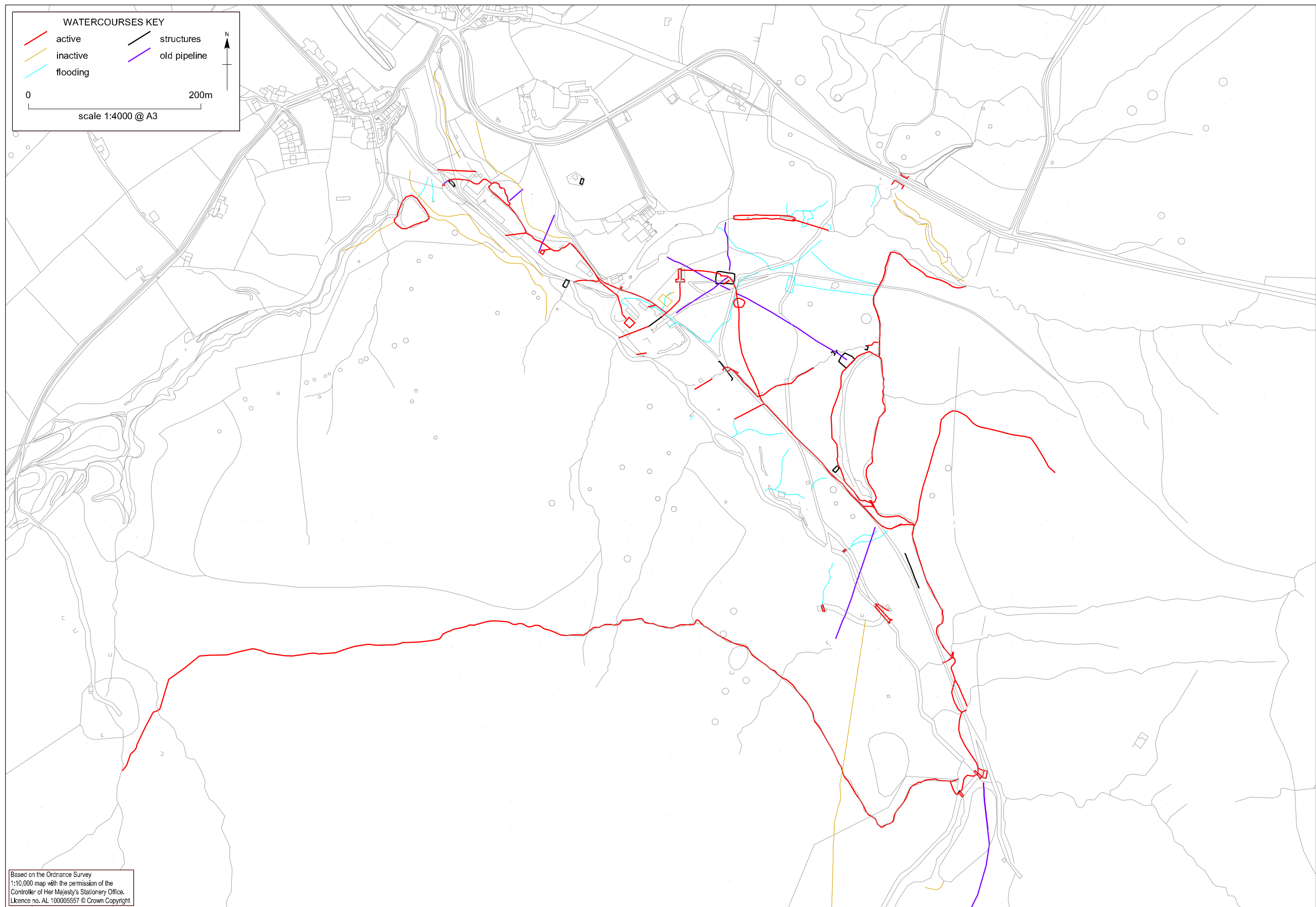
16.0 APPENDIX A: FEATURE CATALOGUE

Context	Interpretative description	Trench	Notes
0029	Leat	8	
0030	Laundry base	8	
2615	Leat	8	Directly out of firestone level.
2616	Ditch	4	
2617	Overflow leat	5	Disused
2618	Ditch	5	Probably modern coming off (2617)
2619	Leat	5	Leat feeding Handsome Mea at southern end.
2620	Leat	1	Running underneath modern track way.
2621	Sump	10	
2580	Leat	4	Overflow leat from (2619), feeding into (2460)
2460	Leat	4, 1, 3	Leat fed by overflow leat (2580)
2462	Leat	6	
0032	Sluice	7	Feeding (2440) from leat (0029)
2440	Leat	7	Fed by (0032) runs into (2462)
2445	Culvert	10	Inspection hatch
2524	Area	10	Fenced area adjacent to Stagg wheel-pit
2575	Culvert	10	Running from (2445) and feeds Stagg wheel-pit
2525	Drain	10	Modern drain acting as an overflow of (2575)
2624	Leat	Smelt mill	Outlet of (2623) adjacent to assay house from Stagg wheel-pit
2623	Leat	Smelt mill	Running NW from junction (2576)
2576	Leat junction	Smelt mill	Junction of leat (2577) and (2623)
2603	Laundry exit	Smelt mill	Possibly connects to (2623)
2604	Conduit leat	Smelt mill	Exit of conduit leat from smelt mill wheel.
2609	Leat	Carr's Level	Exit of leat fed by diversion at area 6 into (2460)
2577	Tailrace Leat	Stagg wheel pit	Leat coming off wheel-pit to south. Joins to (2576)
2625	Fragmentary dam	15	
2626	Handsome Mea		Split into 3 sections 2626/1 - 3
2627	Valve Housing	3	
2628	Sluice Gate		Sluice in culvert 2575 leading off to modern pipe 2525
2629	Sluice Gate		Partial sluice gate diverting water over laundry base 2630 into the Stagg Wheel Pit or diverts water down through culvert 2572
2631	Surface	15	Possible working/standing surface.

