KELD HEADS LEAD MINES AND SMELT MILL, WENSLEYDALE

North Yorkshire

Archaeological Survey Report

Oxford Archaeology North

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SUMMARY

Oxford Archaeology North (OA North) was invited by Historic England to undertake a detailed topographic survey of the lead mining complex of Keld Heads, Wensleydale (SE 0793 9077). The survey was required to inform a management plan for the scheduled monument and its two listed buildings (Engine House, Boiler House and Peat Store). A project design was issued by OA North in accordance with brief from English Heritage, which required the provision of a documentary study, and Level 2 and Level 3 surveys of the overall landscape. The survey was undertaken by means of photogrammetry with photographs taken from an Unmanned Aerial Vehicle (UAV) of open areas and by total station survey in areas of woodland. The survey was undertaken between 20th January and 28th April 2015.

Keld Heads was one of a number of lead mines in the region that were developed in the nineteenth century, the lead extracted and then the mines closed when they were no longer profitable. However, at Keld Heads as well as early enthusiasm, investment and determination to make the mine succeed, innovative new technologies were incorporated both at the mine and the Smelt Mill. These included deep below-ground shafts, the use of steam engines to drain the underground workings, and the sequential layout of mechanised dressing floor operations, as well as advanced ideas for the extraction of lead and silver at the Smelt Mill, Condenser House and its Flue. The intensity of the enterprise and the number of employees at both mine and smelting mill would have had considerable impact on the local communities in the middle of the nineteenth century.

The Keld Heads Lead Mine complex is divided into two distinct areas; to the south is the area of the mine, the main adit, wheelpit, Engine House, workshops and dressing floors, and to the north is the Smelt Mill, Peat House and Condenser Flue and House. The Smelt Mill is largely overlain by quarry spoil, but there is an extant Condenser Flue which extends northwards for a distance of 3.3km. Within the line of the Condenser Flue was the Condenser House, which had a water wheel-powered fan that drew fumes along the flue from the Smelt Mill to the south; the heavier particles in the fumes, which would have contained lead deposits, were condensed in Stokoe Condensers by the flow of water. Further north was a large reservoir *c* 80m wide, which provided water for the operation of the Smelt Mill and Condenser House, and there is a complex water management system flowing in leats, canalised becks and dams.

The survey of the northern area revealed a line of shaft mounds orientated north-west/south-east extending along the main ore vein, which were earlier than mapping of 1828; they were possibly excavated and mined as early as the eighteenth century and there are references to the working of shafts as late as the first decades of the nineteenth century by Henry Calvert, although these were then abandoned *c* 1828.

The most productive and developed phase of mining activity at Keld Heads Mine was after 1843 and was managed by the Keld Heads Mining Company. The main adit of this period was located to the south of Tullis Cote and is associated with a series of extant structures, including a drainage adit, airshafts, workshops and two Agent's houses (Site **60**). Initially, hoisting up the shaft and drainage of the lower levels was powered by a large water wheel but at a later date an engine house, with its adjacent Boiler House and chimney, was used to power the mine operations.

The southern part of the study area was intensively used for dressing the ore, and included an area of bouse teams for the storage and washing of the ore and a dressing floor, including

buddles, for the refinement of the ore. A complex of tramways linked the adit entrance with the various dressing floor elements and also led to spoil heaps on the site and to the west of the study area.

The original Smelt Mill was perhaps built *c* 1650 to 1655 and was probably built to smelt the ore from Cobscar mine, and from cartographic evidence would appear to have been on the site of the later Condenser House. A New Smelt Mill was constructed by the Keld Heads Mining Company in *c* 1851-1854, which according to an indenture of 1854, included storage for coal, coke, soot and ore, as well as a 'a roasting house, metal house' and 'a patent Condenser House' and horizontal chimney. Few of these buildings can now be seen on the ground due to the extensive quarrying which took place after 1949, which resulted in the burying of most of the Smelt Mill beneath quarry waste.

Extending out from the New Smelt Mill was a series of condenser flue terminals, each corresponding to an individual hearth within the smelt mill. These terminals converged upon two Condenser Flues which served to take the toxic gases away from the area of smelt works and to enable the condensing of the lead substrates onto the sides to improve the efficiency of the smelt operation. Superimposed onto the flue was a large Condenser House to further improve the recovery of the lead; it had been built by 1852 and a series of Stokoe Condensers had been installed in 1862.

The survey has highlighted the need for ongoing management of the archaeological remains in order to stabilise and prevent further deterioration of the monuments. There is considerable tree growth across the area, which is mostly young scrub. If allowed to grow to maturity, this could cause root damage to the monuments. It is therefore recommended that the tree growth be cut back from the shafts, the large reservoir (Site **28**), the Smelt Mill and the Condenser House. The upper adit entrances need to be consolidated to stop further erosion (Sites **16**, **19** and **20**), and the main adit (Site **55**) should have a grill inserted part way into it to prevent access by the general public.

A building survey should be undertaken of the Grade II Listed Engine House, Boiler House, wheel-pit, and adjacent chimney (Sites **52**, **53, 65** and **68**) to provide a mitigative record and a structural survey report would be needed to advise on any consolidation work to the structures. Stabilisation of the wheelpit (Site **65**) should include half filling it with rubble to support it from future collapse. The concrete flue (Site **51a**) leading up to the chimney is fractured and is also a hazard, and it may need capping with concrete. There is little surface evidence surviving for the mine shaft (Site **127**) between the wheelpit and Engine House, and probing may be required to identify the structure/nature of any capping over the infilled shaft.

The area of the Engine House contains the most visible and, to the general public, easy to understand archaeological remains on the property. With the relatively high footfall of visitors passing through the area on Keldheads Lane this would be an effective location to locate an interpretation panel to explain the history and visible archaeology of the mines.

The fragmentary remains of the dressing floors (Sites **33** and **38**) are particularly important, and survive almost entirely as sub-surface remains covered with the fine silt waste. There is some potential future threat of dumping, earth movement and storage of materials from surrounding businesses in this area. The area should be demarcated and fenced off to protect the remains.

The New Smelt Mill contains some of most important archaeological elements surviving on the property, but they are in turn very fragmentary and fragile in nature and visibly little is exposed at the surface, with most buried under later quarrying spoil. There is a need to clear

tree cover on, and immediately surrounding, the structures/walls of the New Smelt Mill (Sites **75a**-**75d**) and on the individual condenser flues (Site **6g**).

The structural integrity of the culverted tunnel (Site **134**), carrying Keldheads Gill beneath the Smelt Mill, needs to be ascertained. Visible damage is limited to part OF an ore bin wall (Site **75a**), which has collapsed into the tunnel; any future collapse of this tunnel may lead to a backflow of water that may cause flooding and erosion of the site. Some consolidation works will be required of the north elevation wall of the ore bin. Unstable capping stones and side walls of some of the Condenser Flues channels (Sites **6f** and **6g**) will need removing or consolidating as they are a clear health and safety hazard.

Consolidation works should be undertaken upon the built structures of the Condenser House and Flue. An interpretation panel could be located at the junction of two footpaths and adjacent to the Condenser House. There is potential for a programme of community excavation and geophysical survey in the area of the Condenser House (Site **102**) and adjacent sunken building (Site **117**) to try to elucidate the chronology of structures on the site, and particularly to find surviving sub-surface elements of the Old Smelt Mill (Site **144**).

An assessment should be made of the hydrology of the water courses running through the property, as today water within the catchment area concentrates in a pinch point just north of the culverted tunnel under the New Smelt Mill. Future flooding may be an issue, as is the structural integrity of the tunnel itself.

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The desk-based research was undertaken by Helen Quartermaine and the topographic survey was undertaken by Peter Schofield, Jamie Quartermaine and Hannah Leighton. The report was written by Peter Schofield, Helen Quartermaine and Jamie Quartermaine, and the illustrations were produced by Anne Stewardson. The report was edited by Jamie Quartermaine, who also managed the project.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF THE PROJECT

1.1.1 Oxford Archaeology North (OA North) was invited by English Heritage (now Historic England) to undertake a detailed topographic survey of the lead mining complex of Keld Heads, Wensleydale (SE 0793 9077). The survey was required to inform a management plan for the scheduled monument; parts of the Keld Heads complex are scheduled (NHLE 1014763) and within the scheduled areas are two listed buildings: the Engine House and chimney (NHLE 1179229) and the peat store (NHLE 1130869). It is intended that the survey will provide the basis for a future programme of conservation works and site management. A project design was issued by OA North (*Appendix 2*) in response to a brief from English Heritage (*Appendix 1*). The brief required the provision of a documentary study, and Level 2 and Level 3 surveys (Ainsworth *et al* 2007) of the overall landscape, with more detailed surveys concentrating on the scheduled areas which have the greater complexity, including areas of the New Smelt Mill and Engine House complex. The survey was undertaken between the 20th January and 28th April 2015.

1.2 AIMS AND OBJECTIVES

1.2.1 The aims of the project are as follows:

i) Identify and gather sufficient information to establish the extent, nature, character, condition, quality, date, significance and functional relationships of the surviving archaeological and historical features within the survey area;

ii) Undertake a documentary study into the development of the complex based on primary and secondary sources;

iii) Undertake an archaeological survey at Levels 2 and 3 of the Keld Heads mines and Smelt Mill complex;

iv) Provide a basic structural assessment of the remains of the Keld Heads complex to be compiled in a report.

1.3 LOCATION, TOPOGRAPHY AND GEOLOGY

1.3.1 ***Location:*** Keld Heads Lead Mine and Smelt Mill are to the east of Preston-under-Scar and north-west of the village of Wensley, both in Wensleydale. The mine exploits the natural features of the geological fault running south-south-east to north-north-west directly below Preston-under-Scar, the water of the Keldheads Gill and the deciduous woodlands around. The study area has been divided into four areas: A, B, C and D as defined with the project brief (*Appendix 1, Fig 2*). Area A is the southernmost part of the study area, and comprises an area of spoil heaps, and formerly was the site of the dressing floor. Area B was immediately to the north of Area A, and comprised the main adit, and associated workshops, the water wheel and the later Engine House and Boiler House. Area C was a small area of shafts to the east of the Smelt Mill. Area D comprised the northern part of the study area and

included the complex of water systems, the Smelt Mill, the lower part of the Condenser Flue and the Condenser House.

1.3.2 ***Geology:*** this area of Wensleydale was formed from the Carboniferous rocks of the Yoredale series and Millstone Grit; on the eastern edge was Permian Magnesian Limestone including Main and Undersett limestone. The Yoredale strata comprised limestone, shale and sandstone; faults within the limestones were filled by molten minerals, including lead, galena, barytes, zinc and silver, to form the veins (Raistrick 1975, 11-3). The lead veins (within the Main and Undersett Limestones) are to be found on the north side of Wensleydale and Swaledale (www.nmrs.org.uk/mines). From Swaledale, the Crina Bottom vein extends south-south-east into Wensleydale to become what was later known as the Chaytor Rake (Raistrick 1975, 11-3), and the Keld Heads vein was part of the Chaytor Rake (Spensley 2014, 186). Superficial deposits were of Devensian-Diamaction Till and sand and gravel deposits, derived from post-glacial meltwaters (www.bgs.ac.uk).

1.3.3 ***Historic Land Character (HLC) Analysis:*** the HLC has highlighted three areas of interest: one is to the north of Condenser Wood, including the southern parts of Gillfield Woods recording the mixed coniferous and broadleafed woodland enclosed by dry-stone walls (HER HNY 3644). To the east of Thowker Wood is an area of post-medieval plantation of broad leaved species in an area defined by dry-stone walls; this area had previously been an area of sporadic lead mining (HER HNY 3667). The third area of interest was the fields to the north of Thowker Wood and east of Tullis Cote Farm which demonstrated piecemeal enclosure of medium-sized regular square fields enclosed by dry-stone walls, and were probably of post-medieval origin (HER HNY 3668).

2. METHODOLOGY

2.1 INTRODUCTION AND PROJECT DESIGN

2.1.1 ***Project Design:*** a project design was submitted by OA North (*Appendix 2*), in response to a project brief by English Heritage (*Appendix 1*), and was used as the basis for this investigation. This required that the survey area of the Keld Heads lead mining landscape be subject to a detailed survey at Levels 2 and 3 (Ainsworth *et al* 2007). Following that, a report was required to provide guidance on the conservation and consolidation of the landscape and buildings. The project design was adhered to in full, and the work was consistent with the relevant standards and procedures of the Institute of Field Archaeologists, and generally accepted best practice.

2.1.2 The work programme was divided into three elements: documentary research; detailed field survey; and reporting, and the study was as defined within the attached mapping (Fig 1; *Appendix 2*).

2.2 DOCUMENTARY STUDY

2.2.1 The aim of the documentary study was to collate new information from various sources, and to develop a documentary archive for Keld Heads Lead Mine which will inform the Historic Landscape Survey. The desk-based assessment was carried out in accordance with the relevant Institute for Archaeologists and English Heritage guidelines (IfA 2012a; IfA 2012b; English Heritage 2006a; Heritage 2006b.

2.2.2 ***Documentary and Cartographic Material:*** the data generated during the desk-based study served as a guide to the archaeological potential of the study area, and provided a basis from which historical narratives for the site could be constructed. An archive search of the full range of potential sources of information was undertaken for cartographic and documentary records relating to Keld Heads lead mines. The work involved visiting the North Yorkshire Records Office in Northallerton to search for primary records and mapping relating to the property, together with relevant secondary published sources. Relevant documents included plans, maps, copies of articles, photographs, and unpublished manuscripts. In addition, published secondary sources were consulted that assisted in the understanding of past land-use, and industrial activity on the estate. Mike Gill provided considerable, and much valued, advice as to pertinent information and sources available for the site. OA North has an extensive archive of secondary sources, as well as numerous unpublished client reports on work carried out both as OA North and under its former guise of Lancaster University Archaeological Unit (LUAU); these were consulted where relevant.

2.2.3 A search was made of all pertinent records from the North Yorkshire Historic Environment Record (HER) database to establish the sites of archaeological interest already known within the study area. This included a number of client reports on surveys undertaken within the environs of the study area (*Section 2.2.4*). A gazetteer of sites was compiled based upon cartographic sources and the HER database (Figs 10-33; *Appendix 3*).

2.2.4 ***Sources:*** information for Keld Heads Lead Mine is detailed in the Scheduled Monuments listing online and HER data held by the North Yorkshire County

Council. The Peat Store and Lead Mine Buildings are also Listed Buildings Grade II. Atkins Heritage Report on the *Keld Heads Options Appraisal for English Heritage* written in 2012 was studied. Online sources were accessed including the Northern Institute of Mining and Mechanical Engineers and the Northern Mines Research Society (NMRS). The NMRS was consulted regarding records held by them, as well as publications and notes on areas of survey that are as yet unpublished. Archives and maps from the Bolton Estate Collection, and maps and plans relating to Mining at North Yorkshire County Record Office were examined. Aerial Photographs, in particular the Meridian North Riding Vertical survey of 1971-3, were also examined. The historic OS maps were studied for the years 1856, 1891-3, 1895, 1913, 1919 and 1953-58. Secondary sources were consulted, including articles published by the Northern Mine Research Society, Northern Cavern and Mine Research Society and the Northern Institute of Mining and Mechanical Engineers. Books and articles written by RT Clough (1962), MC Gill (1992), A Raistrick (1975), R Smith (1998), and I Spensley (2010) were enormously useful.

2.2.5 Archaeological investigations touching Keld Heads Lead Mine and Smelt Mill have included the Archaeological Assessment of *Keld Heads Smelt Mill Flue* by The Archaeological Practice in 1995 (TAP 1995; HER ENY 6651). The Wensleydale Water Pipeline was monitored by Northern Archaeological Associates as a desk-based assessment in 1997 (NAA 1997; HER ENY 3418), and a Watching Brief in 1998 (NAA 1998; HER ENY 3446). Atkins Heritage produced a *Keld Heads Mill and Mine Complex Options Appraisal* in 2012 (Atkins 2012; HER ENY 6990).

2.2.6 ***Aerial Photography:*** aerial photography of those parts of the site that were not obscured by trees was undertaken using an Unmanned Aerial Vehicle (UAV). Additional vertical aerial photography was provided by the National Monuments Record (NMR).

2.3 TOPOGRAPHIC SURVEY

2.3.1 The topographic survey was undertaken by a process of photogrammetry and EDM tacheometry using a total station for those areas where the archaeological features were obscured by vegetation, which was most of the study area. The area of spoil heaps in the southern part of the study area, and the area around the Engine House were recorded initially by photogrammetry using images taken from a UAV and the peripheral areas that were obscured by vegetation were recorded with a total station.

2.3.2 ***Survey Control:*** a local survey grid was established as control for the photogrammetry using a survey grade Leica 1200 differential Satellite Global Positioning System (GPS). The 1200 series GPS was able to provide real time accuracies of +- 0.02m. Visible survey control markers were placed on the ground for the aerial photogrammetry. The GPS was able to provide control within much of the wooded areas, but in some areas, the woodland canopy was too dense to enable a reliable GPS fix and, in these instances, the control was established by traverse using a total station.

2.3.3 ***Photogrammetric Modelling:*** the ground plan of the open areas, which included the southern spoil heaps and the area between the Engine House and adit, were modelled by photogrammetry using aerial photographs taken from an Unmanned Aerial Vehicle (UAV), which is a small multi-rotor helicopter.

2.3.4 Photogrammetric processing was undertaken using Agisoft software which provided detailed modelling using an overlap of up to 200 photographs, leading to the creation of a very detailed DTM (Digital Terrain Model) across the site. The photographs were then digitally draped over the model to create an accurate three-dimensional representation of the ground surface. The primary output, however, was an accurate two-dimensional image that was used to provide plan information. In addition, precise 100mm contour information was generated from the primary DTM using ArcGIS, and served to inform the establishment of hachure information for the topographic survey (Figs 10-33). The contour information and orthophotos served as the basis for the draughting of the site.

2.3.5 The drawings were created within an industry-standard CAD package (Autocad 2004) and were then enhanced and annotated to show the form and location of all structural features of historic significance. The contour mapping of the photogrammetry was combined with contouring from LiDAR and superimposed on the archaeological results (Figs 34 and 35).

2.3.6 ***Total Station Survey Mapping:*** where topographic features were within woodland there was a need to use a total station to map the features in order to satisfy the Level 2 and 3 survey requirements. Archaeological earthworks were recorded using a Leica 805 total station linked to a pen computer running TheoLT software. The total station was tied to a running traverse that extended over the extent of the site and between GPS established control points. The pen computer generated a drawing on site within Autocad and was combined with the drawing detail obtained by the photogrammetry. The archaeological detail was drawn up in the field as a dimensioned drawing on the plots with respect to survey markers. On completion of the field survey, the drawings were enhanced within a CAD environment to produce the final drawings.

2.3.7 The survey recorded all pertinent archaeological detail, the internal detail of any structures, the changes between different grades of spoil, and any detail pertinent to the operation of the mines and Smelt Mill.

2.3.8 ***Photographic Record:*** a digital photographic archive was generated in the course of the field project using a digital SLR camera with 16 megapixel resolution. The photographic record comprises landscape and detailed photography. All photography was recorded on *pro-forma* sheets showing the subject, orientation and date.

2.3.9 ***Site Description:*** a descriptive record of each of the individual built elements and monuments that make up each of the wider mining and smelt complexes was created. The data was directly input on site into a palm computer and was incorporated into a Microsoft Access compatible database. The input into the system was guided by a *pro-forma* to ensure uniformity and consistency of input.

2.4 REPORT AND GAZETTEER OF SITES

2.4.1 ***Reporting:*** the present report identifies areas of defined archaeology, together with an assessment and statement of the actual and potential archaeological significance of the material, within the broader context of regional and national archaeological priorities. Information concerning the sites of archaeological interest within the study area has been collated into a gazetteer (*Appendix 3*) and the position of each site is indicated on Figures 10-33.

2.4.2 ***Condition and Recommendations:*** the condition of all the monuments and features was assessed, and areas of particular management concern were highlighted. Recommendations for the repair, consolidation, and long term maintenance of the heritage resource have been proposed.

2.5 ARCHIVE

2.5.1 A full archive has been produced to a professional standard in accordance with English Heritage guidelines (2006a) and the *Guidelines for the Preparation of Excavation Archives for Long Term Storage* (UKIC 1990). The project archive represents the collation and indexing of all the data and material gathered during the course of the project. The archive will be provided to the Northallerton Record Office and digital copies will be provided to North Yorkshire County Council and Historic England.

3. HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

3.1 INTRODUCTION

3.1.1 Keld Heads Lead Mine is designated a Scheduled Monument (NHLE 1014763), divided into two distinct areas. To the south is the area of the lead mine, the entrance to the lead mine and dressing floors, which are at the base of scar slopes, and to the north is the lead smelting mill. At the mine, extant buildings include the Engine House, the chimney, the workshops and the wheelpit. The bouse teams and complex of dressing floors, a mechanised process for the sorting, crushing and washing of the ore, were to the south and survive as degraded earthworks. To the north the Smelt Mill is largely overlain by quarry spoil, but there is an extant substantial condenser flue which extends northwards for a distance of 3.3km. The southernmost 250m of the flue is included within the scheduled area as are the foundations of the Condenser House along this section of flue. The Condenser House had a water wheel that drew fumes along the flue from the Smelt Mill to the south and the heavier particles in the fumes, which would have contained lead deposits, were condensed in Stokoe Condensers by the flow of water. The wheel-pit survives, as do a pair of settling tanks. Further north was a large reservoir *c* 80m wide, which provided water for the operation of the Smelt Mill and Condenser House. There is a complex water management system flowing in leats, canalised becks and dams (some of which are silted up). A peat store survives as a substantial building, which is now roofed with corrugated iron. For a short period of time silver was also extracted at the mine in small quantities.

3.1.2 Keld Heads was one of a number of lead mines in the region that were developed in the nineteenth century, the lead extracted and then the mines closed when they were no longer profitable. However, at Keld Heads as well as the early enthusiasm, investment and determination to make the mine succeed, innovative new technologies were incorporated both at the lead mine and the Smelt Mill. These included deep below-ground shafts and extensions, the use of steam engines to drain the underground workings, the sequential layout of mechanised dressing floor operations, as well as advanced ideas for the extraction of lead and silver at the Smelting Mill, Condenser House and its flue (Atkins 2012, 16-7). The intensity of the enterprise and the number of employees at both mine and smelting mill would have had considerable impact on the local communities in the middle of the nineteenth century.

3.2 HISTORICAL BACKGROUND

3.2.1 ***The Bolton Estate:*** Preston-under-Scar was a township of Wensley held by the de Preston family in the thirteenth century eventually coming into the ownership of Richard le Scrope of Bolton in the fourteenth century (Page 1914, 268-80).

3.2.2 ***Mining and Smelting in the Medieval Period****:* documentary evidence provides references to lead mining and lead smelting in Wensleydale that suggests that lead extraction was being undertaken on the monastic and manorial estates and farms. Miners and smelters may have been itinerant workers working on limited mine outcrops or shafts and temporary smelting installations (Spensley 2010, 172-4). The

'Merchants' cited may have been the miners heading small operations or perhaps groups of men who co-operated in financing larger ventures (*ibid*).

3.2.3 Mining and smelting was certainly being undertaken in the area of Preston-under-Scar in the early fourteenth century. In 1302 there was a payment required from Thomas Barn of Preston-under-Scar for 135 stones of lead. The lead may have been mined close to Keld Heads as there was a bale smelting site being worked there (Spensley 2010, 174, referring to research by R Smith). Bale smelting sites were windblown hearths that were sited strategically in the draught of hillsides and were built and used until the post-medieval period, when Smelt Mills with ore-hearths were used (Gill 1992, 112). In a document of 1307 a lead merchant was named as Thomas Fitz-Richard of Preston-under-Scar (Spensley 2010, 174).

3.2.4 Fieldwork has demonstrated that there are numerous small shafts and spoil tips in Condenser Wood and its environs, which may indicate mining exploitation within the medieval period or during the post-medieval period (Atkins 2012, 11; *Section 4*).

3.2.5 ***Post-Medieval Lead Mining and Smelting on the Bolton Estate:*** in the sixteenth century mining was undertaken on the northern side of Wensleydale on the Bolton Estate under Lord Scrope, possibly at Wet Groves Mine near Woodhall (east of Askrigg) (Spensley 2010, 177). By the 1650s the Cobscar vein (just to the north-west of Keld Heads) had been discovered (*op cit,* 179). The Cobscar Rake extends east to west from Apedale Beck (Smith 1998, 42).

3.2.6 The mine would have needed access to Smelt Mills for the processing of the lead ore, and in the sixteenth century to early seventeenth century there was thought to have been a smelting mill on the Bolton Estate, but the location of this is, as yet, unknown (Spensley 2010,178). It is likely that the Smelt Mills would have been sited close to abundant sources of wood (charcoal) or peat fuel, as well as close to the areas of mining exploitation.

3.2.7 The old Preston Smelt Mill was perhaps built *c* 1650 to 1655 and 'may have been built ..... to smelt the ore from Cobscar [Mine]' (*op cit*, 178; 84). Such a building may have been instigated by Charles Powlett who had married Mary Scrope of the Bolton Estate in 1655 (he became Duke of Bolton in 1689) and who was very interested in the development of mining in Cornwall, Weardale, Swaledale, as well as Wensleydale. He encouraged the mining of Cobscar vein and also mining at Keld Heads and Wet Groves, although these latter two were smaller-scale ventures (*op cit*, 178-9).

3.2.8 The detailed location of the old Preston Smelt Mill, or, as it is also known, the Old Keld Heads Mill, has been identified from eighteenth and early nineteenth century estate maps, and meticulous fieldwork, as being on the site of the Condenser House wheelpit (at NGR 407782 491175) (Gill 1992, 115; Gill pers comm; Smith 1998, 59-61; www.nmrs.org.uk). The Old Smelt Mill was a complex with three hearths as indicated by two eighteenth century plans (*Section 3.3;* Plates 1 and 2) (ZBO (M) 1/1 1723; ZBO (M) 5/1 1778).

3.2.9 The Cobscar vein was very productive and, in addition to the Old Preston Smelt Mill already built, two New Smelt Mills had to be built in *c* 1664, close or adjacent to the Old Mill of 1650-5 (Spensley 2010, 178; 84). A reference in 1664 suggests that the first mill was then called the Old Mill and was on higher ground, with the new mills of 1664 being called 'New Mill', and was on lower ground than the Old Mill, and 'Low Mill' which was even lower. These were collectively known, by the eighteenth

century, as Preston Mill (*op cit*, 181) and subsequently as Old Preston Mill or Old Keld Heads Smelt Mill. However, there was also a Preston Mill marked on OS maps, located west of Tullis Cote, which was shown as a corn mill on the historic OS maps (Smith 1998, 42). It 'is now a cluster of cottages around Preston Corn Mill' (Raistrick 1975 Vol 2, 57); the house itself was dated to 1784 and the mill was of three storeys (EH, Listed Buildings 1130870); despite the proximity to Tullis Cote, and the name there is no indication that this corn mill ever served as a smelt mill. A lease of 1665 for the farm at Tullis Cote mentioned the exclusion from the lease of 'the Lead Mills' and 'liberty to sink for coal or lead' on the lands held by Tullis Cote (ZBO IV 7.0378).

3.2.10 When the mining of ore at Cobscar became more difficult in the 1670s, the Marquis advertised for miners or 'other maintainers of lead to test and work lead within my manors' on leases of 'two meres of ground' within any of his manors (excepting Marricke) (Spensley 2010, 179). The mining at Keld Heads was documented only in 1663, but Wet Groves Mine continued to be mined during the eighteenth century (*op cit*, 186-7). There may have been small-scale mining at Keld Heads in the eighteenth century but documentation for this has not been noted, and it is likely that the mine had been abandoned throughout this period (Spensley 2014, 102).

3.2.11 In 1759-60 William Chaytor continued the development of the Cobscar Mine, also driving the Chaytor Rake at this date (Spensley 2010, 185). The Chaytor Rake extended from the north to the south from Swaledale to the River Ure (Smith 1998, 42). The Cobscar Rake and Chaytor Rake met just east of Cobscar Smelt Mill, which was sited, in 1762-3, to meet the needs of both veins (Smith 1998, 42) as apparently the Old Preston Smelt Mill needed refurbishment in 1762 (Spensley 2014, 181). The Old Preston Mill was noted and marked as *Smelt Mill* on maps of 1723 and 1778 (Smith 1998, 60). It seemed as though the Old Smelt Mill was working again temporarily in 1781-3 when ore from Braithwaite was smelted there (Spensley 2014, 181). By the time of the plan of Lord Bolton's Mines, in 1828 (ZBO (M) 13/6), it was marked as 'Old Smelt Mill'; a similar plan of 1851 showed that the Old Smelt Mill was still standing (Gill 1992, 115; Smith 1998, 59-61).

3.2.12 ***Lead Mining in the Nineteenth Century:*** the earliest mention of mining at Keld Heads in the nineteenth century was in 1805 when a more concerted campaign was begun by Thomas Orde, Lord Bolton, to explore the veins of Chaytor Rake in this area. There had been little interest at Keld Heads until Henry Calvert the mineral agent began trials in 1805 on the vein near the old Preston Smelt Mill, opening Calvert's Level. Good results were recorded in 1807, but it is not known for how long the mining continued (Spensley 2010, 189-90). In the 1820s the mine was in production under Frederick Hall (*op cit*, 190); Calvert's Level and Dent's Shaft were worked until *c* 1823 or later. Dent's Shaft was close to where the Condenser there was later built (Spensley 2014, 187) but the location of Calvert's Level has not been identified during the present documentary study. A new level was driven but this was not productive after 1828 (Atkins 2012,12) and Keld Heads was probably abandoned *c* 1828 (Spensley 2014, 30 and 188).

3.2.13 In 1843 a new company called Tattershall and Co. was set up to manage the mine at Keld Heads and was able to locate substantial ore deposits (Atkins 2012, 12; Spensley, 2014, 104). By the 1850s the mines were substantially increasing production, under the new owners, the Keld Heads Mining Company. This increased production must have overstretched the capacity of Cobscar Smelt Mill (where the

Keld Heads ores were being sent), and by the 1850s extra smelting capacity was being provided at Keld Heads by the Keld Heads Mining Company. The construction of a new smelter (*Section 3.2.18*) located closer to the mining operations would save on transport costs (Gill 1992, 115; Atkins 2012, 12; Spensley 2014, 189).

3.2.14 Both Keld Heads and Cobscar mines became major industries in the area employing 186 miners, and, by 1855, this included 78 at Keld Heads Mine, 56 at Cobscar Mine, 10 on the Smelt Mill and 17 people on 'Engines etc' (Spensley 2014, 35 and 189). These numbers of people being employed would have had a large impact on the local economy providing local employment and bringing labour into the area. The numbers of builders, quarriers and labourers required in constructing and servicing the mines and smelt mills would also have been considerable. Local horse-breeders and cartiers would have gained extra income (Spensley 2010, 190) through the huge transport requirements. The railway had arrived at Leyburn (from Northallerton) by 1855 and had reached Hawes by 1878. In the latter years, the Keld Heads Mine had a yard at Wensley Station (Spensley 2014, 41; Flynn 1999, 109).

3.2.15 At this time the dressing floors at Keld Heads mine were also laid out as a complex, innovative and highly mechanised operation. A detailed account of this was reported in the Ripon and Richmond Chronicle in 1857, entitled 'Improvements at the Keld Head Mines' (Spensley 2014, 63-4). The ores had to be selected, washed and crushed and at Keld Heads there was an assembly line of processes on a raised floor; presumably, this allowed for the drainage of the water via sludge pits. The process began with transporting the ores from the mine exit in wagons on a tramway to a platform from where it was tipped into hoppers and washed with water. The ores then entered the crushing mill, operated by a large water wheel, beginning with coarse crushing, and continuing to be crushed into finer grades before the ore was finally dropped through a grid or sieve. The resulting grit or powder was carried to the Hotching Tubs for further washing and agitating (*ibid*); in addition to the dressing floors there were circular buddles for the final washing and agitating. The processes were depicted very clearly on the 1866 map drawn up for the railway company (ZBO (L) 19, 1866), and can be related to the OS map at 1:2,500 drawn up in 1891-3 (*Section 3.3.21*). The maps show that the ore was stored in the bouse teams by the entrance to the mine, and this is where the ore was presumably washed, before being transported to the water wheel-driven crushers, thence to the Hotching tubs and for further refinement to the buddles (Spensley 2014, 62-4). The finer ores allowed for greater sophistication in smelting techniques and this was reflected in the new technologies at the Smelt Mill (*op cit*, 105).

3.2.16 It is not certain when the water wheels were superseded by the new steam engines, but in 1856 a condensing engine was purchased for Keld Heads Mine and in 1859 two engines were recorded at Keld Heads (one of which may have been at Cobscar). However, in 1863 reference was made to only a single water wheel. The horizontal steam engine and winding engine were installed into the new engine shed in 1878-9 (Gill 2000, 84).

3.2.17 By 1865 there were many small mines in Wensleydale making a total output of 1,419.6 tons per annum, but Keld Heads Mine was reported as producing the greatest amount of lead (*c* 1,200 tons per annum), whereas other lead mines were less profitable (Flynn 1999, 37-8). However, it was reported in 1863 that production at Keld Heads was beginning to fall with difficulties being apparent by the 1870s (Spensley 2014, 192).

3.2.18 ***Lead Smelting in the Nineteenth Century:*** the new Keld Heads Smelt Mill (*Section 7.1*) was probably built *c* 1851 by the Keld Heads Mining Company (Smith 1998, 43; Gill 1992, 115). The indenture of 1854 also stated that there was a 'Roasting House, Metal House, Ore Bins, Coal, Coke and Soot Houses.... Agent's House and Office, the Surface Agent's House and Garden.... Out Houses and Premises belonging to the Engine House, Workshops and Other Buildings' (Smith 1998, 44).

3.2.19 The Smelt Mill also had a 'patent Condenser House in Gill Plantation and a horizontal chimney up to the old Cobscar Smelt Mill' (Smith 1998, 42), which was required to draw the poisonous and corrosive sulphurous fumes far above the good farmland in the vicinity of Keld Heads (Raistrick 1975, 14). It was to be a very long flue, and by 1859 was built to a length of 3.3km (Gill 1992, 115). Part way along this flue a Condenser House had been built by 1852 (Spensley, 2014, 193) and the Stokoe Condensers were installed within it in 1862 (Gill 1992, 115).

3.2.20 The plan of 1866 (ZBO (L) 19, 1866) showed that there were five flues flowing from the north end of the Smelt Mill buildings into the main Condenser Flue (Figs 3 and 36). Raistrick identified the flues on the north side of the Smelt Mill buildings which eventually joined into two flues 'by placing a wall parallel to the west wall of the original flue as far as the Condenser House'; from there it continued as a single main flue (Raistrick 1975 Vol 2, 102). The number of flues installed gives an indication as to the number of hearths operated by the Smelt Mill, and it has been concluded that there were probably two roasting furnaces, four ore hearths and one slag hearth (Smith 1998, 48). In a building to the east of the Smelt Mill was one of the roasting hearths and a sixth flue exited from this (Gill 1992, 115); a seventh flue could be observed on the 1866 map leaving the west side of a north/south extension of the Smelt Mill (ZBO (L) 19, 1866).

3.2.21 The roasting hearths were installed in an effort to make the roasting and smelting gases less polluting and the ore was smelted in these prior to the main smelt in the ore hearths. The ore hearth produced a grey slag, which still contained some lead and thus the ore slag was re-smelted in the slag hearths using coke as the fuel and used a stronger blast of air (Raistrick 1975 Vol 2, 14). This produced a black vitreous slag, but generally there was little slag produced overall, as 32 tons of ore would typically give 23 tons of lead (Raistrick 1975 Vol 2, 14-16).

3.2.22 The mining of the lead veins also found silver and Keld Heads was cited as producing silver in 1864-5, and between 1875 and 1881. The production of silver was a small part of the processing, and possibly was only done if the ore was particularly rich (Smith 1998, 46).

3.2.23 ***After the Closure of the Lead Mine and Smelt Mill:*** in the latter years of the mine operations, Thomas Dymond was the lessee (from 1880 to 1887), and the manager of Keld Heads Mine was John Ascough Rodwell (in 1887) (Flynn 1999, 46 and 88). During the later years of the 1880s the reserves of profitable ores eventually became exhausted; this in part reflected that the costs and difficulties of draining the mines for further exploitation were too great. The mine was therefore left 'standing' probably from *c* 1888 when a buyer or lessee for the mine could not be found, and then it was then actually abandoned in 1898 (Flynn 1998, 43 and 48).

3.2.24 With no ore being produced, it was inevitable that the Smelt Mill would also be closed, and the new smelting mill was probably closed in *c* 1884 (Gill 1992, 115-6); the condensing engine was put up for sale in 1886 (Spensley 2014, 193). By 1906 the

Smelt Mill and Condenser House were broken up (Smith 1998, 48). When the lead mine was closed the chimney adjacent to the Engine House was used to serve as a coal-fired electricity generating plant (Listed Building 1179229). In the early twentieth century the mine buildings at Keld Heads were remodelled, the red brick power house was built, and quarry waste was tipped onto the ruins of the Keld Heads Smelt Mill (Spensley 2014, 147). Aerial photographs from the English Heritage Archives demonstrated the extent of quarrying in the 1940s and 1950s in the areas of Keld Heads Mine and Smelt Mills. Quarrying to the west of Tullis Cote farmstead had begun by 1946, which ultimately covered part of the Smelt Mill.

3.3 MAP REGRESSION

3.3.1 ***Plan of Wensley and Preston showing Preston, 1723*** (ZBO (M) 1/1; Plate 1): this very early and detailed map shows the fields, closes, crofts and holmes with the place names Kell Heads, Tullis and Thocker (now Thowker Wood). At Kell Heads was marked the Smelt Mill with three buildings. From the dam to the north and flowing southwards were two leats; one of which entered into the small square building to the west and the second entered the larger northern east/west orientated building. The small square building to the west (Site **117**) is of interest as it is a building marked on the later eighteenth century maps and there appears to be also a building on this location on the maps of 1856 and 1866 indicating continuity of the structure. Numerous suggestions for the detailed location of the Old Smelt Mill (Site **144**) have been proposed and Mike Gill, for example has suggested that it is *c* 50m to the south of the Condenser House wheelpit at NGR 407777 491143 (Gill 1992, 115; Gill pers comm February 2015; Smith 1998, 59-61; www.nmrs.org.uk). However, in the light of the present survey, and by comparison with eighteenth and early nineteenth century estate maps, it would appear that it was beneath the later condensing house (Site **102**).

Plate 1: Wensley and Preston Estate Map - 1723 map (North)

3.3.2 ***A Plan of the Manor of Wensley and Preston, 1778*** (ZBO (M) 5/1; Plate 2)***:*** the map showed, a similar configuration of the three buildings of the Smelt Mill (Site **144**), the building to the west (Site **117**), the dam and the leats, as was found on the 1723 map. The field to the west was marked Kell Heads, and the beck flowing through the Smelt Mill was what is now known as Keldheads Gill; Tullis Cote farm and Croft were denoted to the south. Access to the Smelt Mill was along a track going northwards and east of Keldheads Gill from the east/west road to Wensley; this track continued up to Preston Moor and Leyburn Common. To the south of Tullis Cote no mining or lead mine entrances were indicated.