17.0 APPENDIX B: CONTEXT CATALOGUE

Context	Interpretative description	Trench	Notes
0301	Base of leat	3	Slate base.
0302	North east wall	3	Original wall. Limestone built.
0303	South west wall	3	Original wall. Limestone built.
0304	North east rebuilt wall	3	Poorly reconstructed.
0305	South west rebuilt wall	3	Poorly reconstructed.
0306	Cut of pipe trench	3	Cut of pipe trench from burst of valve housing (2627)
0307	Backfill of 0306	3	Backfill of pipe trench
0308	Base of rebuilt leat	3	Base of rebuilt leat. Earth and wooden lined.
0309	Capstones	3	Large limestone slabs
0310	Overlying deposit	3	Mine waste deposit.
1501	Stone deposit	15	Possible wall
1502	Reddish brown layer	15	
1503	Greyish brown layer beneath 1502	15	Charcoal inclusions
1504	Stone deposit	15	Possible wall
1505	Topsoil	15	Greyish brown sandy silt
0501	Topsoil	5	Mid grey brown peaty loam
0502	Subsoil	5	Brownish grey clayey silty sand
0503	Cut of ditch	5	Re- cut of older overflow leat.
0504	Fill of 0501	5	Fill of (0503)
0401	Cut of ditch	4	Cut of ditch at the end of trackside leat (2460)
0402	Fill of (0401)	4	Mid grey brown silty fill of ditch
0403	Material above leat (2460)	4	Mixed rubble and mine waste above leats
0404	North eastern wall of culvert (2460)	4	Limestone construction.
0405	South western wall of culvert (2460)	4	Limestone construction.
0406	Stone capping of culvert (2460)	4	Limestone capping.
0407	Northern wall of overflow leat (2580)	4	Limestone construction.
0408	Southern wall of overflow leat (2580)	4	Limestone construction.
0409	Stone capping of overflow leat (2580)	4	Limestone capping.