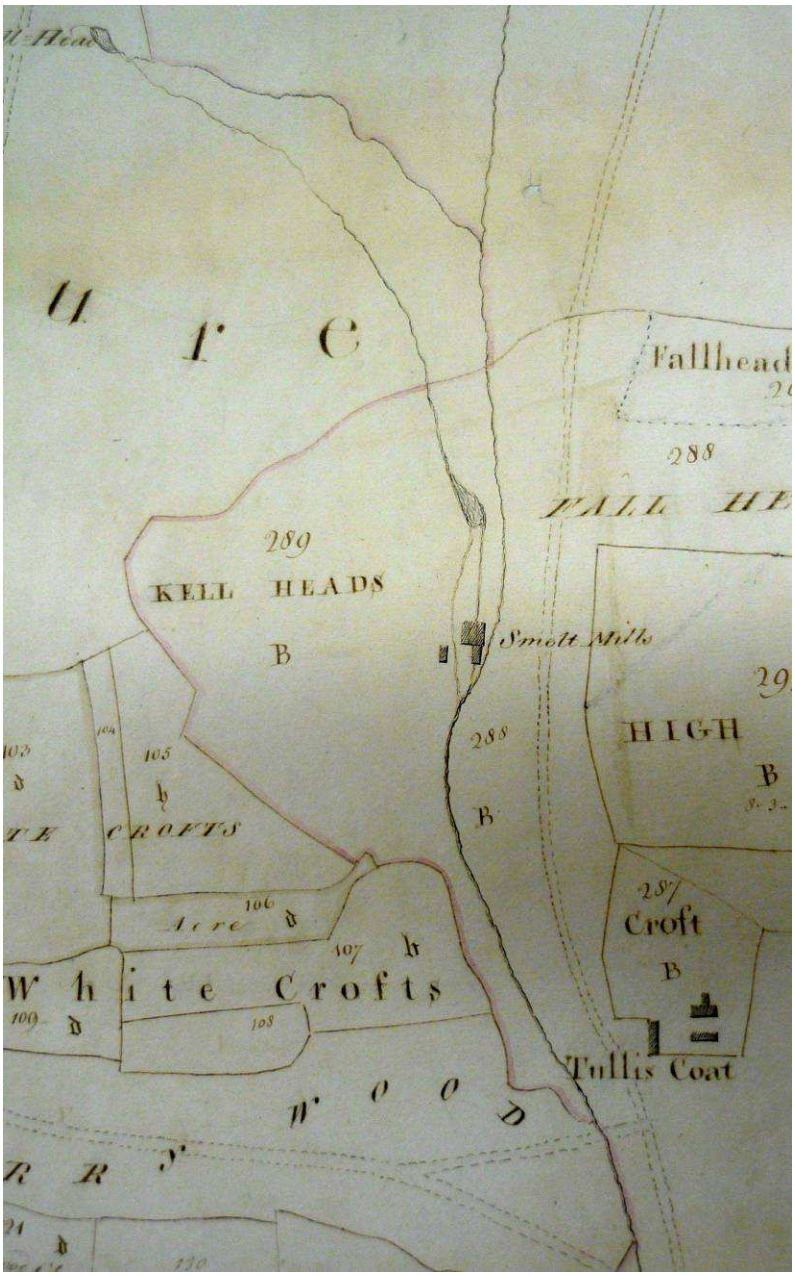

Plate 2: A Plan of the Manor of Wensley and Preston - 1778

3.3.3 ***Eighteenth century map from the Bolton Estate (Plate 3)***: an undated map, but probably of early eighteenth century date, also showed the early Smelt Mill as having three hearths and flues sited along one leat from the dam to the north. A second leat, to the west and also from the dam, goes east of an early structure (Site **117**).

Plate 3: Early eighteenth century map from Lord Bolton's Estate (after Atkins 2012)

3.3.4 ***A plan of Lord Bolton's Mines in Wensleydale, 1828 (Plate 4):*** this map denoted the 'Old Smelt Mill' as one small square building on the west side of a very straight Keldheads Gill. Tullis Cote farm had been developed with buildings remodelled and to the south was an area of woodland (presumably Thowker Wood) with Level Mouth marked underneath. The Cote Vein is marked as a dashed line (very faint) going very close to the Smelt Mill and then to the south-south-east to Tullis Cote and towards the name 'Level Mouth'. On this line was marked what were possible shaft mounds; six to the north-west of the Old Smelt Mill and three to the east of the gill and to the south-east of the Old Smelt Mill. No mine buildings are marked. The piece of woodland comprising Area C of the Study Area (*Appendix 1, Fig 2* (to the east of Keld Heads Lane) was shown only as mixed woodland. The road to the east of the Old Smelt Mill was shown as a walled trackway with a gate at each end (ZBO (M) 13/6).

Plate 4: A plan of Lord Bolton's Mines in Wensleydale, 1828

3.3.5 ***OS 1st edition map, 1856, 1:10,560 (Fig 2):*** the 1856 map depicts the development of the mine as it was at the time of surveying in 1853-54 during the initial phases of the works of the Keld Heads Mining Company (*Section 3.2.13*).

3.3.6 The southern part of the study area (Area A) is located in the field to the south of the complex of buildings associated with the entrance to the main lead mine adit (Site **55**). Its northern edge was defined by the southern edge of Thowker Wood; the southern edge of Area A was what used to be Wensley Brook. In the western part of Area A, the OS 1st edition map showed two small square buildings (Sites **43** and **125**) which were accessed and surrounded by six to seven paths or footpaths. These were all west of a north/south field boundary (Site **126**) and east of this was a curved track stopping at the southern edge of Thowker Wood. Along the southern edge of Thowker wood was a track (Site **132**). Area A also showed the entrance to a lead

mine (Site **55**), an airshaft (Site **127**), and two roofed buildings. To the west was depicted, but not labelled, a large rectangular building that was aligned south-west / north-east (Site **60**), which was the Agent's House (Spensley 2014, 62). This may have been associated with a very small unroofed building in the south-western corner of the field immediately adjacent to the Gill. In the most westerly corner of site A was a small rectangular feature. The small tongue of land to the north of Area B, but within Area A, comprised a parcel of deciduous woodland, that was bounded to the west by Keldheads Gill (a covered stream).

3.3.7 ***Areas B and C:*** to the north-west of the Air Shaft was the east/west orientated wheel-pit denoted as 'Walls' (Site **65**), with attached to its western end, two further walls to the north and west, possibly a leat. Area C comprised a small field of steeply sloping deciduous woodland north of Tullis Cote and east of Keld Heads Lane.

3.3.8 ***Area D*** is a large area in the northern part of the study area and includes the Scheduled Area around the new Keld Heads Smelting Mill and its buildings to the north associated with the Condenser Flue. This was also where the old Preston Smelt Mill (Site **144**) was located, which is now believed to be under the Condenser House (Site **102**).

3.3.9 The OS 1856 1st edition map marked the whole area as of being mixed woodland. To the south was the block of buildings forming the new Keldheads Smelting Mill, which included a large and long east/west building straddling Keldheads Gill (Site **75a**), on the east side of this were two small square structures (Sites **128** and **129**) and to the west was a square unroofed feature. Going into the west end of the larger long building was a leat carrying water which was supplied from two sources, a small round dam to the north (Site **90**) and a leat linked to two leats or canalised becks (Sites **22e** and **26**) from springs on the western side of the woodland. The reservoir itself was fed by a leat (Site **26**) from the area of Adit **19** to the north.

3.3.10 From the north face of the larger long building (Site **75a**) was the Condenser Flue (Site **6**), a long, slightly curved, horizontal flue (marked on the map as chimney) extending northwards to a chimney (Site **7**). Half way along the Condenser Flue was a long narrow condenser building straddling the flue (Site **102**), and just to its south-west was a squared roofed building (Site **117**). To the west was an unroofed, small, narrow, rectangular structure (settling pit) denoted as a 'pit' (Site **100**). At the northern end of the flue was an early chimney (Site **7**), and to the west were two shafts (Site **18**). Further north, close to the northern edge of Area D, was a larger shaft (Site **8**). Close to the northern edge of Area D on the Keldheads Gill was marked a dam (Site **145**).

3.3.11 ***Plan showing portion of the authorised and proposed lines of railway passing through the surface works of the Keld Heads Lead Mines, 1866 (Figs 3, 36 and 37):*** this map, drawn in the years after the 1st edition OS map of 1856 (ZBO (L) 19, 1866), show the buildings of Keld Heads Lead Mine, in Areas A and B and of the new Keld Heads Smelt Mill in Area D whilst they were in the period of full production.

3.3.12 *Areas A and B:* these areas had undergone considerable development as the mining operation, which had focussed on the workshops (Site **58**), the Agent's House (Site **60**), the water wheel (Site **65**) and the shaft or air shaft (on the site of the later Engine House (Site **66**)) to the north of the workshop in Area B. The Agent's House (Site **60**) had been remodelled and extended on its north-east face since the 1856 map. Close

examination of the map suggests that Site **64**, north of the Agent's House, was a Garden. The water wheel (Site **65**) was possibly driven by water flowing from the reservoir (Site **71a**) to the north-west (west of Tullis Cote Farm). The workshops (Site **58**) comprised a complex of around six buildings, rooms or halls, built onto each other, and part of this complex may have overlain the air shaft (Site **127**) and the mine entrance (Site **55**) that had been shown on the earlier 1856 map. South-east of the workshops was a small rectangular building adjacent to the tramway (Site **142**), which is no longer extant, having presumably been overlain by spoil heaps. Also in this area the map depicts a 'level' denoting the entrance to the adit, which is in the same location as the present-day mine entrance (Site **55**).

3.3.13 Further south in area A was an area of spoil heaps (depicted on the later 1895 map as sand, gravel and shingle) and dressing floors (Spensley 2014, 62). The mine level entrance (Site **55**) and workshops (Site **58**) in Area B seemed to have been linked to buildings and locations in Area A by a series of perhaps three or more tramways (Sites **138** and **133**), extending to either the dressing floors or an area of bouse teams. Closest to the workshops (Site **58**) was a yard containing bouse teams against a long retaining wall (Site **50**) located with a building or rooms in the south-west corner (Spensley 2014, 62). To the south was the building (Site **43**) marked on the earlier 1856 map, with an additional small square building to the east which terminates at one of the tramways. Again to the south, and served by a complex of tramways (Site **133**), was another larger yard (Site **134**), which was labelled as dressing floors and were surrounded by revetment walls as the spoil heaps were close by to the north and east. The yard was depicted as containing a series of machines or containers, which were the mechanised Hotching tubs with their own water wheel at the centre of the yard (*ibid*) and mechanised crusher (*Section 6*). Just south of this were three circular features (Site **135**), which were buddles. Two long lengths of tramways (Site **133**) extended to the east of Area A probably for access to the spoil tips.

3.3.14 In the south-west corner of Area A, by the edge of the gill, was a building within an enclosure (Site **30**), labelled as an Agent's House (Spensley 2014, 62) and which is now Keld Cottage and is just outside the Study Area. East of these was a small feature containing Brunton Buddles (Site **36**) (*ibid*). West of the Agent's House (Site **30**) and close to the gill was another water wheel (Site **29**) which was intended to drive flat rods (*ibid*) taking power to mines to the south of the study area. This whole complex of operations was contained to the east by a new field wall, which was not a boundary at the time of the OS 1856 map.

3.3.15 The small tongue of land to the north of Area B, but south of Area D, contained no buildings or features except for two walls at right angles to each other, and to the south of the reservoir (Site **71a**).

3.3.16 ***Area D:*** the Smelt Mill (Site **75a**) by this date comprised two main buildings; to the south was the east/west orientated building shown on the 1856 map and there was a similarly sized new, north/south orientated, building attached to the western side of the north face. The two smaller squared buildings to the east (Sites **128** and **129**) were still standing at this date. To the south-west was a new, long, narrow, building: the Peat Store (Site **73**). North of the Peat Store was a series of square features, perhaps containers or large bins, and north from the smelting mill was a series of perhaps three flues extending from the north face of the earlier east/west building with two flues emerging from the east side of the new north/south building. There was an additional flue from the small building to the east (Site **128**), which was

probably a roasting house for the initial smelting of the ores (Smith 1998, 54). A seventh flue was clearly marked as leaving from the west side of the new north/south extension building leading to the main Condenser Flue (Site **6**) (R Smith has suggested a total of seven flues (Smith 1998, 48).

3.3.17 A tramway (Site **91b**) also extended out from the western side of the north/south Smelt Mill building crossing the outlet from the dam (Site **90**) and leading north before dividing to go to two enclosures and two small square features (Sites **100** and **99**) with another tramway leading to Site **117** (south of the Condenser House). Site **100**, in 1856 was a rectangular square structure, and was in 1866 the soot settling pits for the Condenser House (Spensley 2014, 194); Site **99** was a very small reservoir or pond. The Condenser Flue (Site **6**) extended north through the woodlands, and half-way along it was the Condenser House (Site **102**). Building **117**, to the south of the western half of the Condenser House, was on the same location as the building to the west of the Old Smelt Mill on the three eighteenth century maps, including that of 1723 and 1778. There was an additional small square feature to the west (Site **116**) of the Condenser House not seen on the 1856 map but marked on this 1866 map; it's notation suggested that it was a dam and may have been part of the condensing process storing the lead-rich water from the adjacent Condenser House. In the northern part of Area D, to the west of the Condenser Flue, was a landscaped and revetted rectangular shaped reservoir (Site **28**), aligned east/west, and which marked the northerly point of the 1866 map. The area south of the Smelt Mill appeared to have been bounded by an east/west field boundary against which, on the northern face, were two enclosures of varying sizes and adjacent to one of these was a canalised stream (Site **71**) (coloured blue on the later 1895 map) flowing from the covered section of the stream beneath the Smelt Mill (Site **22e**) and then released into a reservoir (Site **71a**) to the south of the field edge and from there continuing southwards as the Gill.

3.3.18 ***Plan of the Ground leased by Keld Heads Mining Co. 1878 (ZBO (L) 21, 1878) (Fig 4):*** this map (Fig 4) also showed the levels in this area, the Ashbank Main Level extending north-west from east of Hellgill Bridge skirting west of the site of the Agent's House south of Area D, continuing into the Main Bottom Drift of the Keld Heads Level. Only the key buildings seem to have been marked, and excluded the network of flues, dams, leats and tramways and processes. The map appears to have drawn upon the base mapping of the OS in 1856 and may not show the full extent of the development of the 1850s and 1860s.

3.3.19 *Areas A and B:* it is of interest to note that the entrance to the Mine (Site **55**) is clearly marked on, just south of the air shaft and to the east of the workshops (Site **58**) and Agent's House (Site **60**). The Boiler House and Engine House were not depicted and were built in *c* 1879 after the date that this map was drawn (Spensley 2014, 62). From the entrance to the mine level (Site **55**) was another adit (not named) that extends north, underneath Tullis Cote farm buildings, and up to the Tullis Cote Shaft (perhaps airshaft), which was just south-east of the Smelting Mill.

3.3.20 *Area D:* the two parts of the main Smelting Mill building (Site **9**) were depicted, as was the Condenser Flue (Site **6**) and the smaller building to the east (Site **128**). Leading north from the north side of the east/west Smelt Mill building was the leat (Site **26**) stretching north to the dam (Site **90**), and this was fed by the long canalised stream coming out from the northern spring (Site **22e**); the Peat House (Site **73**) was also marked. The whole of the leat system (Sites **22e** and **26**) seemed to have been

delineated leading north from the Condenser House (Site **102**) and the chimney (Site **7**). Here, the two shafts (Site **18**) were marked, with the third main shaft (Site **8**) a little to the north.

3.3.21 ***OS map 1895, 1:10,560 and OS map 1891-3, 1:2,500 (Figs 5 and 6):*** the surveying for these maps took place in 1891 just three years after the mine's last manager had left and Lord Bolton was looking for another lessee. The mine had not been in full production for perhaps five years.

3.3.22 *Areas A and B:* in Area A the ore processing area (Spensley 2014, 62) was given less detail on the 1891-3 map than there had been on the 1866 map (*Section 3.3.8*). No entrance to the mine was depicted but the tramways ended at a place between the workshops and the Engine House that was presumably the adit entrance (Site **55**). The main tramways and aqueducts were clearly shown (Sites **133** and **138**) and the outline of the main yards (Site **48**) were depicted but few of the internal features. Site **33** had a different sort of mechanisation depicted than on the 1866 map and there were by this date only two (rather than three) circular buddles at Site **135**. The southern Agent's House (Site **30**) (now Keld Cottage) was still extant, and in 1891-3 the northern Agent's House and Garden (Sites **60** and **64**), and the workshops in Area B, were still in place. There had been new building since 1866 with the construction of the Engine House, built *c* 1879 (Spensley 2014, 62) and also the Boiler House. Just east of the workshops (Site **58**) was a tramway leading to a small building (Site **142**), which was on the western edge of the track dividing Area A and B. For the first time the chimney (Site **52**) was marked on the 1891-3 map as a tiny square underneath the scars or cliffs to the north of the site; this was marked on the later 1913 map as *Chy*. The small tongue of land to the north of Area B and to the south of Area D, had two walls marked to the south of the dam (Site **71a**).

3.3.23 *Areas C and D:* in Area C there are no marked or denoted features in this area of now mixed woodland, which in 1856 was deciduous woodland. *Area D* showed the development of the smelting mill since 1866 and 1878, and all of the buildings (Sites **75a**, **128** and **129**) were still extant at this date. The reservoir (Site **90**) to the north was marked. There was little other change or development of this part of Area D, except for the earlier two reservoirs (Sites **116** and **99**), close to the condenser building, which were no longer marked and may have silted up. The condenser building (Site **102**) still traversed the flue, and the building to the south (Site **117**) was also marked. The two springs on the north-west part of Area D, from which canalised leats had been developed (Sites **22e** and **26**) in 1856, were by 1895 meandering becks. The Condenser Flue (Site **6**) had (since the map of 1856) been extended and in 1895 turned east along the road at the northern edge of Area D, although then turning north, it continued as far as Cobscar Smelt Mill. The shaft (Site **8**) is marked, and the dam (Site **145**), denoted on the 1856 map, was not marked but in its place was shown a meandering quarry (Site **5**).

3.3.24 ***OS map, 1913, 1:2,500 and 1919, 1:10,560 - Areas A and B (Fig 7):*** Area A was depicted as an area of spoil (or sand, gravel and shingle) mainly on the north and eastern sides which are edged to the east by the field boundary. The buildings at Site **43** were still extant, but there was no record of the tramways or aqueducts, buildings, enclosures and workshops of the nineteenth century dressing floor, instead only the remainder of the north and west walls of the bouse teams (Site **48**) and the tramway (part of Site **138**) which ran adjacent to the buildings at Site **43**. Area B clearly showed the three larger buildings of the now disused lead mines, the Engine House

and Boiler House (Site **66**/**53**), the workshops (Site **58**) and the Agent's House and garden (Sites **60** and **64**); the buildings were still roofed. A small narrow rectangular structure, probably the wheel-pit (Site **65**), was to the north. The letters *Chy* on the 1913 map denotes where the Chimney (Site **52**) was marked, but there were no other new structural features shown. A photograph (Plate 5) shows the mine entrance with the Engine House in the background, and another one (Plate 6) shows the complex of workshop buildings (Site **59**).

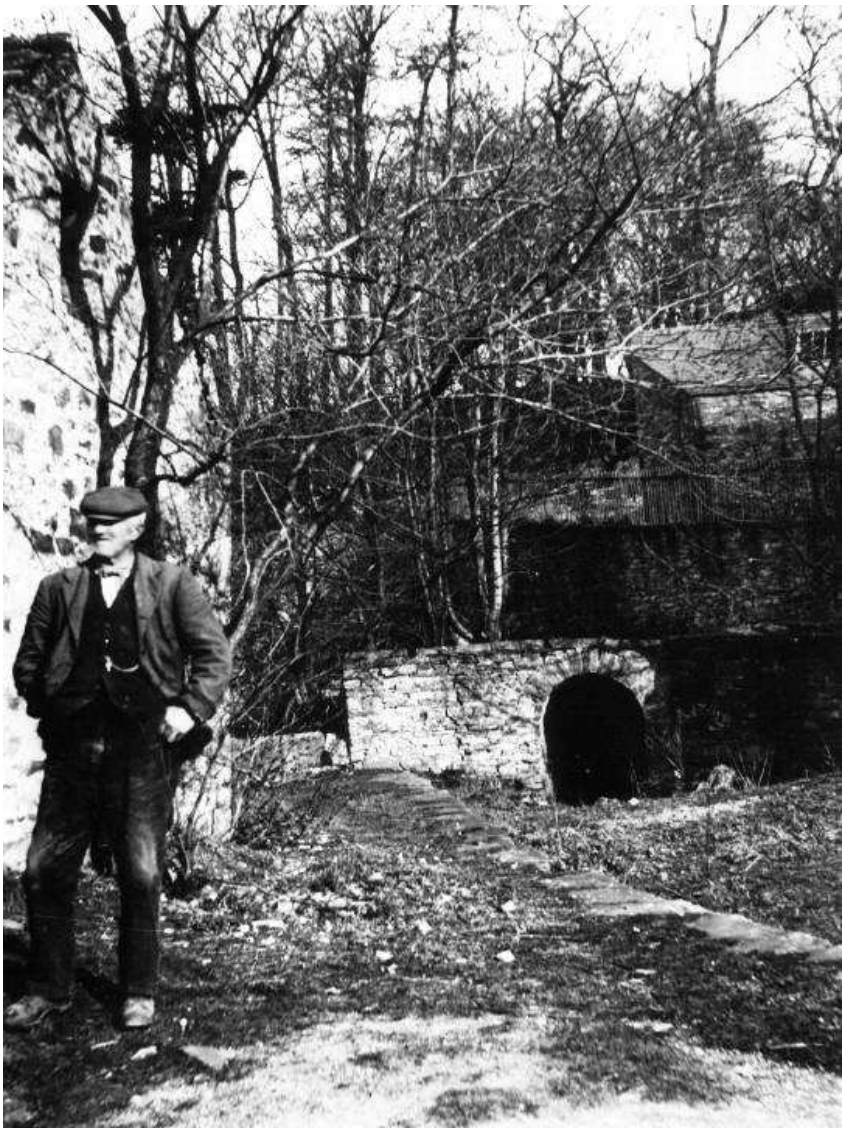

Plate 5: A photograph of the Mine Entrance survives from the James Backhouse Collection *c* 1908 of the mine entrance **NMRS photos**. The photograph is taken from approximately grid reference 40773 49110 and looks north

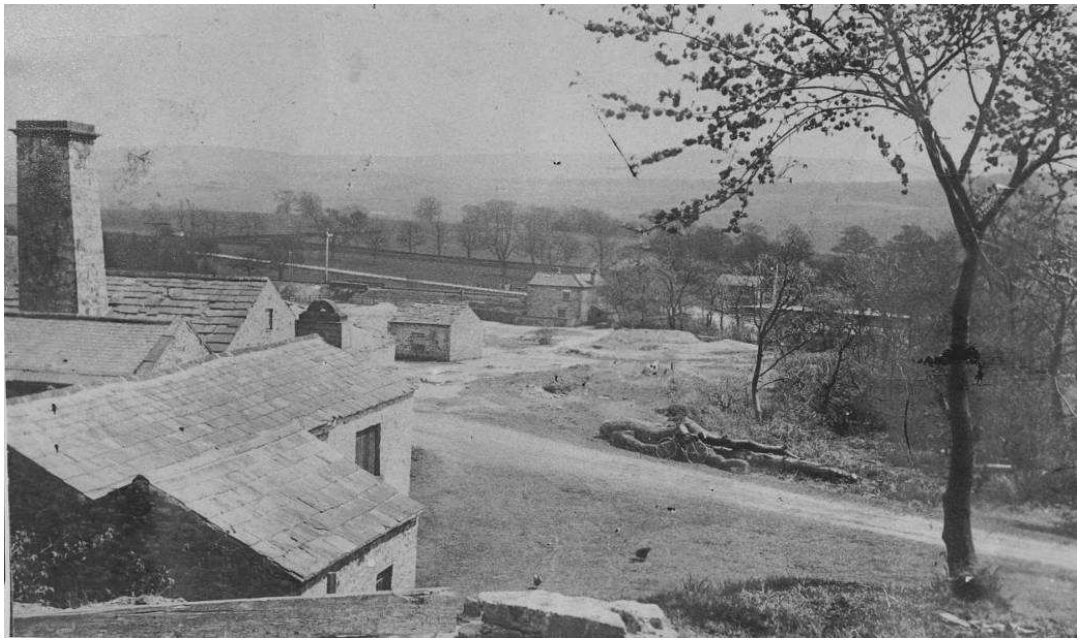

Plate 6: An unreferenced photo of the workshop buildings around the main adit and the dressing floors beyond (copy is held by the owner of Engine House Garage). The photograph is taken from approximate grid reference 40792 49076, and looks south-east

3.3.25 *Area D* depicted the buildings of the disused Smelting Mills (Sites **75a, 128, 129** and **92**), which can be seen in a photo of the RT Clough Collection (Plate 32). The Condenser Flue (Site **6**) was delineated and was still shown to continue beyond the road eastwards and then northwards. Only the eastern portion of the Condenser House (Site **102**) had survived and this can also be seen in a photo of *c* 1908 (Plate 50)**.**

3.3.26 By the road marking the northern edge of Area D, Old Shaft (Site **16**) was marked; the soot settling pits (Site **100**) were also marked but their associated workings (including the pond Site **99**) or the tramline (Site **91b**) leading to it from the south, were not shown; the reservoirs Site **90** and **28** were shown. The two leats on the western side of the area (Site **23**) were depicted as being less meandering than in 1895 (OS 1895 map), and were perhaps more controlled on the 1919 OS map.

3.3.27 ***OS map, 1953-58, 1:10,560, Areas A and B (Fig 8):*** Area A had been developed since the map of 1919; there was less spoil noted and a rail track or siding (Site **41**) was depicted going west into Area A, and stopping at buildings, Site **43**, and a new building to the north of the line (Site **140**). Outside of the eastern edge of Area A, and just to the north of the sidings, was a small squared unroofed feature. This was the southern terminus of an aerial ropeway that extended to the north-west over Area D. The mapping for Area B showed that the three larger buildings, with the exception of the Engine House, were roofed. No other changes were depicted.

3.3.28 *Area D:* showed no changes to the remains of the Lead Smelt Mill since 1913. The aerial ropeway (Site **141**) extended over Area D to an upper terminus north of Condenser Wood.

3.4 AERIAL PHOTOGRAPHY

3.4.1 Aerial photographs held by the NYCRO were consulted but there was no specific coverage of the study areas**.** Aerial photographs from the English Heritage Archive demonstrated the extent of quarrying in the 1940s and 1950s in the areas of Keld Heads Mine and Smelt Mills and showed the line of the aerial ropeway of the 1950s.

4. EARLY MINE ACTIVITY

4.1 THE SHAFT MOUNDS (FIGS 12, 13, 15, 17, 19 AND 34)

4.1.1 The survey of Area D revealed a line of shaft mounds orientated north-west/south-east extending along the main ore vein, which lay both west and east of the alignment of the Condenser Flue (Figs 9, 10 and 12). In places (Sites **111** and **88**), the contours of the shaft mounds were overlain by the flue, which had been built *c* 1854-6 (*Section 8.2.1*), and cartographic evidence has demonstrated that the line of shaft mounds was probably excavated and mined prior to 1828. On the 1828 estate map (Plate 4), on the denoted Cote Vein, a line of what were probably shaft mounds was marked; six to the north-west of the Old Smelt Mill and three to the east of Keldheads Gill and south-east of the Old Smelt Mill. (These were not shown on the earlier plans of 1728, 1778). The Cote Vein appears to have been part of what was later known as Keld Heads Main Level (Spensley 2014, 183).

4.1.2 The shaft mounds were possibly excavated and mined as early as the eighteenth century (Spensley 2010, 189) prior to their abandonment in this period; they were not shown on the 1778 map, and this may reflect that they were not in use at that date. Until the late eighteenth century ore was prospected and mined via a linear series of shafts dug down into the vein (Spensley 2014, 80). A miner or company of miners would take out a license to excavate their own *meer* or length of vein (in Wensleydale *c* 32 yards). All ore, waste and water would have been hand-winched up by a windlass; such a system was later developed by the use of wooden engines called 'whims' or 'gins' where a horizontal wheel could wind up the loads (Spensley 2014, 53-57). This linear group of shaft mounds, however, may have been excavated and mined as late as the first decades of the nineteenth century during Henry Calvert's and Frederick Hall's administration. Calvert began trials in 1805 on the vein near the Old Smelt Mill, opening Calvert's Level (stone lined) and Dent's Shaft (to the north of Calvert's level). Calvert's Level was 'in front of where the condenser was later built' (Spensley 2010, 189-90 and Spensley 2014, 30 and 187-188) (*Section 3.2.12*) but no further documentary evidence of where Calvert's Level was located has been found. Keld Heads mine was then abandoned *c* 1828. By 1856, when the 1st edition OS map was produced, only three of these shafts were known or marked, two close to the chimney (probably Site **18**) and the larger one to the north close to the field boundary (perhaps Site **8**).

4.1.3 The siting of the Condenser Flue along the earlier works of the shaft mounds may have been due to the geography of the woods or perhaps because there was already a well-used path or track from one shaft mound to the next.

4.1.4 ***Shaft Descriptions:*** four strands of evidence have been examined to ascertain the physical appearance of the shaft mounds: the contour survey, the walk-over field survey, its photographic evidence and the LiDAR mapping. The northernmost sector of the shaft mounds comprised Sites **10**, **8**, **18**, and **111**. Site **10** is the northernmost shaft mound, partially overlain by the enclosure wall, 21m x 18m in size, with a relatively deep sunken area of *c* 1m at its centre and mounded at its eastern edge (Plate 8). Site **8** (Plate 7) includes four shaft mounds within an area of 38m x 20m; the photographed shaft mound (Photos 8.1 and 8.2) had a deep sunken area of at least 1m and had a very pronounced mound around its shaft edge *c* 2m in height. Sites **10**

and **8** may have been open and worked in 1856 and 1878 as they are marked as *Shafts* on these maps (but not denoted as *Old Shafts*, which they were on the 1891-4 OS map). Perhaps during the second half of the nineteenth century they were kept open as airshafts. Site **18** had two shaft mounds in an area measuring 29.5m x 19m; Site **111** had four shaft mounds in an area of 31m x 22m.

Plate 7: Shaft Mound (Site **8**)

Plate 8: Shaft Mound (Site **10**)

4.1.5 There may be an indication of further shaft mounds on the southern end of this section, and just west of the main alignment and close to the Condenser House. There are remains of several large scoops (Sites **112**, **114** and **115**); one measuring 11.1m x 8.1m; and another two measuring *c* 19m x 7m. The siting of a reservoir (Site **116**) is also within this alignment, although it is small (8.6m x 7.3m), and is latterly part of the processes of the Condenser House in the 1850s. The LiDAR mapping, which showed many of the shaft mounds in this alignment, did not reveal similar delineations or any clear features in this area of scoops.

4.1.6 South of this section the area is taken up with the remains of the Condenser House and flue (Sites **6** and **102**), which may have obscured earlier shaft mounds. However to the east of the flue was found a further series of shaft mounds, perhaps including the remains of those indicated in the 1828 map. In the same alignment as Sites **10**, **8**, **18** and **111** were Sites **87**, **84**, **80**, **79** and **81.** Sites **87** and **84** are overlain by the track or lane and boundary forming the western edge of the square field to the east; this field is marked on the 1856 OS map but also on the 1828 map. This may indicate an a date for this part of the alignment of shaft mounds, during the eighteenth century or perhaps very early in the nineteenth century.

4.1.7 Site **87** was a small linear group of four shaft mounds in an area measuring 50m x 20.5m and overlain by enclosure walls; the spoil mounds were approximately 2m high (Photo 87.1). In the woodlands of the enclosure to the south (and in Area C) Site **84** comprised three shaft mounds in a linear area 34.5m x 18.5m on the slope of the hillside evidenced by a deep sunken shaft (Photo 84.1). In the same area, Site **80** comprised one shaft mound, 12.5m x 10m in size, whilst sites **79** and **81,** which were also single shaft mounds, were of a similar size: 17m x 14m and 15.4m x 10.8m respectively. Sites **80** and **79** had spoil mounds less than 1m in height (Photos 80.1 and 79.1) and were much disturbed by tree roots.

4.1.8 To the west of the southern section was a group of sites **86**, **88**, **77** and **78**, which were also very disturbed by the installation of the Condenser Flue and by the trackway to the east and the boundary for the enclosure of the woodland to the east. Site **86** was a small semi-circular scoop *c* 8.2m x 5.5m, and probably associated with a shaft mound. Site **88** was a small shaft mound, 9.5m x 8m in size. Sites **77** (Plate 9) and **78** were well-pronounced shaft mounds (and these show up well on the LiDAR mapping (Fig 34)) being 16m x 15.5m and 17m x 14m in size, with extensive spoil mounds on the downslope edge (Photos 77.1 and 78.1). It is not clearly understood why these shaft mounds were excavated away from the main alignment.

4.1.9 The LiDAR mapping (Fig 34) shows an extensive length of the alignment of shaft mounds corresponding to those recorded in the field survey. Most prominent were single shaft mounds within Sites **10** and **8** to the north of the alignment, Site **111** north-west of the site of the later Condenser House, and within sites **87**, **84** at the south-east end of the alignment. Also shown on the LiDAR were sites **77** and **78**, which were west of the line. The extensive size of their spoil mounds, as shown on the LiDAR mapping, might be an indicator that they were relatively deep or extensive shafts.

Plate 9: Shaft Mound (Site **77**)

4.2 THE ADITS AS EXTANT (FIGS 12 AND 15)

4.2.1 The drainage of the shafts was the most onerous problem and, by the nineteenth century, drainage adits were being driven into the hill to allow the water to flow out. Such adits were generally *c* 1m wide and 1.3m high (Spensley 2014, 58). By the early part of the nineteenth century larger tunnels, *c* 1.3m in width and *c* 2m high, were being driven into the hillside to both drain the mines and to transport material out, either by manual labour or horse pulling and these were known as 'horse levels'. These tunnels would have been large enough for a horse to pull wagons along rails (*ibid*). Both Henry Calvert and Frederic Hall, working at Keld Heads after 1805 and prior to 1828, would have worked with horse levels in their previous careers and it is likely that they would have had these driven at Keld Heads *(op cit*, 102). Calvert's Level was stone lined and perhaps used for extraction, but it is not known from the documentary evidence where this was sited. However, the field survey found three adits, Sites **16a**, **19** and **20** located within Survey Area D, that were perhaps an early group of adits (Figs 10, 12, 13, and 15). These may have been drainage adits and had narrow, stone-lined walled entrances (Photos 16a, 19 and 20) but relatively large spoil heaps are located close to the entrance, probably indicating that they may also have been used to extract and transport spoil and ore. The stone-walled arched and vaulted entrance to Site **16a** was *c* 1.8 m high but less than one metre wide and had flanking walls extending three to four metres outwards (Plate 10). Drainage was controlled by a metal sluice, part of which can still be observed (Photos 16a.1 to 16a.5). The leat from the adit curved to the west around the large area of spoil tips to the south (Photo 16b.1). The remains of Site **19** comprise the degraded walls of the two sides of the entrance with the whole tunnel being obscured by further collapse. The remains indicate an entrance height that was perhaps greater than one metre, and probably less than 1m in width (Photo 19.1 and 19.2). Site **20** has been modified by more recent water management features (Photos 20.1 to 20.3) and has embanked

wall foundations enveloping the adit mouth except downslope to the south. A wooden screen was placed on top of the adit mouth and a bypass channel had been cut above it to redirect a stream away from the opening. There were fittings for a metal sluice in the channel to the south of the adit.

Plate 10: Adit entrance - Site **16**

4.2.2 The LiDAR mapping shows clear delineations of adits **16a** and **20** and their spoil tips (Site **16b**) to the south with the built-up reservoir Site **28** further south. Sites **16a**, **19** and **20** are connected to well-developed drainage channels and this was probably the initial purpose of the adits. There are the remains of spoil tips covering a large area (Site **16b**) (Plate 11) and these would have been composed of spoil derived from the creation of a drainage adit and probably enhanced by material in the course of the extraction of ore. Such spoil tips may have been of considerable size and covering a large area; the absence of any further archaeological remains of extensive spoil tips might be explained by their subsequent removal to re-landscape and form the reservoir (Site **28**) on the south edge. The reservoir (Site **28**) was landscaped and constructed as a supply of the water for the Condenser House built *c* 1851-4 (Spensley 2014, 193; Smith 1998, 44 and 55). Thus it was later, after *c* 1854, that the adits and their leats would have drained around the newly constructed reservoir in a bypass channel (Site **17**).

Plate 11: Spoil tips at drainage adit (Site **16b**)

4.2.3 It is evident that the adits and outlying spoil tips reflect a later phase of development of lead mining at Keld Heads that post-dated the cluster of shaft mounds running along the main ore vein. It is also likely that the adits were opened as a part of the development of the mines in a phase prior to the extensive workings undertaken by the Keld Heads Mining Company in the 1850s. The main phase of workings were based further south at a single adit (Site **55**), where their dressing floors were also established in the 1850s and 1860s (*Section 5.1*). It could be suggested that the adits **16a**, **19** and **20** might date to the period of Henry Calvert's and Frederick Hall's administration, that is, from 1805 to the date of their abandonment in *c* 1828. These adit entrances are not marked on the estate map of 1828, nor on the OS map of 1856, or on the subsequent plan of the levels and drifts of 1878. Although these adits were no longer providing ore after 1828 the archaeological evidence indicates that they continued to be maintained as they provided a source of water that fed into reservoir 28 and was used to provide power for the smelt works and condenser (*Section 9.1.6*).

5. MAIN ADIT AND ANCILLARY STRUCTURES

5.1 HISTORIC DEVELOPMENT OF THE MAIN ADIT

5.1.1 The most productive and developed phase of mining activity at Keld Heads Mine was after 1843 (*Section 3.2.13*), and was later managed by the Keld Heads Mining Company formed in 1844 (Smith 1998, 43). By the late 1850s the main Keld Head Level was one mile in length, producing *c* 1000 tons per annum of lead and employing a workforce of 250 people (Spensley 2014, 189 and 192). The main adit of this period (Site **55**) was located to the south of Tullis Cote and is associated with a series of extant structures, including a possible drainage adit (Site **63**), airshafts (Site **143** and **127**), workshops (Sites **56-59**) and one of the two separate Agent's houses (Site **60**). Mining and drainage operations from the adit also required hoisting along the adits and levels using power initially provided by a water wheel (in the wheel-pit at Site **65**), via a tunnel (Site **67**), and then at a later date from an engine, using connecting rods via the tunnel (Site **67**) from the Engine House (Site **66**) with its adjacent Boiler House (Site **53**) and chimney (Site **52**).

5.1.2 ***The Plan of Lord Bolton's Mines in Wensleydale, 1828:*** this is the earliest cartographic evidence found for mining activity in the area of the main adit (Site **55**) (Plate 12) which was later exploited by the Keld Heads Mining Company. The actual location is not clear but the *Level Mouth* is marked south of the woodlands (known as Thowker Wood on the plan of 1723 and the OS map of 1856). The adit entrance may have been on the southern edge of the woodlands and east of the track (Keldheads Lane) which goes north past Tullis Cote and on to the Old Smelt Mill.

5.1.3 ***OS 1:10,560 1st edition map, 1856:*** in the same general location as on the 1828 plan; that is, on the southern edge of Thowker wood and east of the track and gill, the OS map depicted the *Entrance to Lead Mine* (Site **55**) with an *Air Shaft* (Site **127**) to the north and *Walls* (Site **65**) to the north-east. The large east/west broad wall was where the wheel-pit is located; two further walls attached to its western end and going to the north and west may have been walls containing the leat. To the west was depicted, but not labelled, a large rectangular building that was aligned south-west/north-east (Site **60**) being the Agent's House (Spensley 2014, 62). No other buildings were marked in the immediate vicinity.

Plate 12: Extract of *Plan of Lord Bolton's Mines in Wensleydale, 1828* showing the Level Mouth south of the woodland below Tullis Cote

5.1.4 ***Plan showing portion of the authorised and proposed lines of railway passing through the surface works of the Keld Heads Lead Mines, 1866 (Plate 13):*** the area of the *Entrance to Lead Mine* had, by 1866, undergone considerable development as the mining operation had developed and been extended with additional workshops (Site **56-59**). The adit itself (Site **55)** was depicted as a *Level* and was in the same location as the present-day mine entrance. The Shaft (Site **127**) was marked to the north of the workshops and east of the wheel-pit that was overlain by the later Engine House in *c* 1878-9. The workshops (Site **56-59**) comprised a complex of around six buildings, lean-tos or extensions, built onto each other, generally in a north/south orientation. The Agent's House (Site **60**) had been remodelled and extended on its north-east face since the 1856 map. It is not certain how the small yard (Site **64**), north of the Agent's House, functioned, particularly as there are walled links to the workshops. It may have been a store, or it was possibly a reservoir as there is a drainage adit located nearby (Site **63**), and eventually it developed as a walled garden.