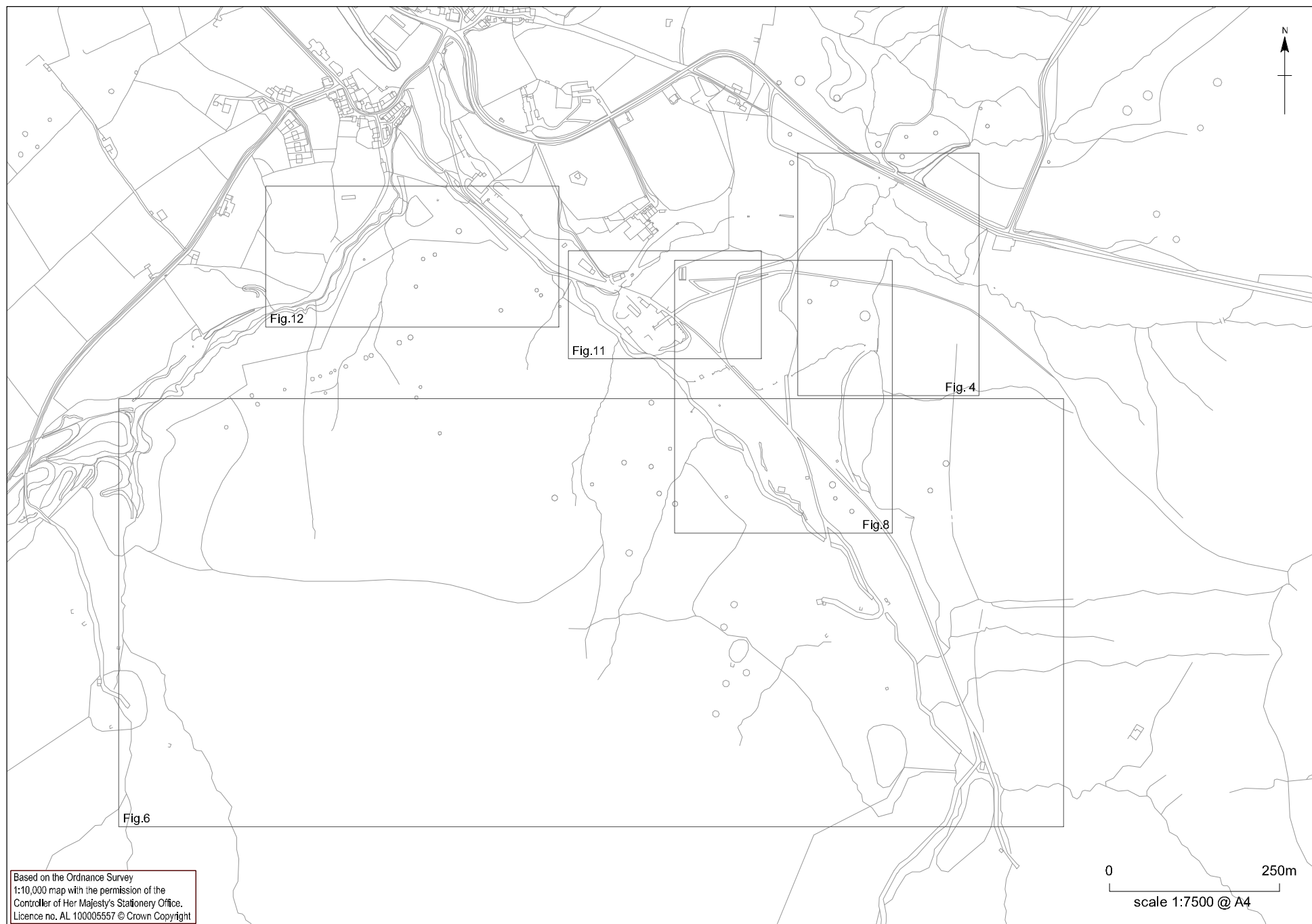


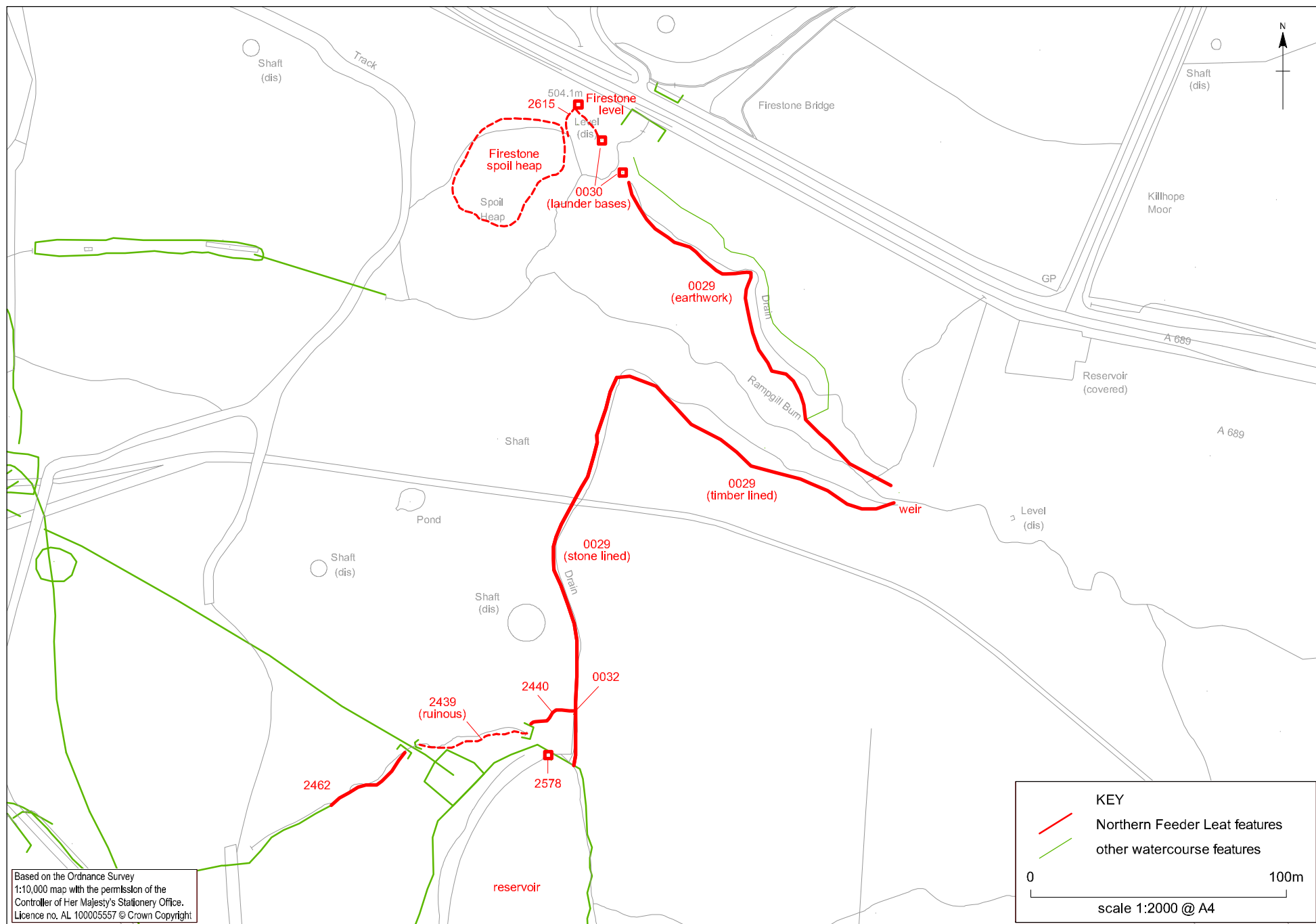
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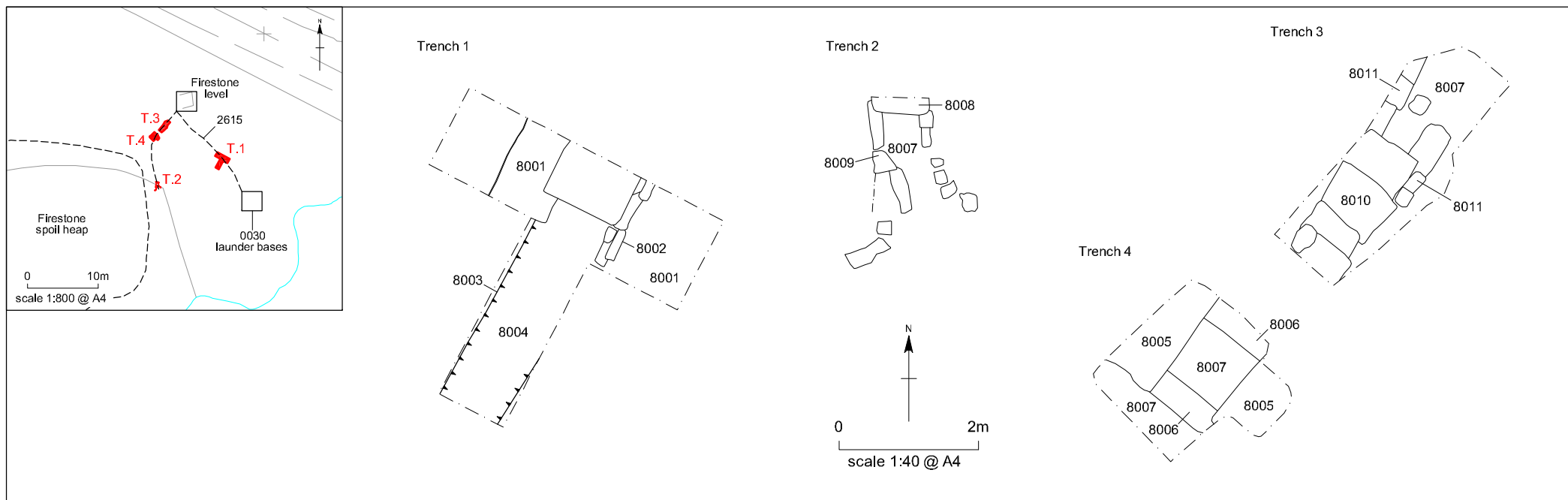