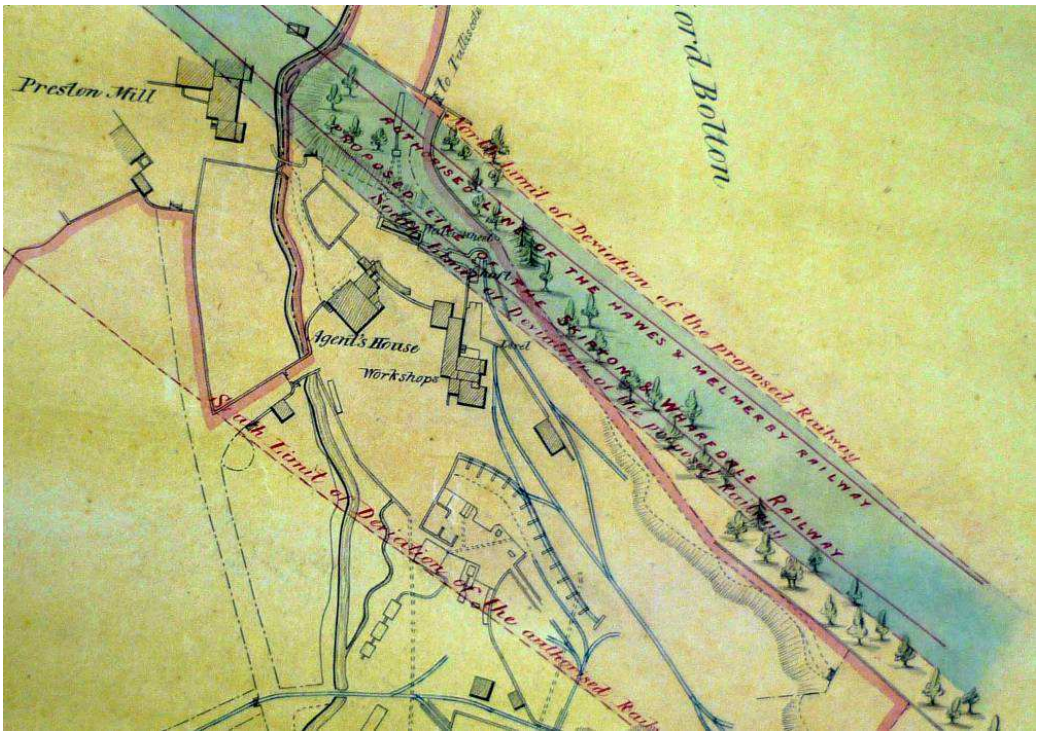

Plate 13: Extract of plan showing the proposed lines of railway passing through Keld Heads Lead Mines, 1866

5.1.5 ***Plan of the Ground leased by Keld Heads Mining Co. 1878:*** the map appears to have drawn partly upon the base mapping of the OS in 1856 and may not show the full extent of the development of the 1850s and 1860s; it did include the workshops by the mine entrance but did not include the dressing floors to the south. It is possible that the Engine House, Boiler House and chimney had not been built at this date.

5.1.6 ***OS map of 1:10,560, 1895:*** there had been new building since 1866 with the construction of the Engine House, built *c* 1879 (Spensley 2014, 62 and 193) and also the Boiler House. Within the Engine House had been placed a horizontal steam engine to pump the shaft below and to power a winding engine (controlling hoists and wagons) (Spensley 2014, 193). On this map for the first time the chimney (Site **52**) was marked as a tiny square underneath the scars or cliffs to the north of the site.

5.2 THE EXTANT BUILDINGS AND ASSOCIATED FEATURES (FIGS 9, 11, 21, 26, 28 AND 35)

5.2.1 ***The Main Mine Adit:*** the mine entrance (Site **55**) was marked as a small rectangular building on the 1856 map (slightly inaccurately) and then as *Level* on the 1866 map; to the west were the workshops (Site **56-9**). The adit can presently be seen set into the slope of the hillside going back at least 30m (Plate 14). It is stone lined, barrel-vaulted and has a stone arch at the entrance standing at approximately 2m tall, and 1.3m wide. A retaining wall is present to the west of the arch heading across the front of the adit, which stands up to 2m high. There were also retaining walls to the east and the west. All the walls have been constructed using angular stones and the adit has also been lime mortared.

Plate 14: The entrance to the main adit (Site **55**)

5.2.2 ***The Drainage Adits and Air Shafts:*** mine adits, shafts and levels needed drainage and ventilation: one adit for drainage (Site **63**) at Keld Heads was possibly driven from north of the Agent's House. This was observed on the field survey as an open adit mouth with surrounding curvilinear retaining walls which extend to the east. The working floor and spoil heaps further to the east were also enclosed on the south end by a retaining wall. The drainage adit (Site **63**) would have also required a leat or launder into which to drain but this has not been located. It is possible that this was the tailrace of the Site **65** wheelpit carrying waste water to the area of the dressing floor (Site **33**), but no direct connection has been identified and could instead have been carried by elevated wooden launders.

5.2.3 Some access for winding gear and ventilation for the main adit may have been via the air shafts marked on the OS map of 1856 and on the 1878 plan: one was north of Tullis Cote (Site **143**) (Fig 19) and the other (Site **127**) was close to the main adit. The location of the *Shaft* marked on the 1866 plan suggests that it may have housed the winding gear powered by the water wheel (Site **65**) to the west, and which was eventually powered by the Engine House (Site **66**). The tunnel (Site **67**) would have accommodated drive shafts or connecting rods from the wheel-pit to the winding gear in the shaft.

5.2.4 ***The Wheel-pit:*** a water wheel would have controlled the winding and pumping mechanisms at the mine before the engine was installed *c* 1878-9 (Gill 2000, 84). The extant wheel-pit (Site **65**) is a stone-revetted rectangular pit, aligned east/west, partly cut into the hillside and partly above-ground; it is 13m in length by 2.7m wide. There are socket holes for various fixings include two opposing axle pads in the centre of the structure. The coursed stonework is obscured and overgrown; however, very large blocks of cut stone can be observed. Squared slots were also noted in a section of north/south walling at the eastern end of the wheel-pit (Plates 15 and 16); a row of three slots served perhaps for connecting rods linking it to the mine shaft (Site **127**).

There are fragmentary remains of another structure on the east end consisting of wall stubs offset south from the wheel-pit and several iron pipes protruding from the hillside (Site **65b**) suggests the remains of part of a structure associated with the infilled shaft (Site **127**). The wheel in the pit would have been served by leats from the north (Sites **68-70**).

Plate 15: The wheel-pit (Site **65**) looking west

Plates 16: One of a series of square slots set into the walling at the east end of the wheel-pit (Site **65**)

5.2.5 The wheel-pit was on the same alignment as the Engine House (Site **66**) and the connecting tunnel (Site **67**), suggesting that the wheel was the determining factor in the design and orientation of the tunnel (to accommodate a drive shaft) and the Engine House (built for the later steam engine *c* 1879). Thus the Engine House may have been located on the site of earlier winding mechanisms and the shaft. Similarly, the tunnel may have been built at an earlier date than the Engine House (Plate 17; Photograph 67.4).

5.2.6 The barrel-vaulted, stone-lined tunnel (Site **67**) was inserted into the revetted walls for the north/south track (going from the dressing floors, up to the Smelt Mill further up the hill) in order to create a sub-way connection between the wheel-pit and Engine House. The tunnel would have accommodated the drive shaft connecting the engine, the pumps and machinery to the mine shaft to the west (Atkins 2012, 6). It was *c* 7m in length, 1m in width and 1.5m in height. Inside was a stepped change in the floor level (to allow for the slope of the hillside).

Plate17: The barrel-vaulted tunnel (Site **67**) for drive shafts/connecting rods between the Engine House and mine shaft.

5.2.7 ***The Engine House:*** this building (Site **66**) was built *c* 1879 (Spensley 2014, 62). It was a rectangular stone structure measuring 20m east/west by 10m north/south and set into the hillside above the entrance to the mine and the wheel-pit (Plate 19). The building housed the engine bed for a horizontal steam pumping engine (for drainage water) and a winding engine (for the hoists) was installed *c* 1878-9 (Gill 2000, 84)

(Plate 18); drive shafts from the engines would have gone through the arched tunnel (Site **67**) to reach the mine shaft mechanisms. The engine bed comprised a large stone platform running the entire length of the north side of the structure and elements for securing the engine survive on the eastern end of the platform. To the south of the platform is a deep pit, which descended below ground level on the south wall adjacent to the Boiler House (Site **53**) and which probably housed the main drive wheel. The south wall between the Boiler House (to the south) and the Engine House provided apertures for points of access for machinery and connecting links between the boiler and the engine.

Plate 18: Interior of the Engine House (Site **66**), looking east

5.2.8 The large brick-arched doorway at the western end of the south elevation would have given access to the pathway (Keldheads Lane) outside. The western end of the platform has several steps which lead up, and into, the barrel-vaulted tunnel (Site **67**) to accommodate the drive shaft connecting the engine the pumps and machinery for the shaft to the west (Site **127**), although its remains have not been identified.

Plate 19: Aerial view of the main adit and Engine House area

5.2.9 ***The Boiler House:*** the early steam engine would have required a boiler, water supply and heating; the offset rectangular building (Site **53**) to the south of the engine comprised the Boiler House (Spensley 2014, 62). This is confirmed by the presence of the flue (Site **51**) and the chimney (Site **52**). The north end of the flue (Site **51b**) abuts the Boiler House and has an entry point set into the building. The chimney (Site **52**) lies 20m to the north-east of the Boiler House and has a circular opening at the south-west side of the base of the chimney, where a flue joined (Site **51b**) (Atkins 2012, 7) (Plate 20).

Plate 20: The circular opening leading into the side flue (Site **51b**)

5.2.10 South of this junction between the Boiler House and chimney was a north/south length of flue (Site **51a**), which was orientated directly towards the dressing floors. It seemingly stops short of the spoil heaps, but potentially continued underneath them. There is no obvious section of it on the southern side of the spoil heaps but the area of a potential outfall is heavily disturbed. It is possible that this was intended to transport steam from the Boiler House to a small engine in the area of the dressing floor, which could have supplemented or replaced the water wheel. Alternatively, this flue is a late feature associated with the twentieth century power house (Site **48**) constructed on the dressing floors to the south (*Section 10.2.1*).

5.2.11 The Boiler House was a two-storied building with a loft, the whole divided into three cells (Plates 22 and 23). The gable wall of the eastern cell had beam end slots and a brick archway leading from the flue (Site **51b**). The central cell (Plate 21) had three larger holes in the northern wall which led to the Engine House, and these would have held steam pipes to drive the engine. The central beam also had six hanging bolts which connected to the Engine House.

5.2.12 The internal walls butted against the external walls suggesting that the space was divided at a later date, and may have been when the Engine / Boiler House was converted for use as 'adjacent stables and stores..... a building with timber roof structure' (Listed Building Entry). The gable of the western cell abutted the Engine House.

Plate 21: The interior of the central cell of the Boiler House (Site **53**), looking north

Plate 22: The western elevation of the Boiler House (Site **53**)

Plate 23: The southern elevation of the Boiler House (Site **53**)

5.2.13 ***The Chimney:*** the chimney was marked on the OS map of 1891-3 map as a small square underneath the scars or cliffs to the north-east of the Boiler House (Site **53**) and Engine House (Site **66**); this would have been built alongside the Engine House and Boiler House after 1878. It is square in plan and is slightly tapered, narrowing towards the top, where there is an over-hanging band of capping stones; it is 2.5m x

2.5m in plan and 16.5m in height (Atkins 2012, 7) (Plate 24; Fig 27)). It is well constructed with quoin stones up to half way from the base. It had a circular opening at the south-west side of the base of the chimney, where a flue (Site **51b**) once joined, from the Boiler House (Site **53**).

Plate 24: The chimney (Site **52**) and flue (Site **51a**) looking north

5.2.14 ***The Workshops:*** the workshops (Sites **56**, **57**, **58** and **59** (Plate 25)) comprised a series of buildings immediately to the west of the main mine adit (Site **55**) and south and east of the drainage adit (Site **63**) and are clearly depicted on the 1866 plan as separate buildings, lean-tos or extensions (Fig 37). In addition, there is a photograph showing the workshops that was probably taken around the start of the twentieth century (*Section 3.3.24*: Plate 6).

Plate 25: The workshops looking north-east (Sites **56-9**)

5.2.15 A small building (Site **59**) on the west was, in the 1866 plan, directly linked, via a retaining wall, to a walled area Site **64**. The building is now a small lean-to abutting the west side of a larger rectangular workshop building (Site **58**) to the east. The two larger buildings were orientated north/south and shared a long wall. The western building (Site **58**) was offset with respect to the eastern buildings (Site **56a** and **56b**), and was depicted as a long building on the 1866 plan; it is still extant as a long rectangular barn with a large, arched, entrance on the western side with three windows. The buildings to the east were depicted as three separate 'cells' on the 1866 plan, with two to the north (Site **56b**) and one to the south (Site **56a**). The sunken area to the north of the building (Site **56b**) was possibly the remains of two small yards or bins, although on the 1866 map it was depicted as part of the 'workshops' buildings. The southern element (Site **56a**) was originally depicted on the 1866 map in a historic photo (Plate 6) as having a large chimney attached to the north end, but now largely gone. In the angle between these two buildings was a small square building (Site **57**) which was a single story lean-to, butting against the western gable end of Site **56a**, and its northern end abuts Site **58**.

5.2.16 The Agent's House (Site **60**) is close to the workshops (Site **58** and **56**), by the main adit (Site **55**) and the drainage adit (Site **63**). It was depicted on the 1856 map as a simple east/west orientated building, and by the time of the 1866 map it had been enlarged to a square building with an extension on the north-eastern side. Associated with the House, and lying to the north, was an enclosed feature which may have been a yard or a small reservoir (*Section 3.3.12*), but was eventually landscaped as a walled garden (Site **64**). The house has survived, and has been refurbished and is currently occupied.

6. THE SOUTHERN SPOIL HEAPS AND DRESSING FLOOR

6.1 HISTORICAL BACKGROUND

6.1.1 The southern part of the study area (Area A) now comprises a series of substantial spoil heaps, and in-between these, the area presently has transient use as a garage, a lumber compound and is used for upland estate management and has a number of temporary buildings. However, for a short period this area was intensively used as part of the mine operation and included an area of bouse teams for the storage and washing of the ore and a dressing floor, including buddles, for the refinement of the ore. A complex of tramways linked the adit entrance with the various dressing floor elements and also led to spoil heaps on the site and to the west of the study area. Relatively little surface remains survive of these dressing floor elements, but the high quality, and relatively accurate, 1866 estate map does provide a valuable indication as to the form and location of the dressing floor (Figs 3 and 37).

6.1.2 The earliest features on the site were a pair of buildings (Sites **43** and **125**) shown on the 1856 OS map, of which one (Site **125**) is no longer extant, and indeed had gone by the time of the 1866 mine map (ZBO (L) 19). The other building (Site **43**) is still extant (Plate 26) and is the earliest surviving feature within the complex. It is a small (5m by 4.5m) square, stone-built, single-storey building, constructed using rough angular stones and lime mortar, and presently has a slate roof and two doors on the south side. The remains of two walls flank either side of the building, and butt against the standing structure. The function of the building is uncertain, but it can be conjectured that it related to ore dressing. It is immediately north of the later dressing floor (Site **33**) that was first depicted on the 1866 mine map, and its southern wall is parallel to the walled enclosure around the dressing floor (Fig 37). It is possible, however, that there was an earlier dressing floor in the area, and although there was not one specifically represented on the 1856 map, tracks and probable spoil heaps seem to extend around the area containing the two buildings, suggesting that this was the site of a small-scale manual dressing operation. Only a year later than the OS map, in 1857, the Ripon and Richmond Chronicle detailed an account, entitled 'Improvements at the Keld Head Mines' (Spensley 2014, 63-4), which describes an intensive mechanical dressing operation and the description corresponds with the features shown on the 1866 mine map. The implication is that this was an improvement of an earlier dressing operation. By the time of the 1866 map there was a further small building depicted extending out from a wall that was shown to extend between an area of bouse teams and the dressing floor. There are fragmentary remains of a curvilinear retaining wall (Site **44**) which corresponds to the historic boundary wall; it stands up to 0.5m high and is 0.4m wide. There is at least one wall stub surviving for a further building, which was shown on the historic OS mapping.

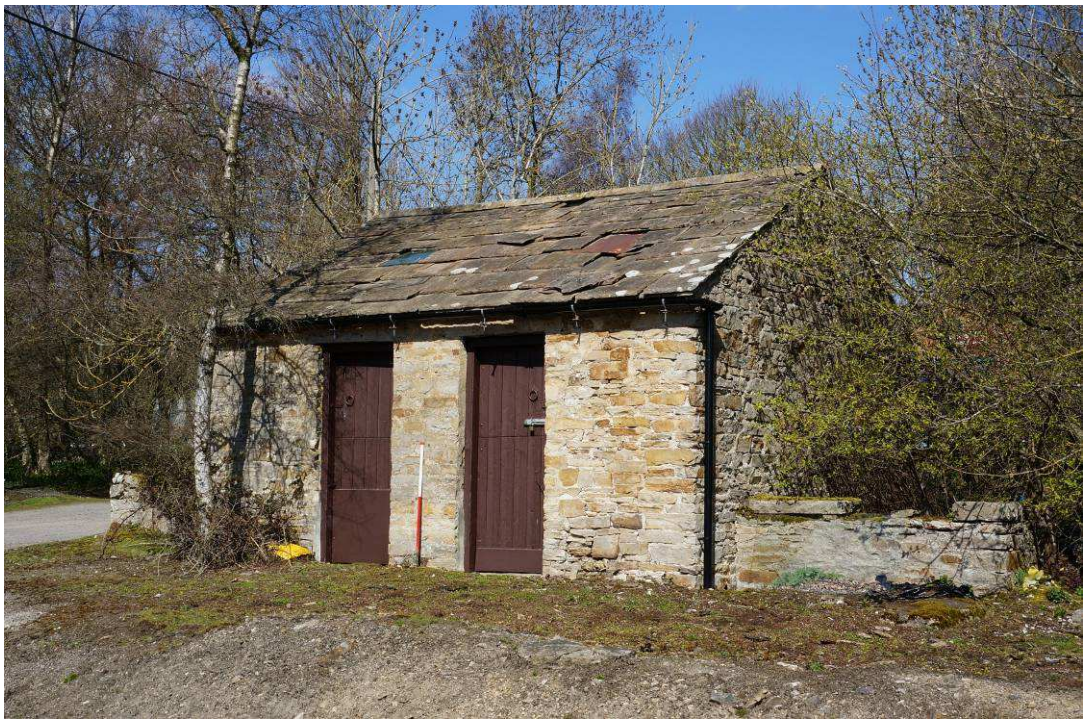

Plate 26: Early dressing floor building (Site **43**)

6.2 THE DEVELOPMENT OF THE BOUSE TEAMS AND DRESSING FLOOR (FIGS 28, 29, 30, 32 AND 35)

6.2.1 ***Bouse Teams:*** the dressing floor operation is well represented by the 1866 mine map and the 1857 Richmond Chronicle account (*Sections 3.2.15, 6.1.2*). Two lines of tramways extended out from the adit entrance (Site **55**), one led to a large spoil heap (Site **42**), which has expanded considerably subsequent to the extent shown on the 1866 map. The other tramway (Site **133**) carried the ore, or gangue, out from the mine adit and led to a series of up to 14 bouse teams on the south-west side of the tramway (Site **140**), and the implication is that the bouse teams, or storage bins, were set below the embanked tramway (Site **140**), so that the gangue could be tipped straight into the bins (Plate 27). The line of the documented (1866 mine map (ZBO (L) 19)) tramway corresponds with the line of an embanked slope (Site **50**) and very closely with an extant but fragmentary section of retaining wall (Site **50a**), which is 1.5m tall and 0.5m wide and is made from angular stones. Typically, bouse teams were also used to wash the gangue, but the 1866 map does not show a water supply feeding the line of bouse teams. However, set into the embankment was an oval iron pipe, which measures 0.15m by 0.08m with a 0.04m diameter hole, and was visible for approximately 1.2m; this potentially provided the water supply to wash the gangue in the bouse teams.

6.2.2 The 1866 map (ZBO (L) 19) showed two adjoining small rectangular buildings, south of the bouse teams and set into the corner of a rectangular compound. These approximately correspond to two parallel concrete pads (Site **46a**) observed during the survey and are possibly the remains of the floors of the two buildings shown on the 1866 map (Plate 27). The east pad measures 3m by 4m and the west pad is slightly larger at 4.5m by 3m; both pads are flush with the current ground surface. The level foundation of a north/south dividing wall, measuring 0.5m wide, is present

between the two pads, and a partially extant L-shaped retaining wall (Site **46b**) forms the south-west corner of the building. The wall is made from rough, angular stones with lime mortar and it stands to 1.3m high and is 0.4m thick. These pads have a slightly different orientation to that of the buildings shown on the 1866 map and it is therefore possible that they were later structures that related to the later power house (Site **48**) rather than to the bouse team complex.

Plate 27: Southern area of bouse teams and the site of a former building (Site **46**)

6.2.3 ***Dressing Floor:*** a further tramway was shown on the 1866 mine map (ZBO (L) 19), which extended south-east from the base of the bouse teams, taking the stored gangue, onto a rectangular dressing floor platform and directly to a crushing plant adjacent to a large wheel-pit. The water supply for the pit was shown as a probable launder extending from the area of the bouse teams (Site **50**) but there was no tail race depicted; however, it is probable that the water was then re-used for the hotching tubs and buddles. There are presently slight earthworks consisting of fine silt waste overlying the wheel-pit and crushing plant (Site **33**; Plate 28) and there is a mound with three large retaining bolts, which stand upright (1.25m high) and are 0.95m apart (Site **33d**); they approximately coincide with the southern edge of the crusher.

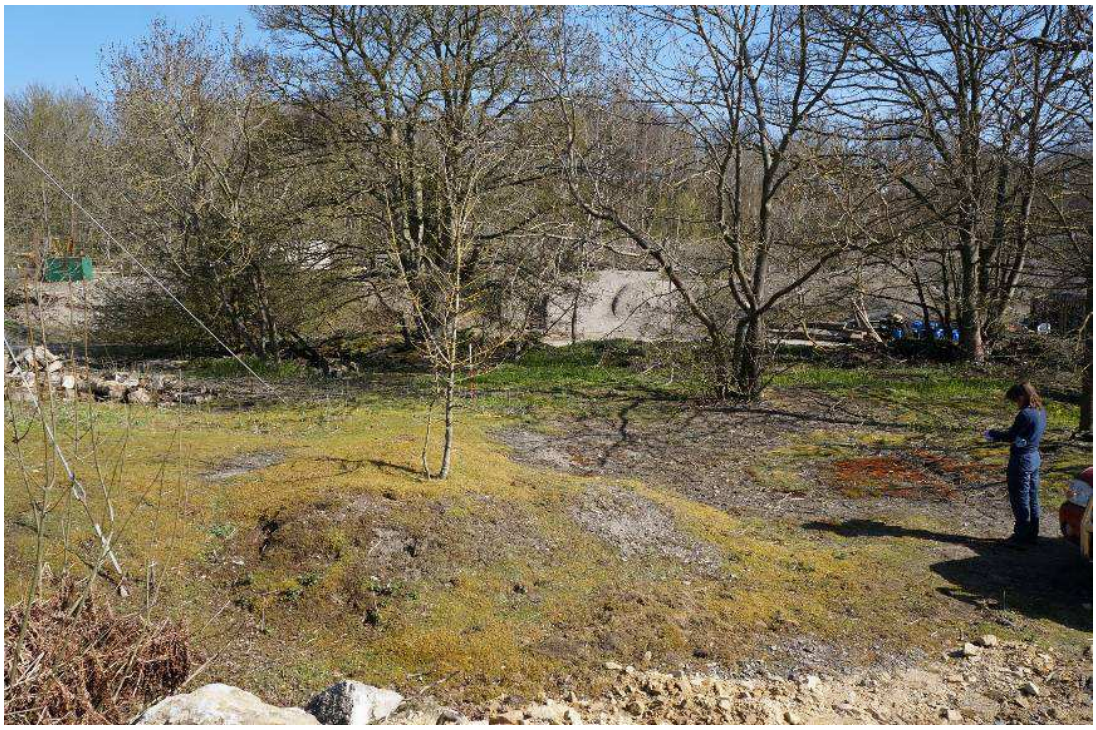

Plate 28: Lower dressing floor, showing the surviving earthworks (Site **33**)

6.2.4 The Richmond Chronicle account states that the crushed gangue was taken to a series of hotching tubs for further washing and agitating (Spensley 2014, 63-4). The 1866 mine map appears to show seven hotching tubs on either side of the crushing plant, and from each of these were run off channels leading to, what appear to be, settling tanks. The physical remains within this area comprise areas of fine silt waste which are now mostly covered in moss (Site **33**). Nothing survives of the hotching tubs, but these were movable features, and would not be expected to have left physical remains. However, there are now three low, parallel, linear banks (Site **33b**), which run east-north-east/west-south-west and may correspond with elements of the settling tanks. They are parallel to the line of the settling tanks shown on the 1866 map and stand up to 0.3m high and 1m wide, and the northernmost of these banks is directly on top of the southernmost edge of a settling tank; it is probable these are the remains of settling tanks. There is a line of five small vertical bolts (Site **33c**) running between the north and middle linear banks (Site **33b**), and this coincides with the southern edge of the dressing floor platform. To the south of the bolts lies a mound of spoil measuring 5m by 3m, probably a residual mound of crushed gangue.

6.2.5 The partly processed ore was then refined in a series of buddles (Spensley 2014, 62-4) and there are three of these depicted on the 1866 mine map, and one of these is 2.5m away from an extant circular patch of orange moss (Site **33a**) covering a pile of fine silt waste. The patch measures 1m by 2m and the distinctive colour of the moss may potentially indicate the location of a former buddle. There is also a small, sub-square, platform with a slight gully on the south-west side of the dressing platform (Site **33e**), but this does not correspond with any specific features shown on the 1866 map (ZBO (L) 19).

6.2.6 The 1866 mine map shows a series of tramways extending out from the western side of the dressing floor platform leading to a substantial spoil heap to the east of the study area; this would have carried the waste product from the dressing process.

There is the survival of this communication line, outside of the survey area, representing the alignment of the embanked tramway leading west to spoil heaps near Wensley Station.

6.2.7 In the southern part of the area, a second 'Agents House', surrounded by a garden enclosure, first appeared on the 1866 map and this corresponds with the present day Keld Cottage (Site **30**) (Plate 29). It is probable that this is the Surface Agent's House used to run the dressing floors rather than the other property used for below ground workings. It has a rectangular plan, two stories and has been constructed using lime mortar and angular quarried stones, and has large stone lintels above the doors and windows, some of which have been blocked. The garden wall (Site **31**) has not changed significantly in plan and is now made from angular stones, bonded with lime mortar, has flat coping stones on the top and stands to 1m in height.

Plate 29: Agent's House (Site **30**)

6.2.8 To the west of the Agent's House was the site of another water wheel (Site **74**) which was intended to drive the flat rods of a power system under the railway to mines located south of the main complex (Spensley 2014, 62). The map shows that the water was carried to the wheel-pit by launder and leat from a take-off point higher up the gill. There are no surviving visible remains of the wheel-pit, but there is a surviving culvert (Site **29**) on a line extending south from the wheel-pit, and which may have been intended to carry the flat rods.

6.2.9 To the east of the Agents House, the 1866 map (ZBO (L) 19) (Fig 37) shows a pair of what look like more hotching tubs, and has been interpreted as an area of dressing floor called Brunton Buddles (Spensley 2014). There are no present day surface features corresponding with possible hotching tubs, but there is a series of four parallel banks (typically 0.6m wide by 0.3m high) to the south and east of them (Site **36**), which may correspond to settling tanks, although there are none depicted on the 1866 map.

6.2.10 ***1895:*** by the time of the 1895 OS map the dressing floor and bouse teams were still in place, even though by this date the mine had not been in production for perhaps five years. The dressing floors had a similar layout, but the lines of the tramways had changed slightly. The waste from the dressing process was no longer being taken to a spoil heap to the west, and the tramways for the main spoil heap (Site **42**) had been extended to reflect the expansion of the spoil heap.

6.3 THE SPOIL HEAPS (FIGS 21, 22, 31 AND 33)

6.3.1 ***Spoil Heaps:*** the 1895 map indicates that by this date the spoil heaps had reached their present extent (Fig 6; Plate 30); however, at that date spoil mounds (Sites **40** and **42**) were a single spoil mound and the tramways of that date showed that they had been feeding spoil to the southern part of the large spoil mound (Site **40**). At some date, between the 1919 OS map and the 1953 OS map, an east/west railway siding (Site **41**) had been established, in order to carry stone, via the aerial ropeway (Site **141**), from the Preston-under-Scar limestone quarry. This extended east/west, terminating at a point just to the north of building **43**. This had entailed the excavation of a large cutting through the spoil heap, and now gives the false impression that there had originally been two spoil heaps (Sites **40** and **42**), when the reality that it was originally one (Plate 31). Some wooden sleepers survive along the alignment of the railway line (Site **41a**) as well as a single mine wagon (Site **41b**). The overall spoil heap (comprising both elements Sites **40** and **42**) was over 165m in length and had fanned out to a width of 80m near its eastern end. At its highest it was up to 10m in height, again at its eastern end. The layout of the southern element of the spoil heap (Site **40**) had been deliberately designed to avoid the area of the dressing floor, indicating that the dressing floor was still being used up until the final years of the operational life of the mine.

Plate 30: Aerial view of the southern spoil heaps and dressing floor

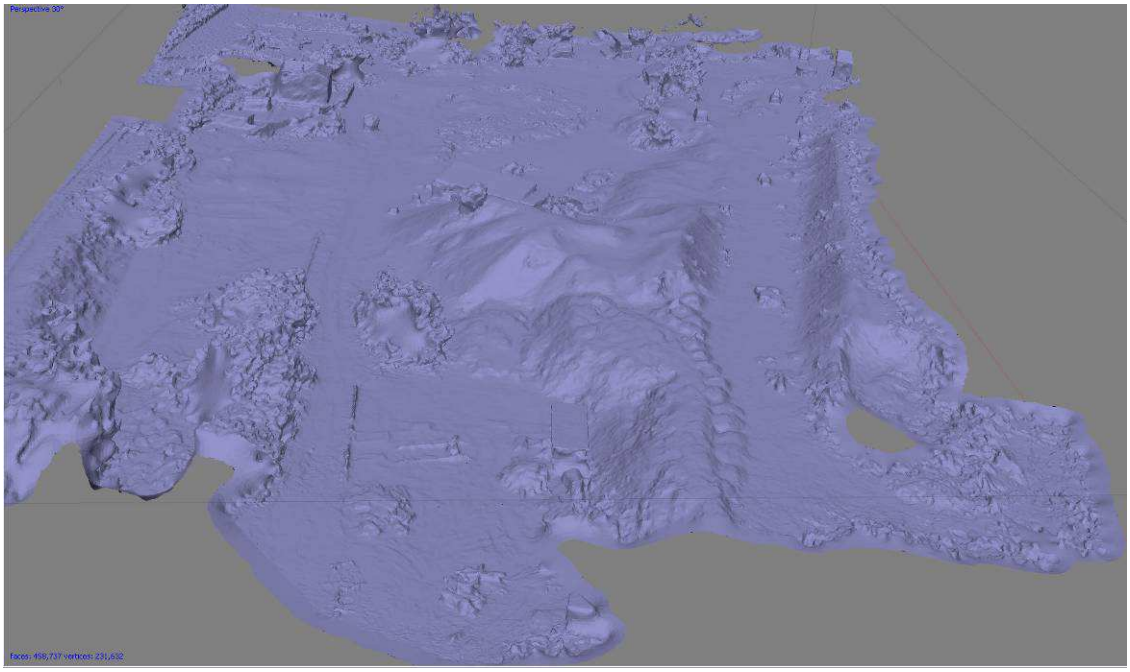

Plate 31: An isometric view of Area A (looking west) showing the area of spoil heaps (Sites **40** and **42**) cut by the parallel-sided cutting for the railway (Site **41**)

7. SMELT MILL AND PEAT STORE

7.1 THE DEVELOPMENT OF THE SMELT MILL

7.1.1 The New Smelt Mill constructed by the Keld Heads Mining Company *c* 1851-1854 appeared to have utilised new technologies of lead ore smelting and, according to an indenture of 1854, included storage for coal, coke, soot and ore as well as a 'a roasting house, metal house' and 'a patent Condenser House' and horizontal chimney (Smith 1998, 43-44). The list of assets also included an engine house. Few of these buildings can now be seen on the ground due to the extensive quarrying which took place after 1949 that covered the Smelt Mill with spoil waste. There are four plans and maps which were drawn up in 1856, 1866, 1878 and 1891-3 which detail the main buildings, outhouses and yards of the Smelt Mill.

7.1.2 ***OS 1:10,560 map of 1856:*** this map showed three, perhaps four, roofed buildings of an early phase of construction. One very large roofed building (Site **75**) (which may have been two buildings) was orientated east/west, straddling Keldheads Gill; from the east side of the north elevation, the Condenser Flue (Site **6f**) emerged to go north. On the south-east corner of this large building was a small square building, perhaps the roasting house (Smith 1998, 53) (Site **128**), with a yard to the south and on the southern edge of this a small rectangular building (Site **129**). On the south-west elevation of the large east/west building was another yard or unroofed space. Into the west side of the east/west building a leat flowed from a small sub-circular reservoir or dam (Site **90**) to the north. Keldheads Lane was on the east side of the Smelt Mill complex.

7.1.3 ***The 1866 plan*** (ZBO (L) 19, 1866) (Fig 36): the plan mapped three main buildings and two smaller buildings, one of which comprised an early roasting house (Site **128**) mentioned above; the two largest buildings to the north were an east/west orientated rectangular building with a north/south aligned rectangular building which was added to the western part of the northern elevation. To the west of the north/south orientated building were a series of three demarcated spaces with an outhouse on the west elevation. The leat, which had fed into this west wall on the 1856 map, by the time of the 1866 plan appeared to be parallel to a tramway linking the Smelt Mill to the Condenser House. From the two largest Smelt Mill buildings, six flues emerged to join into the main Condenser Flue going north up the hillside. A seventh flue could be observed on the 1866 map leaving the north side of the small square building (perhaps a later roasting house: Smith 1998, 53-4) attached to the south-east corner of the main east/west building. The third largest building was detached and lay at the south end of four ore bins (Smith 1998, 50 and 53) and was the Peat Store (Site **73**). South and east of the two main buildings was a smaller rectangular building (Site **129**) with square storage bins or pits to the south. This rectangular building has been interpreted as being possibly an office, assay house or metal house (Smith 1998, 53).

7.1.4 ***Plan of the Ground leased by Keld Heads Mining Co. 1878:*** (ZBO (L) 21, 1878): this showed the three main buildings and two smaller buildings as they were configured on the 1866 map but with no additional changes or detail.

7.1.5 ***The 1:10,560 OS maps of 1895 and 1919:*** the earlier map had the same configuration of the three main buildings, two smaller buildings and storage yards, and all the buildings were designated as being roofed. The tramway west of the Smelt Mill complex was marked and labelled. The Smelt Mill was labelled as *Keldheads Smelting Mill (Dis-used).* By the 1919 OS map all of the Smelt Mill buildings except the Peat Store (Site **73**) were designated as being unroofed.

7.1.6 ***The Photograph of the Smelt Mill (undated) (Plate 32)*****:** this showed the south elevation with storage bins to the west. The south wall had at least two large, wide doorways with windows or openings above and to the west of these. The storage bins had curved or buttressed side walls with, probably, two side walls and a back wall with the fourth side or front remaining open for uninhibited access; however the southernmost outbuilding or store on the photograph had a wide doorway (NMRS, *RT Clough Collection*).

Plate 32: Photograph of the south elevation of the Smelt Mill (NMRS *RT Clough Collection*). The photograph is taken from grid reference 40781 49102 and is looking south-west.

7.2 HOW THE SMELT MILL WORKED

7.2.1 It is apparent that there were two phases of construction at the Smelt Mill as evidenced by the plan and maps of 1856 and 1866. The documentary evidence demonstrates that this was to accommodate increased productivity of the mine and the development of the hearth technologies.

7.2.2 The description of the Smelt Mill at Keld Heads by RT Clough from his work done in the late 1940s (Clough 1962) is of enormous value, as after 1949 the area was subject to quarrying and re-landscaping. The majority of the mill buildings have been buried, with only the Peat House remaining completely extant (*Section 7.3.1*). He described the earlier east/west mill building as being '60 feet long, 30 feet wide with

a water wheel 27 foot in diameter' (this was on the western elevation). Within the two main buildings of the second Smelt Mill were large hearths taking up most of the height of the building, made of brick with arched openings and sunken features for catching the molten lead and slags (Plate 33). 'In this part of the building were three ore hearths and in a building to the rear [the later north/south building] were two slag hearths' (Clough 1962, 96). Clough described the five flues as being '2 foot 3 inches wide and 5 feet 5 inches' probably located adjacent to the arched openings along the length of the building and which left 'the building to the north forming to join two separate stone-flagged flues up to the Condenser House' (Clough 1962, 97 and 99).

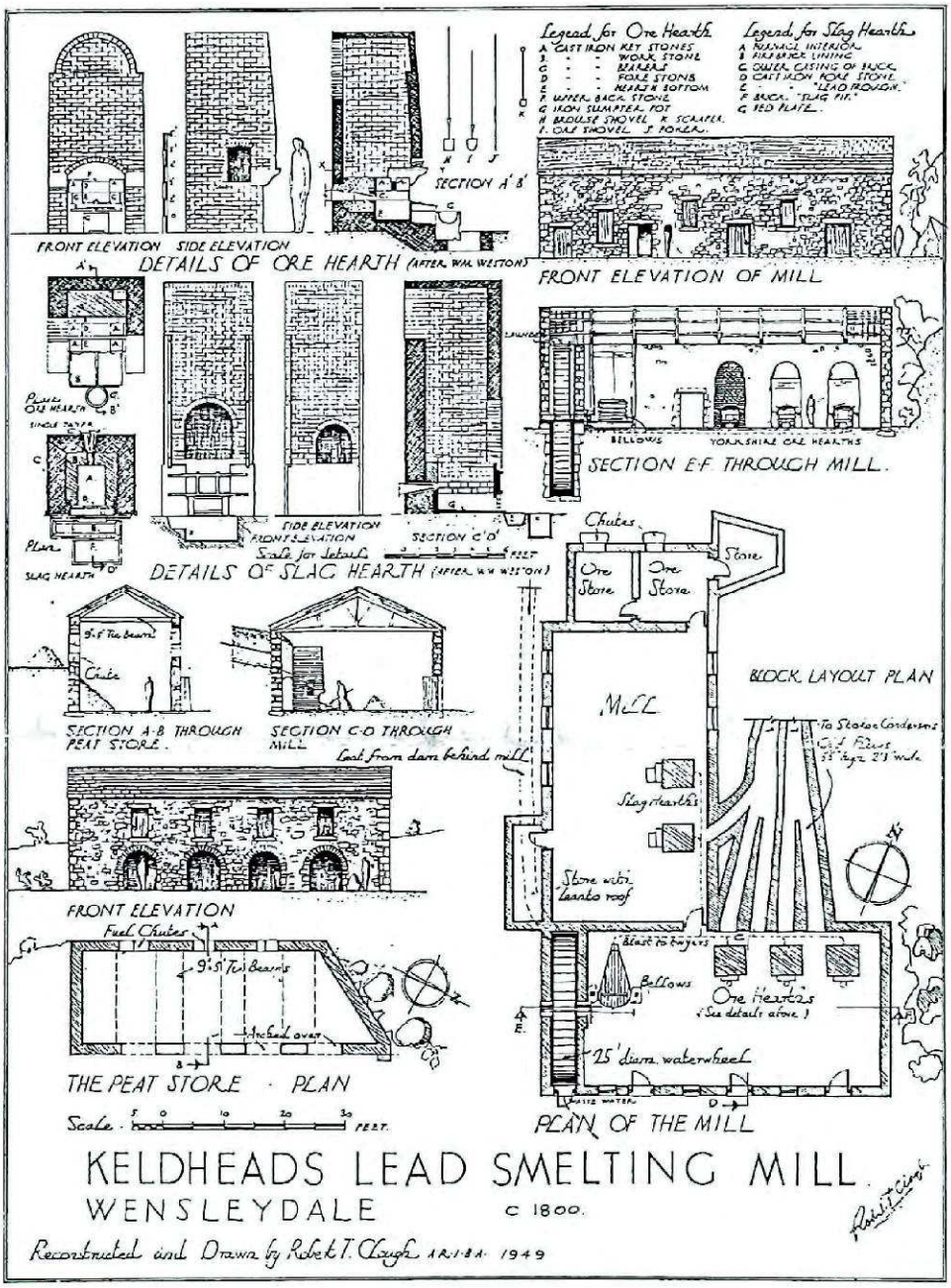

Plate 33: Reconstruction Drawings of the Smelt Mill, Hearths and Peat Store dated 1949 (Clough 1962)

7.2.3 Dr A Raistrick argued that the early phase of the Smelt Mill probably only had two hearths in the main east/west building (as recorded on the 1856 OS map) with just one main condenser flue extending from the mill (Raistrick 1975, Vol 2, 103). The second flue (for the additional hearths of the second phase) was possibly added later by 'placing a wall parallel to the west wall of the original flue as far as the Condenser House' (Raistrick 1975, Vol II, 103).

7.2.4 J Percy, writing in 1870, provided a detailed account and diagrams of the ore-hearths and slag hearths at Keld Heads. He reported that only ore hearth and slag hearth smelting was undertaken at Keld Heads in the 1850s (Spensley 2014, 193); a reverbatory furnace (cited in a document of 1859 (Spensley 2014, 194)) was perhaps another installation. The deposited scrapings from the lead fumes in the flue (Percy 1870, 437) would also have required processing, but this is not detailed.