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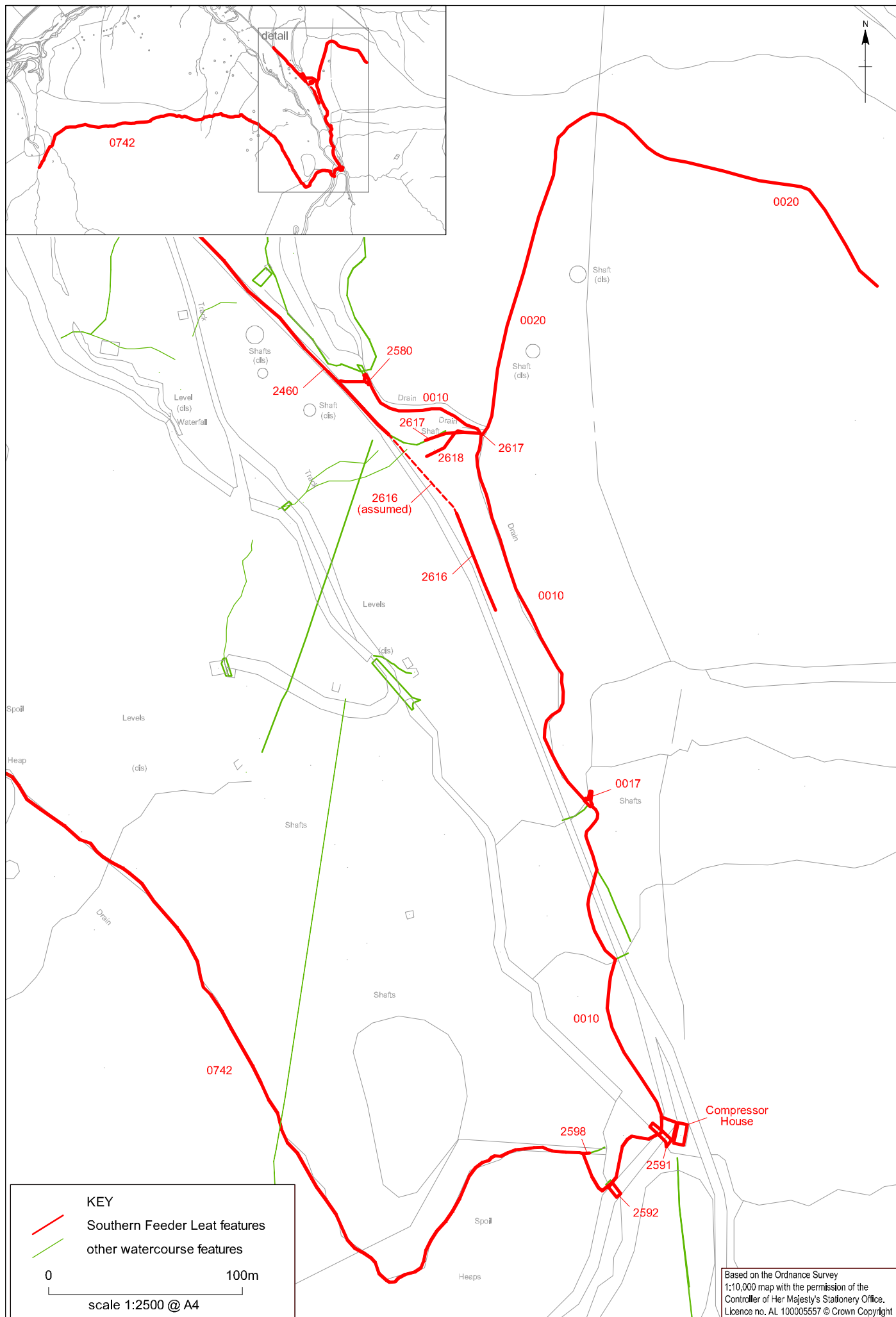
Nenthead Altogether Archaeology Watercourse Survey: overview