7.2.5 The fuels used for the roasting hearths and smelting hearths were peat, chopwood and coal (Raistrick 1975, Vol II, 16). Peat was stored in large quantities in the extant Peat House to the south-west of the mill buildings.

7.2.6 ***The Hearths and Flues:*** more recent analysis of data and exploration of the flues has argued that, by the second phase of construction, there was a total of seven hearths corresponding to the seven flues (Smith 1998). Percy's analysis of lead production figures from Keld Heads suggested that the amount of lead actually produced per annum equated to a year' s supply from four ore hearths, which would have served a single slag hearth (Smith 1998, 48). Thus of the seven hearths, four were probably ore hearths (forming two pairs of hearths) and one was a slag hearth. Three of the ore-hearths had flues leaving the east/west building and there were two flues leaving the east wall of the later north/south building, one of these was possibly the slag hearth (Raistrick 1975, Vol II, 102; Smith 1998, 48 and 53-4). There were two additional hearths; one of them was a roasting hearth from the early phase as cited in the indentures of 1854 (Smith 1998, 44) and was maybe sited in the smaller square building (Site 128) to the east as seen on the OS map of 1856 (Smith 1998, 4). The second hearth was perhaps inserted at a later date on the far western elevation of the large north/south building and was possibly also a roasting hearth.

7.2.7 ***Roasting Hearths:*** as technological understanding advanced in the first part of the nineteenth century roasting hearths began to be used (often added in annexes to the main mill building) prior to the main smelting process, for the roasting of ore to make the smelting gases less pollutive (Raistrick 1975 Vol 2, 14). The waste gases included sulphur dioxide, which was both poisonous and corrosive and a danger for people and farmland (Percy 1870, 278). It was a condition of the terms of the lease for the smelting mill to install a long condenser flue to draw away the gases and fumes up onto the moors away from centres of population and the good farmland (Smith 1998, 44). Thus the roasting hearth was the first part of the smelting process with its fumes being diverted into the long Condenser Flue (Raistrick 1975, Vol 2, 14). Such a long flue was also profitable as, through condensation, valuable lead was retained (*ibid*).

7.2.8 The *Roasting Hearth* of the indenture of 1854 would have been an important building of the mill, and was likely to have been a very simple process within a four-walled structure. One wall was the firebridge with the main fuel and heat on the outer side; two opposing walls had three openings or doors, through which the dressed ore was introduced and rotated in the interior. The ore was constantly moved to maintain

the production of smoke and fumes, thus burning the sulphur and preventing the formation of slags. A third wall had the two outlets through which the fumes would go up into the chimney (Martell and Gill 1990, 24 and 29).

7.2.9 It has been suggested that the westernmost roasting hearth, inserted at a later date into the far western wall, was required not only perhaps to roast the dressed ore prior to smelting but was also used, at the end of the lead extraction process, to dry and agglomerate fume settlings from the Condenser House (Smith 1998, 53). These would have been brought down from the Condenser House via the later, and adjacent, tramway (marked on the 1866 plan but not on the 1856 OS map (*ibid*)).

7.2.10 It is possible that the roasting hearth installed in the annex to the east of the main east/west building was replaced by a refining furnace (Smith 1998, 46) for the removal of other metallic impurities from the molten lead or as a cupellation furnace for the removal and production of silver (Smith 1998, 54).

7.2.11 ***Ore Hearths:*** at Keld Heads the ore-hearths were constructed of brick with cast iron fittings at the base to support a hearth-bottom or hearth-box (measuring 1 foot 11 inches x 1 foot 9 inches wide x 1 foot deep), a workstone (3 foot 2 inches wide x 2 feet in depth) set at a gradient, with a groove cut in to conduct the molten lead from the hearth bottom into an iron pot below (Percy 1870, 279) (Plate 34). This space was open for access for approximately one foot. There was a flue above (perhaps as much as a metre from the ground) to draw the smelting gases away (*op cit* 278); each hearth had its own chimney (*op cit* 286). The space behind the hearth was filled with solid half-brick and clay (*op cit* 281), and through this air was piped and then blown under pressure through the tuyere or twyer, into the hearth. It was in these hearths that the dressed ore was placed; the ore hearth produced a grey slag, which still contained up to 25% in lead oxides. The grey slag was then re-smelted in the ore-hearth. The particles in the flue were returned to the roasting furnace for roasting again (Martell and Gill 1990, 26).

7.2.12 ***Reverbatory Furnace:*** a general description of reverbatory furnaces indicate that this was a long structure *c* 8 feet by 6 feet wide at its centre and 2 feet high (or proportionally larger) with the hearth placed at one end and the vertical chimney at the other end. One long wall of the furnace would have had openings for controlling the fuel intake and airflow of the furnace; the opposite side had openings for 'serving in the discharge of the lead and slags'. The bottom of the furnace comprised the layers of the reverbatory furnace slags with the lead pouring away through a tap hole at the lowest point at the centre into a big lead pan (Martell and Gill, 1990, 23-24).

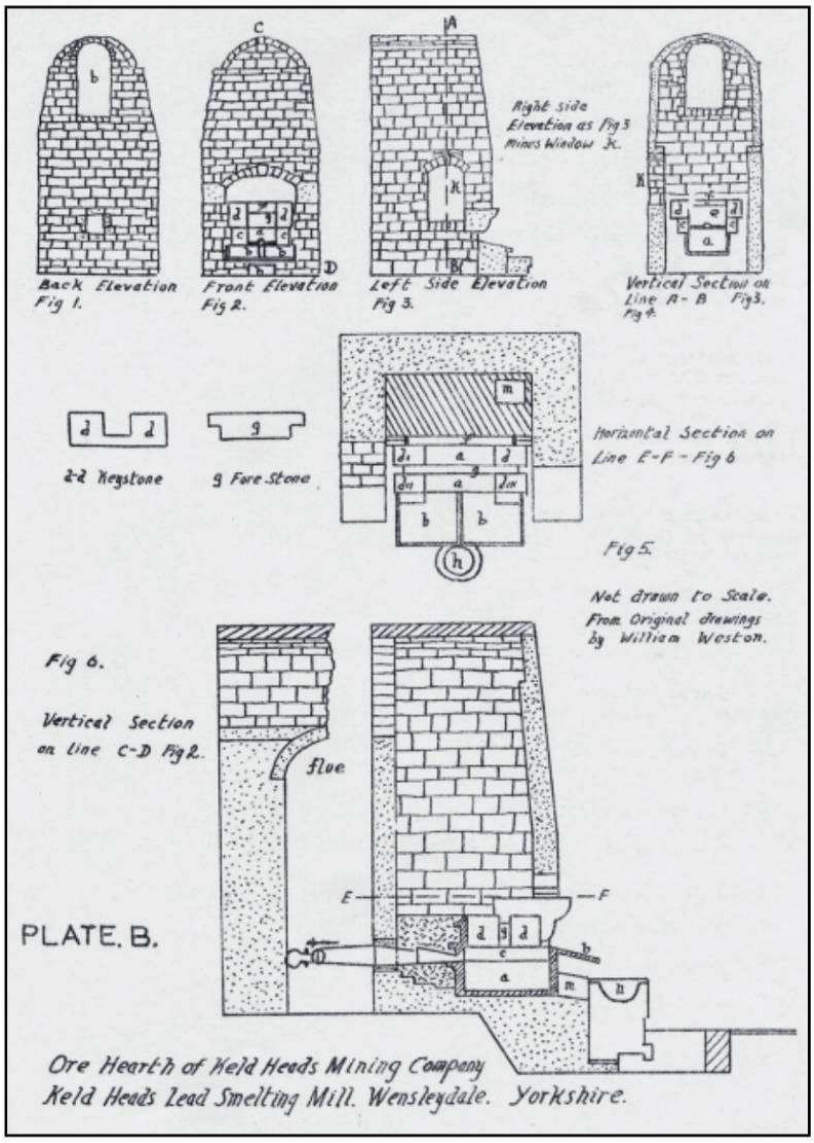

Plate 34: Keld Heads Ore Hearth (after Northern Cavern and Mine Research Society Records 1965)

7.2.13 ***Slag hearths:*** the 'grey slag was taken from the ore hearth for further treatment in the slag hearth' (Clough 1962, 99) and re-smelted in the slag hearth using coke as the fuel and using a stronger blast of air (Raistrick 1975 Vol 2, 14). This produced a black vitreous slag, but generally there was little slag produced overall, as 32 tons of ore would typically give 23 tons of lead and 2 1/4 tons of grey slag (Raistrick 1975 Vol 2, 14-16). Keld Heads had one slag hearth (Smith 1998, 48) and this was described by Percy (in 1870) as being like a small blast furnace, made of fire-brick forming a short tower from which the chimney extended (Percy 1870, 413-4). It had one tuyere or twyer (bellows which forced air in under pressure) and cast-iron fittings for the hearth itself. The slag hearth appears to have been capable of gaining higher temperatures, yielding larger quantities of lead for the same amount of peat and coke. Slag hearths were also used to process the ores from the reverbatory furnace (Martell and Gill 1990, 28).

7.3 THE EXTANT REMAINS OF THE SMELT MILL (FIGS 17, 18, 25 AND 34)

7.3.1 A detailed survey was undertaken of the area of the Smelt Mill, but relatively little of the structure now survives as surface evidence (Plate 35). Large amounts of quarry waste (Site **94**), comprising mainly large boulders, have been dumped upon the southern remains of the Smelt Mill; however, it is probable that the foundations still survive beneath this overburden. Those elements that could be recorded comprised the northern elements of the Smelt Mill and the flues, but, in conjunction with the plan compiled by Clough in 1949 prior to the deposition of the quarry waste, these provide some indication as to the original form of the building.

7.3.2 The main building of the Smelt Mill was built on a large rubble platform which spanned the valley and Keldheads Gill. Through the platform were two culverts, one of which was for the supply of water for the water wheel (Site **92**) (Atkins 2012, 12). The other culvert is perhaps that cited in the Atkins report as carrying water underground emerging south of the Peat Store (Site **134**).

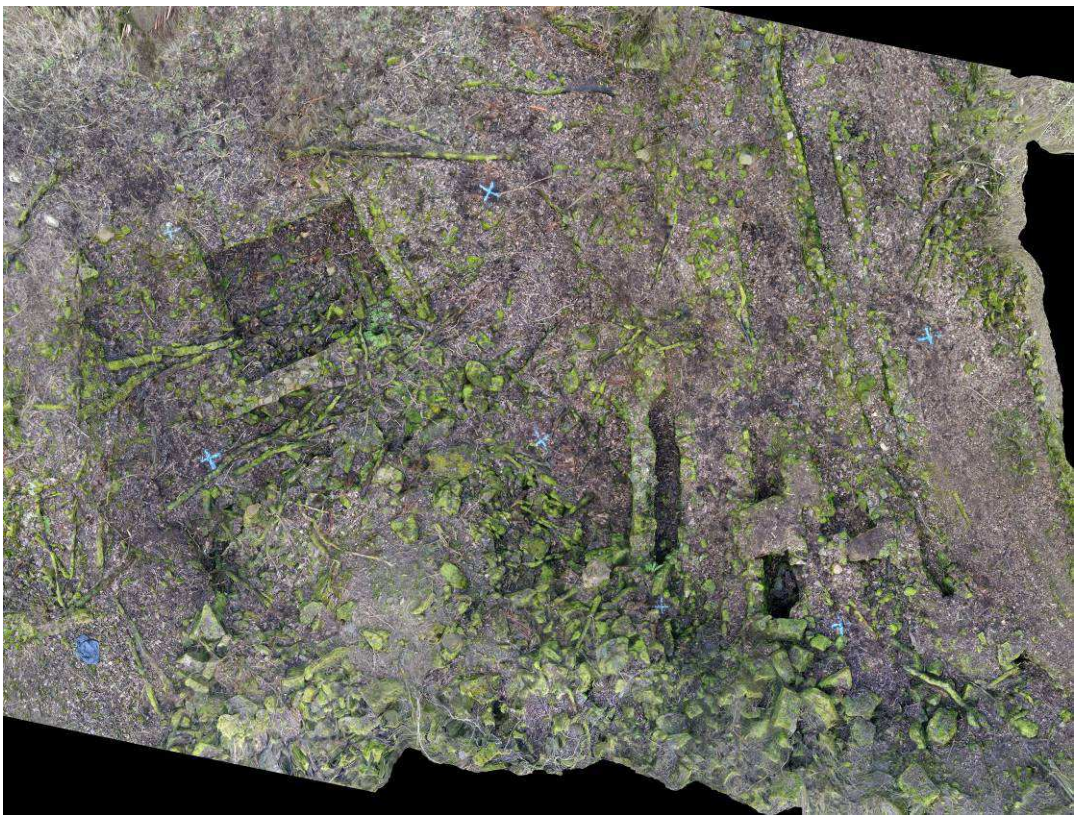

Plate 35: Aerial view of the northern part of the Smelt Mill

7.3.3 ***Northern Mill Building (Ore Stores Site 75):*** the most visible element of the mill are two small rectangular cells at the northern end of the mill, which correspond with two ore stores (Plate 36). The easternmost of these (Site **75a**) is the most exposed, and has earth retaining walls on its western, northern and eastern sides, and a standing wall to the south; it is 4.45m in width by 3.7m and its maximum depth is 1.7m. It has a large hole in the northern wall revealing the vaulted culvert for the gill (Site **134**) which passes underneath the Smelt Mill. Adjacent to its north-western corner is a sloping chute where the dressed ore was deposited into the ore store. The plan of the site by Clough (1962, Fig 31; Plate 33) shows a doorway in the eastern end of the southern wall; however, this section of wall is too degraded to be able to confirm the survival of a wall here. Clough's plan (1962, Fig 31; Plate 33) also shows

a quadrilateral-shaped 'store' butted onto the eastern side of the ore store and a door extending through the eastern wall of the ore store to provide access to this store. However, there is no sign of a door through that extant wall, and, although there are the remains of a quadrilateral shaped structure (Site **75b**), it is located to the south-east of the ore store; it has only partial survival as a series of earth-retaining walls. This highlights that there are inaccuracies within the Clough drawing and although this provides the most detailed record of the Smelt Mill, some elements of detail cannot be too heavily relied upon.

Plate 36: The Smelt Mill ore bins (Site **75a**) looking north

7.3.4 The westernmost of the two ore stores is largely filled with collapse but there is up to 0.5m in height of earth retaining wall visible, particularly on the western side. There are indications of the western side of a chute feeding through the northern wall of the ore store and this is comparable, albeit in worse condition, to the chute extending into the eastern store. The western wall of the ore store is in line with a section of retaining wall (Site **75c**) to the south which corresponds with the western wall of the mill building. This arrangement corresponds with the 1866 plan of the Smelt Mill; however, the Clough reconstruction (Plate 33) depicts this wall as being staggered to the east by approximately a metre, and would appear to provide a further indication of errors within the Clough plan (Plate 33).

7.3.5 To the west of the mill is a small fragment of east/west orientated walling (Site **75d**) which survives to five courses; this corresponds in position with a cross wall on an unroofed structure shown on the 1866 mine plan, which was shown to butt onto the western side of the Smelt Mill building. The unroofed structure was not depicted on Clough's plan (Plate 33) and was to the west of the later roaster house on the west side of the later mill building.

7.3.6 ***Flues:*** the survey has revealed two main Condenser Flues, which split into five separate flue-ends that converge on the different elements of the Smelt Mill. The southern and western terminals of these flue arms; however, have been obscured by

the quarry waste. The easternmost of the flue-terminals (Site **6g.1;** Plate 37) curves around the eastern end of the original Smelt Mill building and leads up to what is believed to have been the original roaster house (Site **128**). It clips the corner of the Smelt Mill building, as defined on the 1866 map and it is possible that it extended beneath the building. This flue ultimately connects to the easternmost of the parallel flues (Site **6f**), but there is no extant evidence of the point of connection, and this has probably become obscured.

7.3.7 The easternmost of the conjoined flues splits up into two terminals (Sites **6g.2** and **6g.3**) which both extend towards the original east/west Smelt Mill building. These both have the survival of one capping stone each.

7.3.8 The westernmost of the conjoined flues (Site **6f**) splits up into two flue-terminals (Sites **6g.4** and **6g.5**), with the easternmost of these leading towards the southern (earlier) mill building. The westernmost conjoined flue-terminal has a marked east/west dog leg where it joins with the main flue, and then extends towards the south-eastern corner of the northern (later) mill building, as is represented on the 1866 mill plan. Flue-terminal **6g.4** is almost completely filled with collapsed material, whereas the adjacent flue-terminal **6g.5** is mostly empty.

Plate 37: Flue-terminals **6g.1**, **6g.2** and **6g.3** looking south

7.3.9 The 1866 mill plan (Fig 36) shows a further flue-terminal to the west of **6g.5**, but which is not evident on the ground; however, its former location and orientation can be fairly confidently inferred on the basis of the shape and form of the adjacent features. The location and orientation of the dog-leg in flue-terminal **6g.5**, along with the unusual, quadrilateral shape of the store house (Site **75b**) are an indication that there was a former flue-terminal extending parallel to the dog-leg and the southern wall of the store house. This would have extended into the middle of the eastern wall of the northern (later) mill building.

7.3.10 A further flue-terminal (Site **6h**) is depicted extending out from the eastern side of the conjoined flues, around the northern end of the later mill building (Site **75**) and over the large culvert of Keldheads Gill (Site **134**). It is then shown on the 1866 plan converging on the later, small, roasting house on the west side of the mill. However, on the ground once it had extended over the gill culvert, it was observed to enter into an underground flue and thereafter, there was no surface impression to indicate its onward course. It was in relatively good condition, and had, for the most part, intact retaining walls.

7.3.11 On the basis of the observed evidence and the cartographic mapping it is evident that there were seven flues, and these would have led to seven hearths. The easternmost was the early roasting hearth in building **128**. With the expansion of the Smelt Mill, this roasting hearth went out of use, being replaced by one on the western side of the new mill building, and its flue-terminal was Site **6h**. Three flue-terminals (Sites **6g.2**, **6g.3** and **6g.4**) led into the northern side of the southern mill building, and it is probable that these provided the exhaust for three ore hearths. Two of the flues fed into the eastern side of the northern Smelt Mill building, and it is probable that at least one of these serviced a slag hearth; the other may have been for a further ore hearth (*Section 7.2.11*).

7.3.12 ***Peat House:*** the Peat House (Site **73**; Plate 38; Fig 18) survived in its entirety (except for the roof): it was a building *c* 17.4m by 6.1m of rubble stonework. It is trapezoidal in shape, of double height with no second storey and is open to the roof. It was supported on seven tie-beam trusses of wood (Clough 1962, 101) and has four bays; at ground level with four cart openings and plain rectangular openings above. The gables are both blind; the west elevation has four square windows above to match those at the front of the building. Photographs are included in Clough 1962 and Raistrick 1975 showing that it previously had stone slate roofing, but the roof has now been replaced with modern corrugated iron.

Plate 38: The Peat House (Site **73**) looking west

7.3.13 Externally, the north side of the structure would have adjoined another ancillary building, as part of a range of buildings associated with the Smelt Mill (Site **75**), the foundations of which are now beneath a large quarry spoil heap (Site **94**).

8. THE OLD SMELT MILL, CONDENSER FLUE AND CONDENSER HOUSE

8.1 THE OLD SMELT MILL

8.1.1 ***The Site of the Old Smelt Mill:*** while there has been considerable uncertainty in the past as to the precise location of the Old Smelt Mill, the suggestions for its location have always placed it in the general area of the later Condenser House (Smith 1998, 59-61; Gill 1992, 115). Smith (1998) notably suggested that it was *c* 50m south of the site of the Condenser House wheel-pit, at NGR 407777 491143 (Gill pers comm). The Old Smelt Mill was complex with three hearths and perhaps three buildings as shown on the three eighteenth century plans (*Section 3.2.8*) (ZBO (M) 1/1 1723; ZBO (M) 5/1 1778; Atkins 2012). The 1723 map showed that from the dam to the north, flowing southwards, were two leats, one of which entered into a small square building to the west and the second entering a larger northern east/west building of the L-shaped pair of buildings just to the east. The early *Eighteenth century map from the Bolton Estate* showed the early Smelt Mill as having three (perhaps four) hearths and flues sited along the eastern leat with another building alongside the second leat.