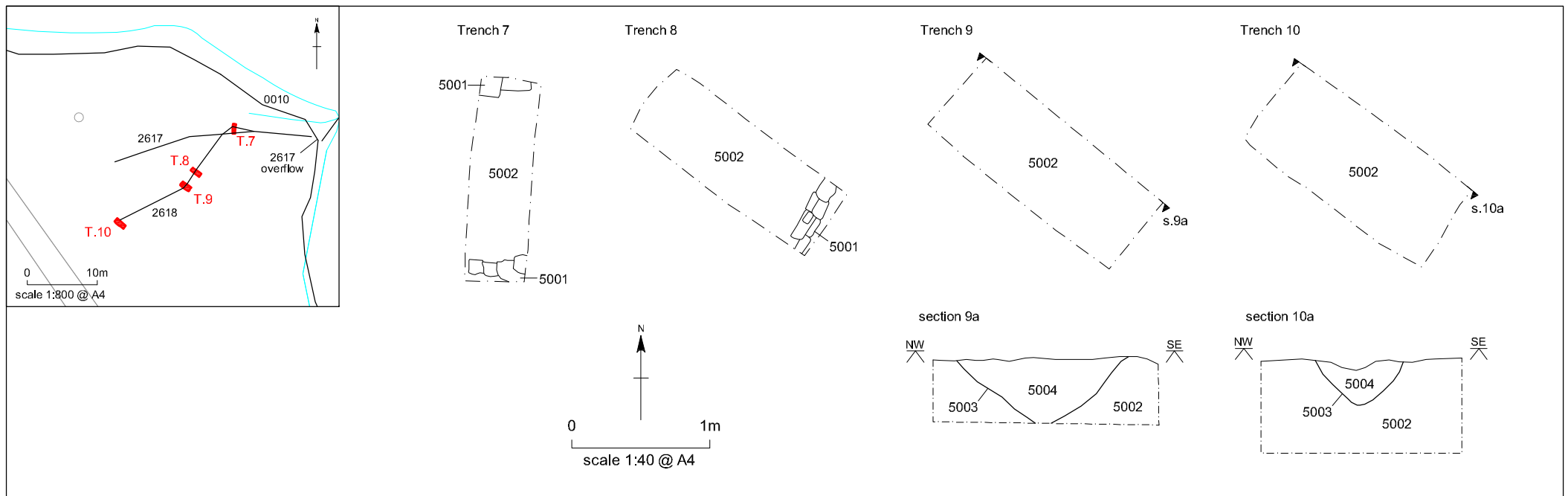
Figure 2

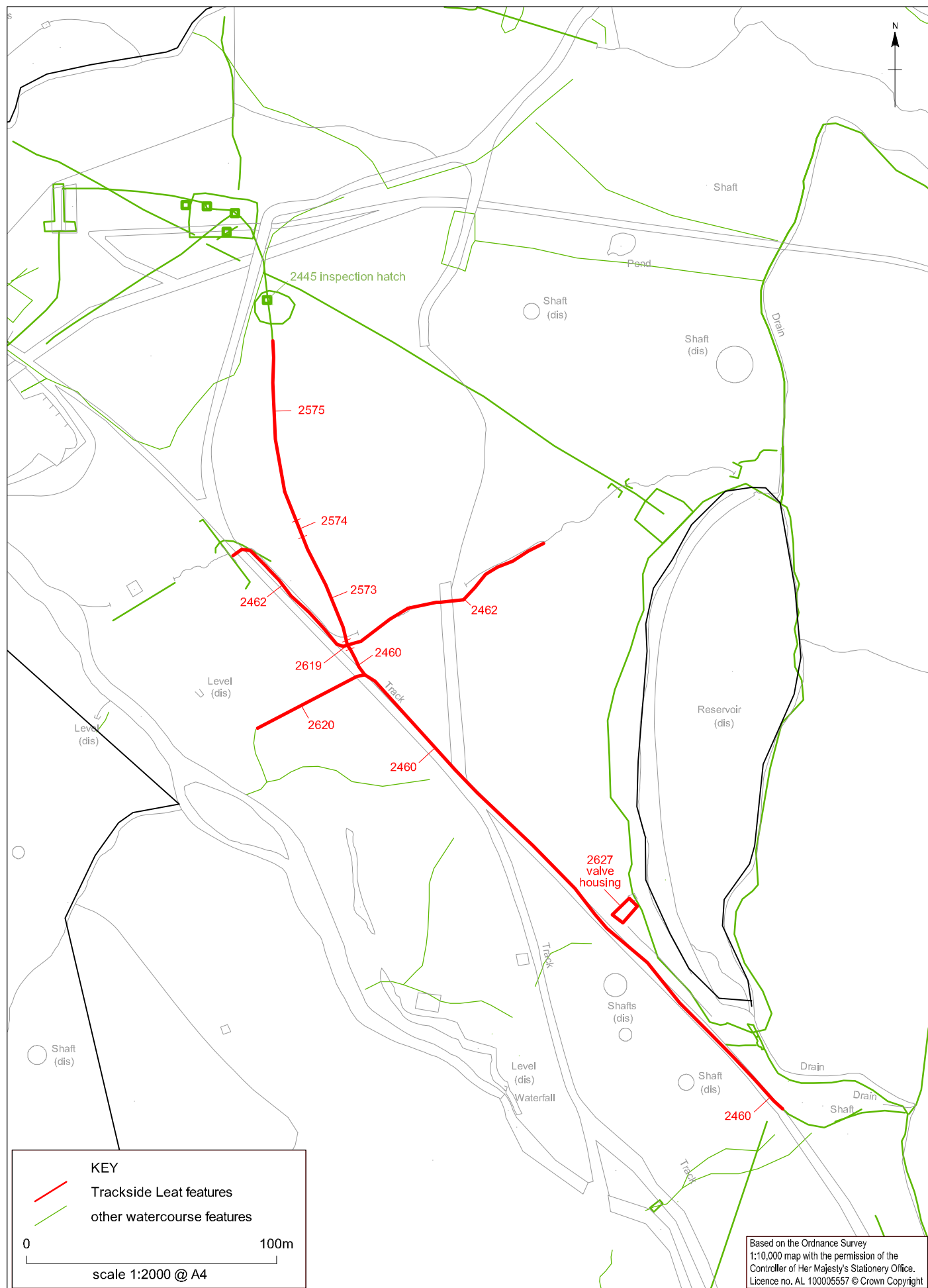


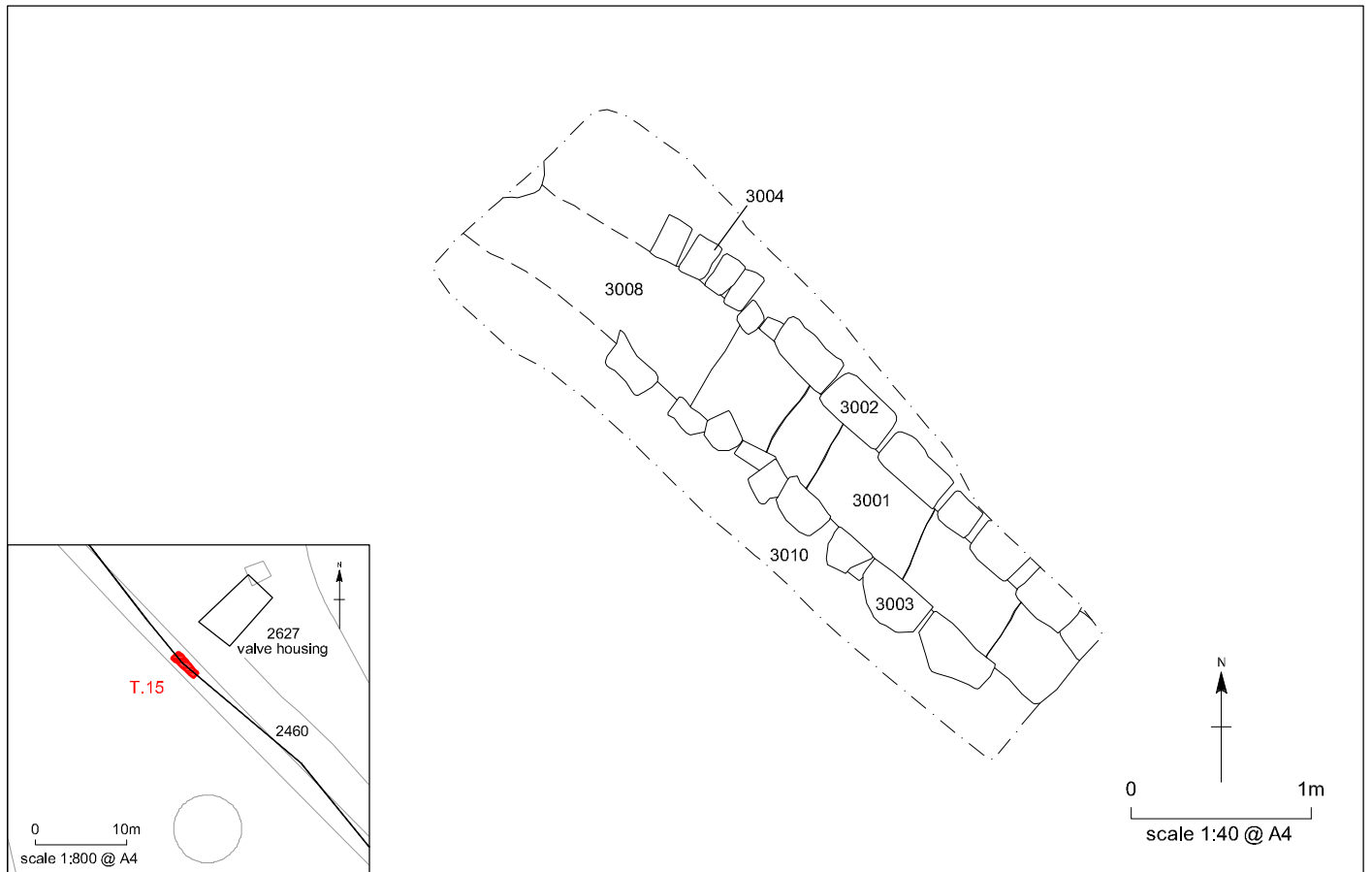








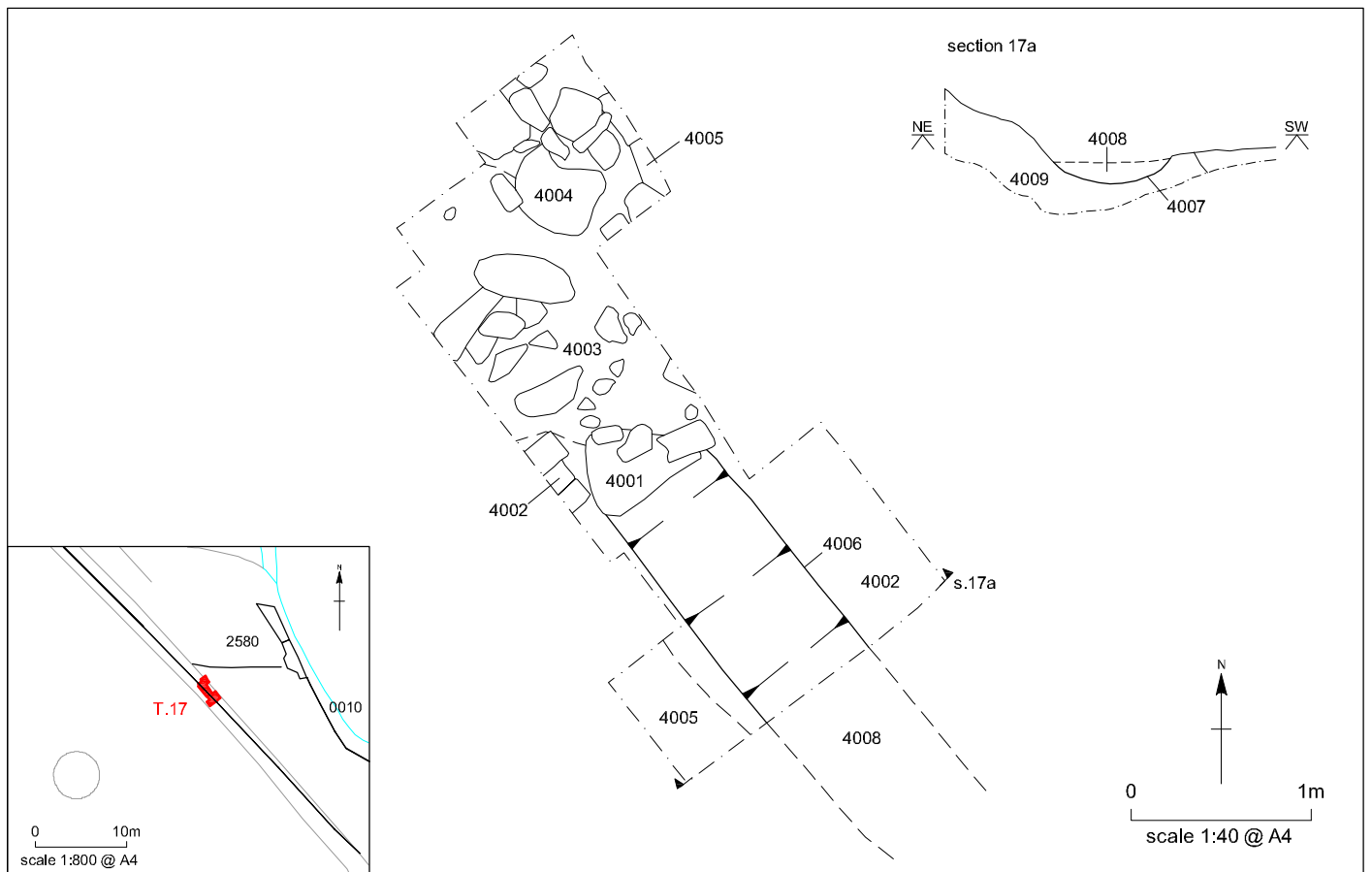




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Nenthead AA Watercourse Survey: Trackside Leat, Trench 15

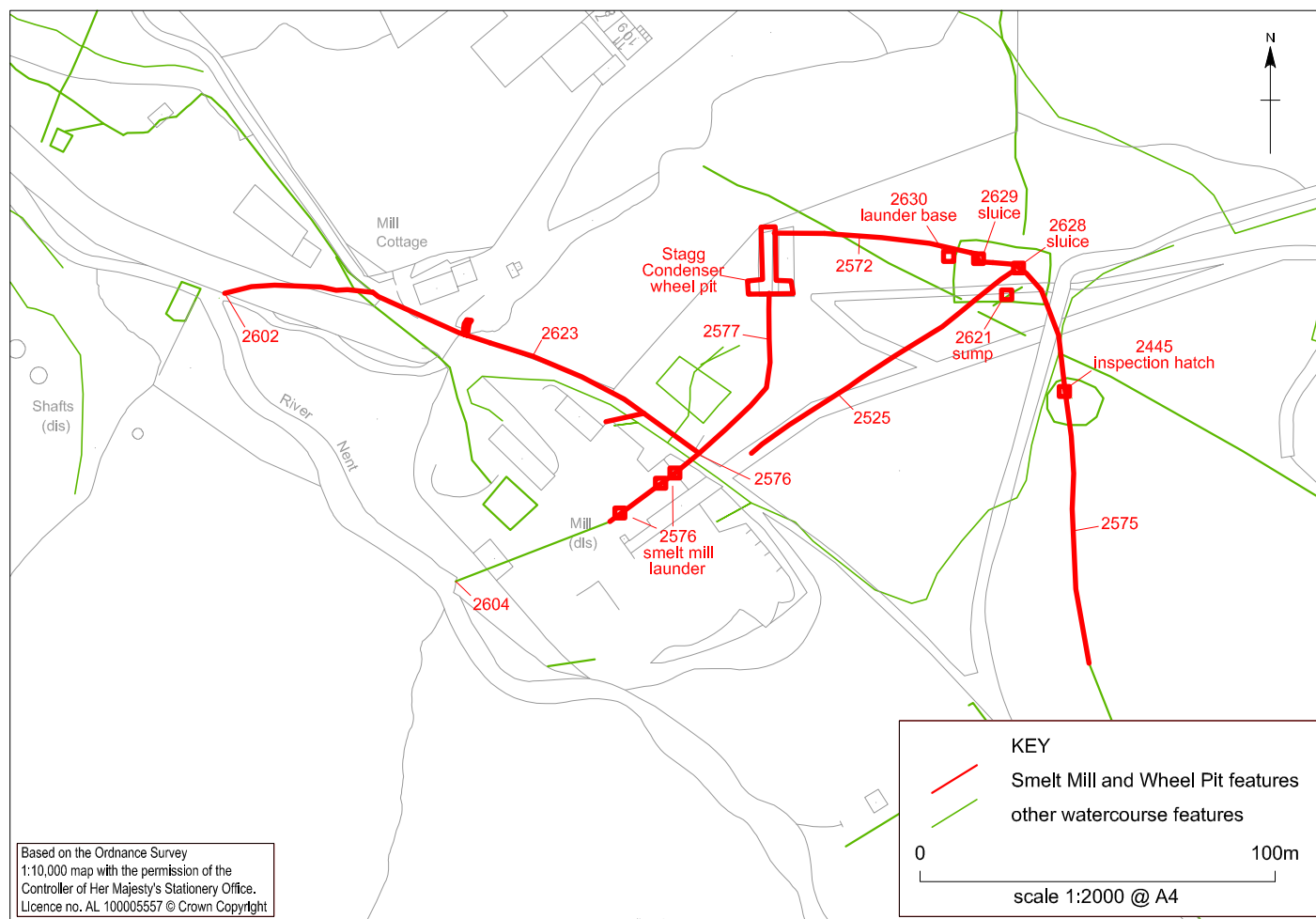
Figure 9



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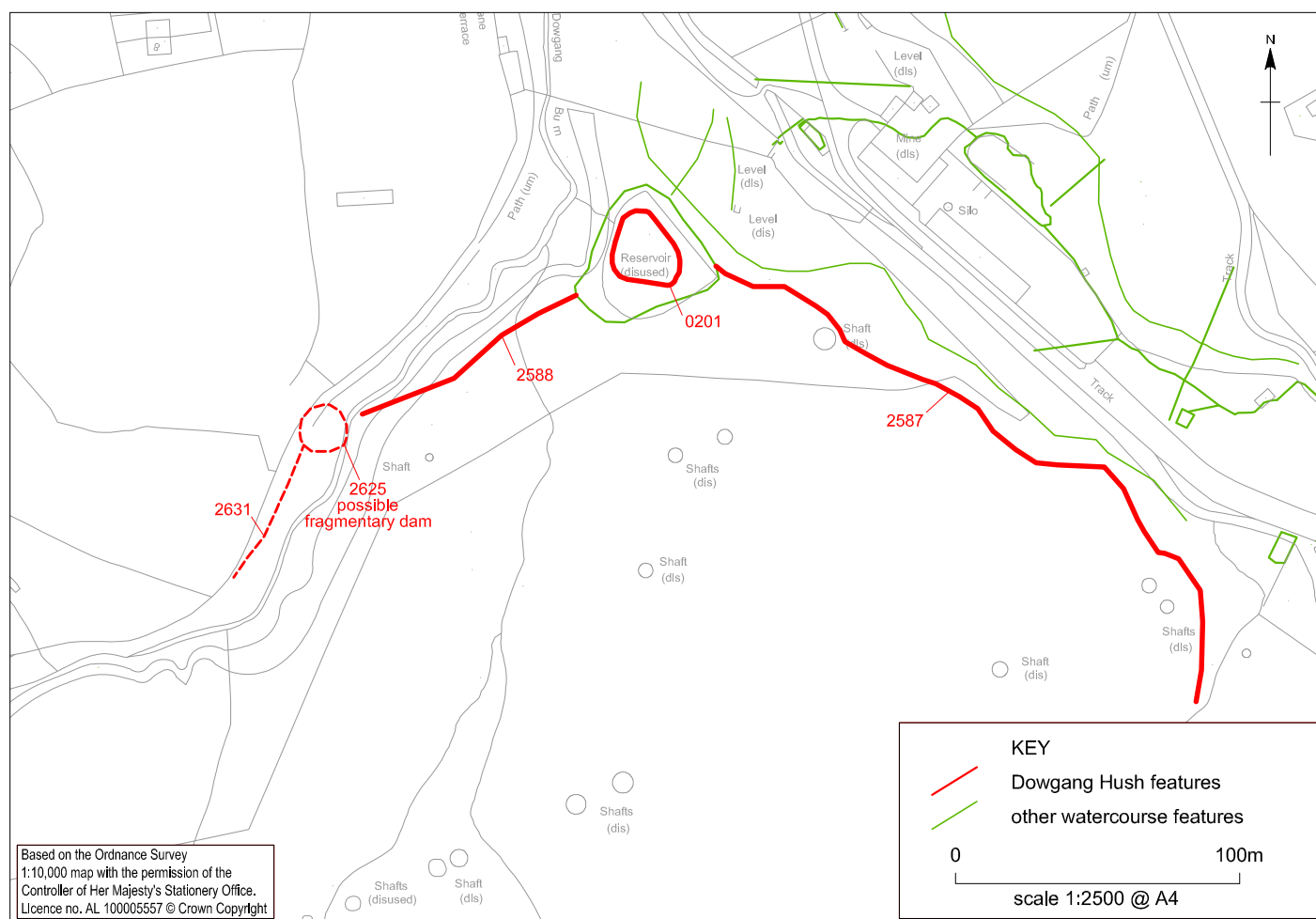
Nenthead AA Watercourse Survey: Trackside Leat, Trench 17

Figure 10



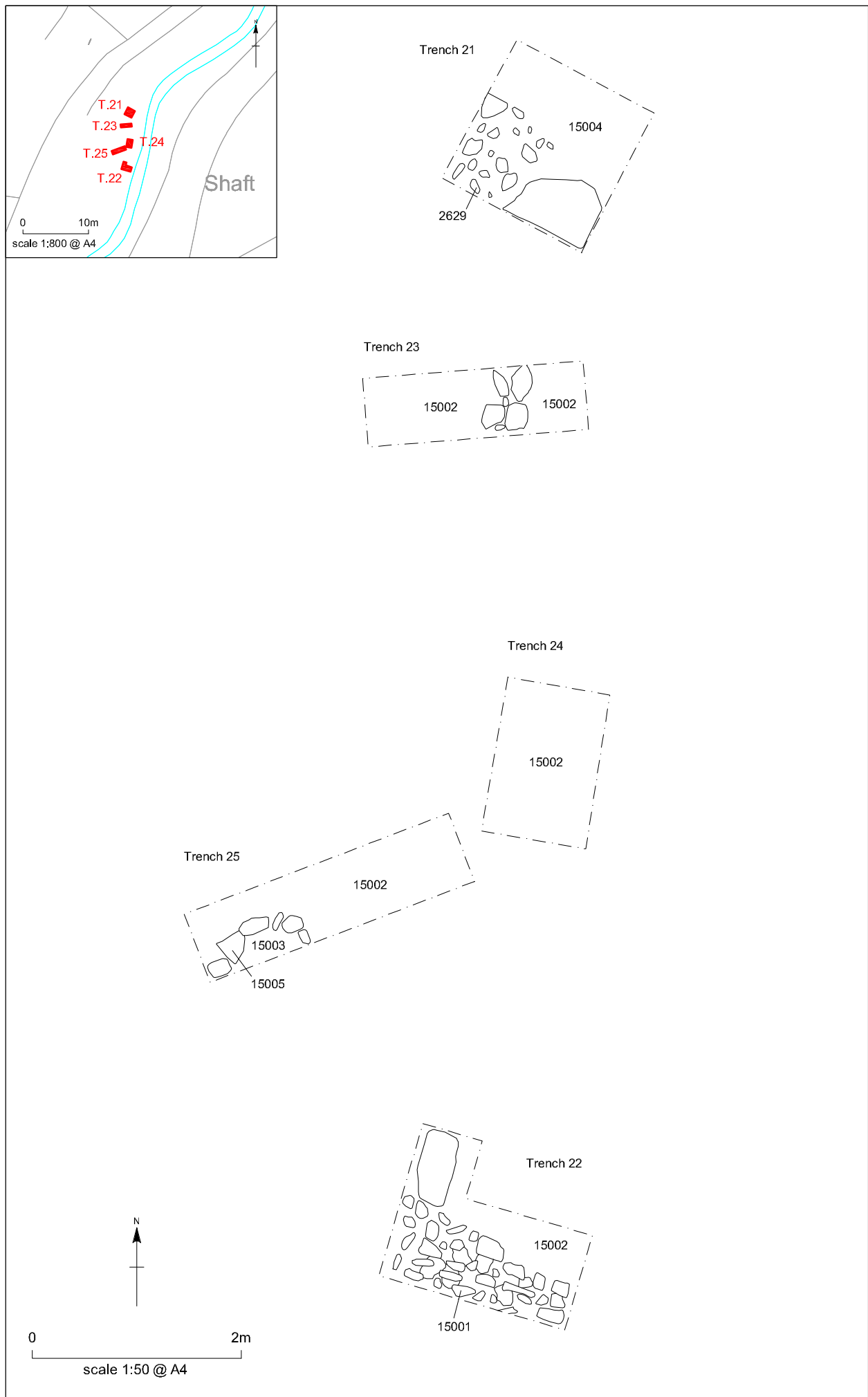
Nenthead Altogether Archaeology Watercourse Survey: Smelt Mill and Wheel Pit

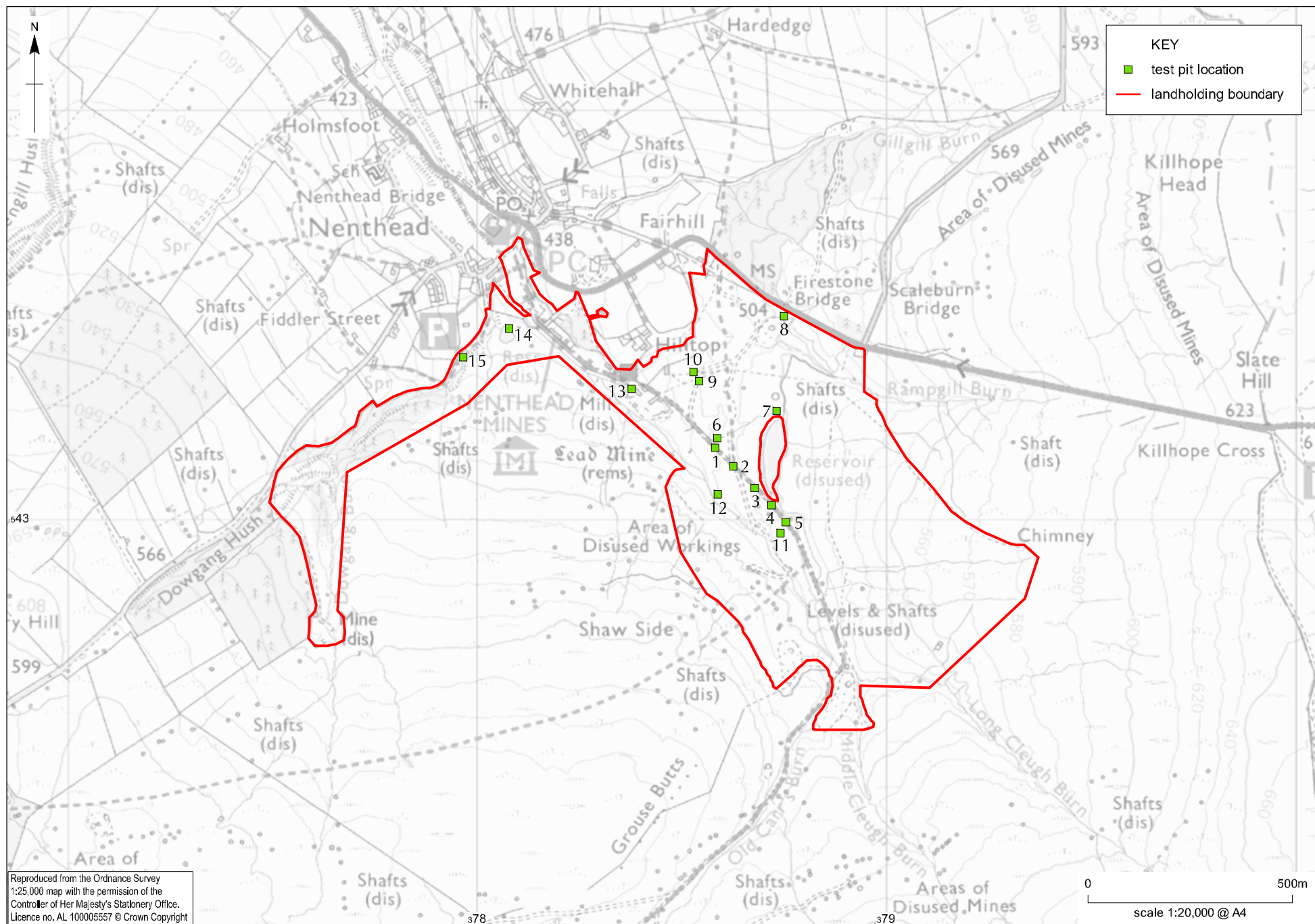
Figure 11



Nenthead Altogether Archaeology Watercourse Survey: Dowgang Hush

Figure 12





Nenthead AA Watercourse Survey: test pit locations

Figure 14