8.1.2 Comparing the historic maps with the present survey has demonstrated that the two leats came south from the Preston Mill Dam (Site **145**), which was to the north-east of the later large sub-rectangular reservoir (Site **28**) of the 1850s. This early reservoir was then subsequently worked as a small quarry (Site **5**) (Smith 1998, 60), but elements of the original reservoir do survive on the east side. South of the dam towards the wheel-pit of the Condenser House, a flat platform area (Site **102f**) had been identified by Smith (1998, 61). The Condenser House itself (Site **102a/d**) is sited at the top of a steep bank at the southern edge of this platform; this may have been the site of an earlier water wheel. It is interesting to note that the alignment and flow of the leats (particularly Sites **108b** and **102b**) and Keldheads Gill seem to have been relatively accurately depicted on the 1778 map (ZBO (M) 5/1, 1778) (Plate 39). It may then be possible, therefore, to rely upon the map to determine that this is indeed the location of the Old Smelt Mill (Site **144**) (Fig 15).

8.1.3 The present fieldwork and contour survey of 2015 has located the modern quarry (Site **5**) and potentially the remains of the earlier reservoir (Site **145**) (Figs 13, 15 and 23). South of the quarry a north-east/south-west leat (Site **108b**) was identified which fed water to the Condenser House and which was depicted on the 1778 map as supplying the Old Smelt Mill (Site **144**). The southern end of the leat survived as a well-defined embanked feature (Site **108b**), which crossed the large platform (Site **102f**) north-east of where the Condenser Flue emerged from the Condenser House. On the north side of the stone condenser building there was a small rectangular annex (Site **102e**; Plate 41), which measured 7.6m by 5.25m, it had short wall stubs on the south end, and was slightly levelled suggesting extant flooring close to the ground surface. This small levelled annex was either a part of the Condenser House, or was part of the earlier Old Smelt Mill.

8.1.4 The site of the L-shaped Old Smelt Mill buildings shown on both the 1778 map and early eighteenth century map (Figs 15 and 23; Plates 39 and 40) closely resemble the footprint of the stone section of the Condenser House with the wheel-pit (Site **102a**),

along with the platform/levelled area east of the wheel-pit outflow to the south (Site **102b/c**). It is clear that the footprint of the Old Smelt Mill is either partially overlain by the Condenser House, or it in fact re-uses part of the smelt mill building with the wheel-pit in the newer structure.

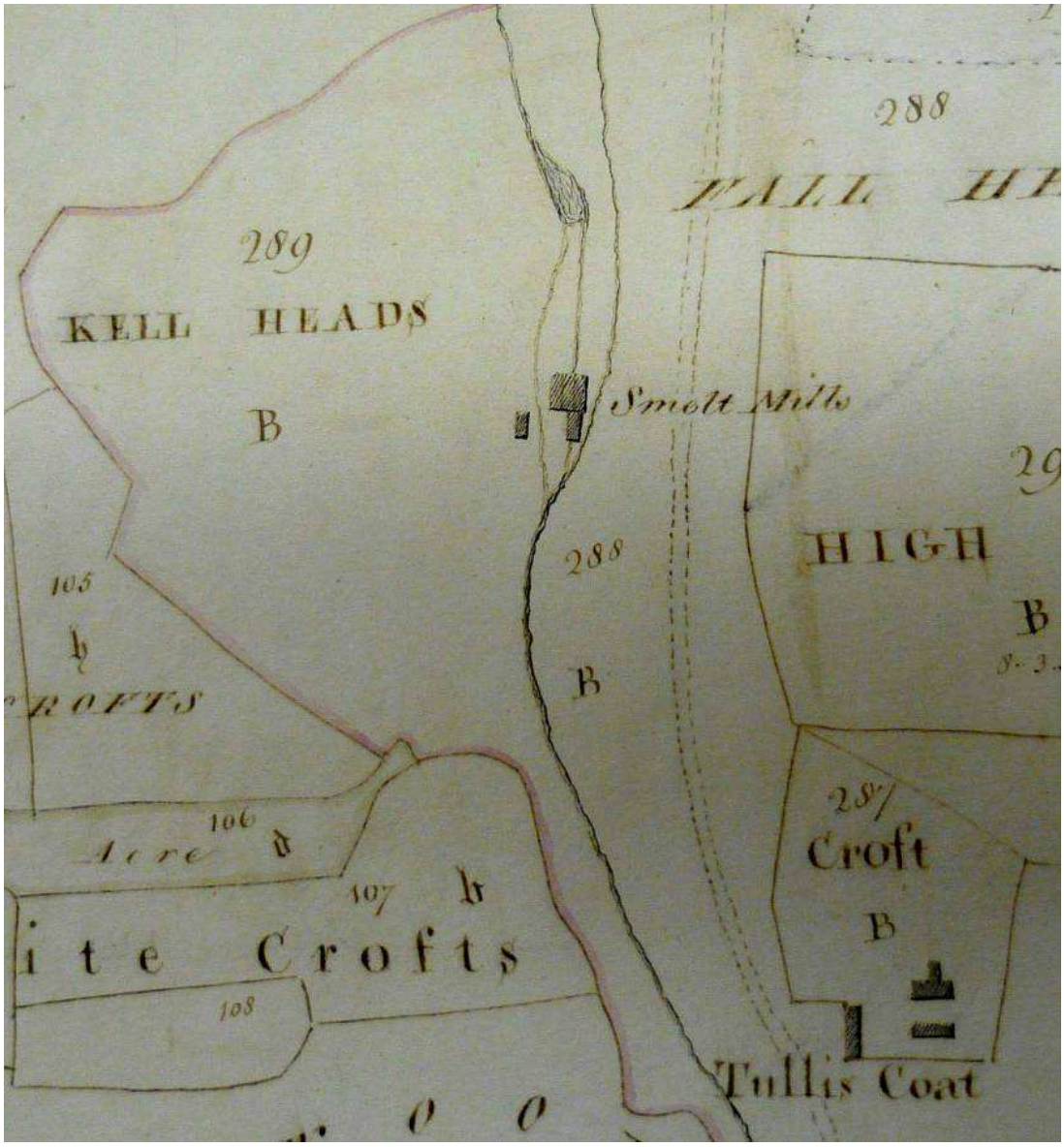

Plate 39: Extract of A Plan of the Manor of Wensley and Preston, 1778, showing the Old Smelt Mill and its leats

Plate 40: Extract from *The Eighteenth century map from the Bolton Estate* showing the Old Smelt Mill

Plate 41: The small annex (Site **102e**) at the southern edge of the large platform (Site **102f**)

8.1.5 Given that the launder platform (Site **108b**) has not changed since the 1778 map, there is an implication that in the Old Smelt Mill (Site **144**), the wheel-pit that it originally supplied, is in the same location as the wheel-pit for the Condenser House

(Site **102**),. The large north/south orientated tail-race (Site **102b**) would have served both the Old Smelt Mill and the later Condenser House.

8.1.6 ***Ancillary Old Smelt Mill Building:*** the three eighteenth century maps also depicted a rectangular building located west of the main L-shaped block of furnaces and to the west of the western leat (Figs 15 and 23; Plates 39 and 40). The present survey has demonstrated that elements of this building were still extant (Site **117**; Plate 42), though there was no clear surviving evidence for the early leat running to this feature. This building was also shown to the south of the western half of the Condenser House on the 1856 and 1866 maps (Figs 2 and 3). Smith describes it as a 'square, stone-lined earthwork' (Smith 1998, 55) that was set into the ground, with its base being up to a metre below the present ground level. On the 1856 map it was denoted as a building and on the 1866 plan it was a square building with a tramway leading from it, down to the yard on the western side of the later Smelt Mill. Close examination of an early nineteenth century photograph (Plate 50; NMRS, Clough Collection) seems to suggest the surviving remains of the southern corner of the building within a raised level of ground (*Section 8.3.10*). This image shows on the raised ground level adjacent to the visible remains of the building, the channel for an above-ground water-course leading to the settling pits, which seemingly overlay the square store or structure (Site **117**). The deep drop to the south of this (and the growth of the trees) suggests that the stone structure had been landscaped in, to form a partially underground building, accessed from ground level on the south side.

8.1.7 This square structure, was marked on the 1866 map as the collection or delivery point for the tramway between the later Smelt Mill and the Condenser House. It may latterly have been used as the store for the solid lead material gained from the Stokoe Condensers (whereas the western tramway collected the lead material from the settling pits) eventually going back to the roasting hearth in the north/south extension of the Smelt Mill.

Plate 42: The sunken building Site **117** looking north

8.1.8 This building (Site **117**) does appear as a constant on all the historic maps back to that of 1723; it may have been a building with an underground stone-lined storage facility for lead; firstly from the Old Smelt Mill of the eighteenth century and then later, from the Condenser House of the mid-nineteenth century. Its consistent location is significant as it provides a locational reference which can be used to define the location of the Old Smelt Mill, which no longer survives as a clearly identifiable feature. On this basis it can be fairly reliably inferred, by comparison between the 1778 map and the present survey (Figs 15 and 23), that the northernmost element of the Old Smelt Mill (divided into three partitioned entities) was on the site of the Condenser House and wheel-pit (Site **102a**), and that the southernmost part of the 'L' shaped building extended over the area of the tail race and adjacent platform (Site**102b/c**).

8.2 THE CONDENSER FLUE (FIGS 15, 17, 18, 23, 24, 25 AND 34)

8.2.1 The New Smelt Mill constructed by the Keld Heads Mining Company *c* 1851-4, was built much closer to the area of the main mine adits and dressing floors south of Tullis Cote. This perhaps enabled the site of the Old Smelt Mill to be used for the building of the Condenser House. The indenture of 1854 referred to the 'patent Condenser House' and horizontal chimney (Smith 1998, 43-4). The extraction of lead from the smelt gases leaving the Smelt Mill had been found to be very profitable and was part of the raft of new technologies installed by the Mining Company. In order to extract as much lead as possible from the smelt gases and smoke, the flue needed to be very long to allow for a greater period of time for the lead particles from the smelt gases to settle (Percy 1870, 437). However, it was also a condition of the terms of the lease for the Smelt Mill to install a long condenser flue to draw away the poisonous gases up onto the moors away from centres of population and the good farmland (Smith 1998, 44).

8.2.2 At the southern end of the flue the first of the two main Condenser Flues was associated with the early phase of the New Smelt Mill comprising the east/west orientated building (as seen on the 1856 OS map) with the small extension on the east of this being the roasting house (Site **128**) (*Section 7.3.6*). Within this was thought to be the roasting hearth and flue (Site **6g.1**), which was the initial part of the smelting process, and its gases and fumes were diverted into the easternmost Condenser Flue (Site **6f**) (*Sections 7.3.6; 7.2.7*; Smith 1998, 44-8, 54; Martell and Gill 1990, 29-30; Raistrick 1975, Vol 2, 14). Two other hearth flues (Sites **6g.2** and **6g.3**) also led from the original smelt building to conjoin into the easternmost Condenser Flue (Site **6f**; Plate 43) (*Section 7.3.7*).

8.2.3 The later extension of the Smelt Mill, as seen on the 1866 plan, comprising the north/south building with its extra hearths and flues (Sites **6g.4** and **6g.5**) probably occasioned the building of the westernmost of the conjoined flues (Site **6f**; Plate 44) which was possibly done by 'placing a wall parallel to the west wall of the original flue as far as the Condenser House' (Raistrick 1975, Vol II, 102-3). It is apparent that the easternmost flue was the earlier of the two Condenser Flues. The two conjoined flues of the main Condenser Flue were only built as far as the Condenser House, and to the north of the Condenser House, it was a single main flue.

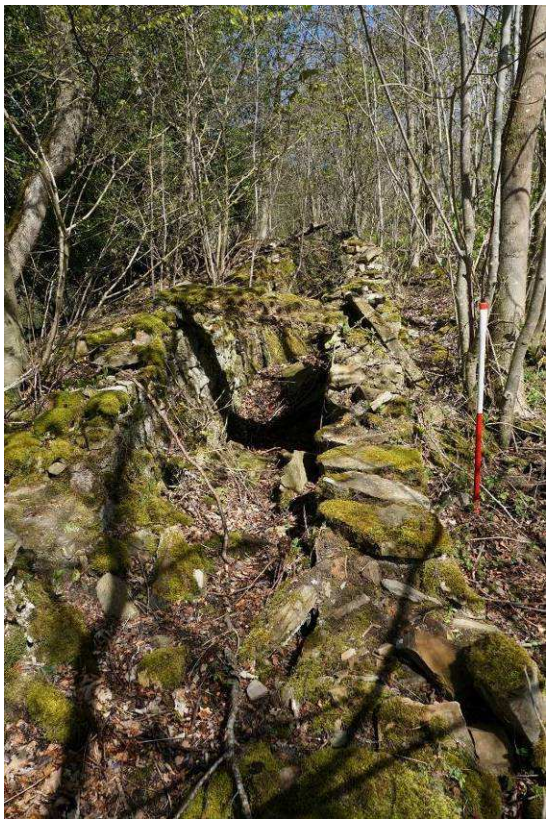

Plate 43: The earlier eastern Condenser Flue (Site **6f**)

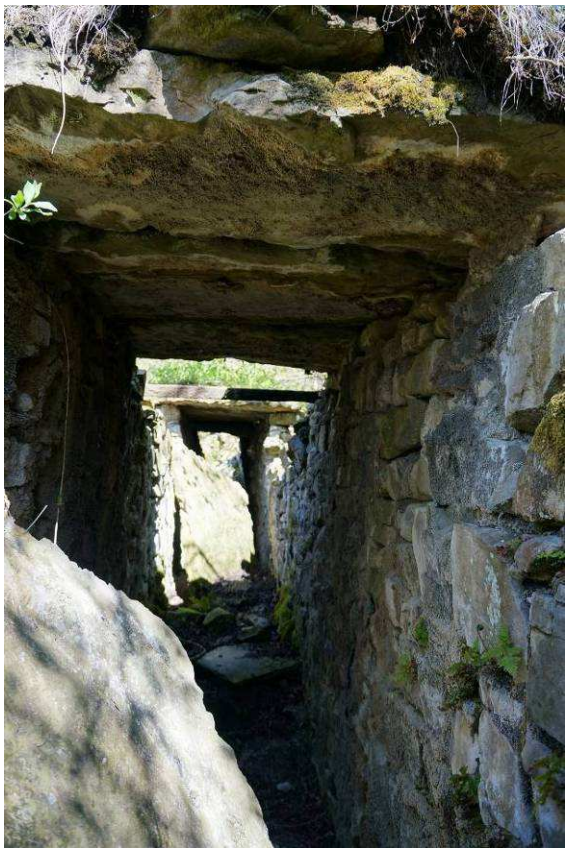

Plate 44: Part of the conjoined Condenser Flue leading north to the Condenser House (Site **6f**)

8.2.4 The early phase of the Condenser Flue was probably built by 1854, as indicated by the *Indenture* of that date (Smith 1998, 44) and seems to have terminated at an upstanding chimney (Site **7**) (Fig 12) as marked on the 1856 OS 1:10,560 map. Surviving remains of the chimney are evident where the flue (Site **6c**) changes alignment at what now survives as a small platform (Site **7**). Shortly after 1854 and 1856 the Condenser Flue was extended by 3.3km to Cobscar Mill (Site **6b**).

8.2.5 Cartographic evidence for the use and survival of the upstanding chimney is unclear as the area of the chimney is not covered by the 1866 plan. The chimney was shown on the 1878 plan, but this plan does appear to draw heavily on the 1856 OS map with only some amendments, and may not be an accurate portrayal of the site in 1878. The chimney is not shown, however, on the 1891-3 OS map. Smith suggests that the upstanding chimney may still have been required during the years after the condensing flue was extended in order to balance or enhance the draughts between Keldheads Mill and Cobscar (Smith 1998, 58).

8.2.6 ***Condenser Flue Description:*** the Condenser Flue is double and aligned running upslope north/south on the southern end near to the New Smelt Mill (Site **6f**), it then curves around further to the north-north-west/south-south-east (Site **6e**) before reaching the Condenser House. From here is continues on the same orientation as a single flue (Site **6d/c**) before turning sharply to the north-west/south-east in the area of the original flue chimney (Site **7**) and runs towards the road (Site **6b/a**). The surveyed section of flue measures *c* 400m in length and the general build was of a rectangular flue, having a mortared stone construction with a stone slab roof. In several places, this roof had been replaced by an arched vaulted roof; for instance there was a vaulted arch roofed section running under a trackway (Site **23e**) and at the northern end of the surveyed part of the flue (Site **6a**) immediately beneath the road. The best preserved element is the section of double flue (Site **6e**) located where it led up to the south side of the Condenser House (Site **102**). North of the Condenser House, the flue continued only as a single flue and it is much more damaged and fragmentary (Sites **6d** and **6c**).

8.2.7 Outside of the study area to the north of the road defining the northern edge of the study area, the flue continued 3.3km up the moorland to the Cobscar Mill Chimney. It was described as being *c* 1.02m wide and had short vertical walls 0.45m thick, standing to a height of 0.45m above ground level. The walls had springers for an arched roof (TAP 1995, 2) and in places had a stone-flagged roof (EH Scheduled Monument Entry).

8.2.8 ***Extracting the Lead from the Waste Gases:*** within the Condenser Flues deposited materials (sometimes referred to as smelter's fume) were scraped down or hosed-off for collection and then re-smelting, and this would probably be undertaken during a period of shut-down for the mill workings (TAP 1995, 1). Percy also mentioned that 'the flues had openings at intervals through which men may enter and bring out the fume [the settled deposit]' during periods when the furnaces were not operating (Percy 1870, 437).

8.2.9 It had also been discovered that lead could be extracted from the smelting gases and smoke by the action of jets of water and air, to form a steam from which sulphurous acid and lead compounds would be formed in condensing chambers. The Condenser House was built to utilise this second method of extracting lead (*op cit*, 434, 436-7 and 442-3).

8.2.10 At Keld Heads lead from the ore and slag hearths, mined from 1856-57, amounted to 1374 tons, and from the condensing systems 96 tons 13 cwt of lead was extracted (Percy 1870, 456). This data was collated prior to the installation of the later Stokoe Condensers in 1862, demonstrating that the investment in the Condenser Flue and house was economically justified.

8.3 THE CONDENSER HOUSE (FIGS 15 AND 23)

8.3.1 The Condenser House (Site **102**) had been built by 1852 (Spensley 2014, 193) and the Stokoe Condensers were installed in 1862 (Gill 1992, 115); there is no information as to the type of condensing operations that happened prior to 1862.

8.3.2 ***Cartographic Study of the Condenser House Site:*** the four plans and maps drawn up in 1856, 1866, 1878 and 1891-3 detail the one long east/west building on either side of the Condenser Flue. On the 1856 OS map the Condenser House was at the southern end of a leat (Site **108**) emerging from Keldheads Gill (the full northern extent of this leat was not shown on the 1866 plan). On the 1856 map there was also marked a small detached square building (Site **117**) to the south of the west end of the Condenser House (this map was drawn up prior to the installation of the Stokoe Condensers). There was another feature to the west of this labelled *Pit*, and was probably the precursor of the large settling pits (Site **100**) that were seen on the 1866 plan.

8.3.3 The 1866 map (Fig 36) showed the detail of the east/west Condenser House as two parts (Sites **102a/d**) with the wheel-pit on the south side of the eastern half and a reservoir immediately to the west of the western half (Site **116**). The detached square building to the south of the western half of the Condenser House (Site **117**) was depicted as being at the end of a tramway which connected to yards or bins on the west side of the north/south later Smelt Mill building. A western arm of this tramway (Site **95**) went through the settling pits (Site **100**). It has been suggested that fume settlings from the condensing operations were sent down from the Condenser House to the new roasting hearth of the New Smelt Mill via this adjacent tramway (Smith 1998, 53). These fume settlings were possibly roasted for drying and agglomeration in the westernmost roasting hearth of the New Smelt Mill (*ibid*) (*Section 7.2.9*). The detached square building (Site **117**) on the eastern arm of the tramway may have latterly been a store for the solid material gathered at the base of the Stokoe Condensers.

8.3.4 By the time of the 1891-3 OS map, the Condenser House was shown as a long east/west building with the reservoir to the west and a detached square building (Site **117**) to the south.

8.3.5 ***Condenser House Description:*** the building for the Condenser House was 21.3m long and 7.6m wide with a stone-slated roof (Clough 1962, 99) and was aligned east/west straddling the Condenser Flue (Site **6**) 145m to the north of the Smelt Mill building (Site **75**). To the east it was built of stone (Site **102a**) and on the western half (Site **102d**) was a timber structure for the actual Stokoe Condensers, with the condensing flue from the Smelt Mill between the two parts (Plate 45).

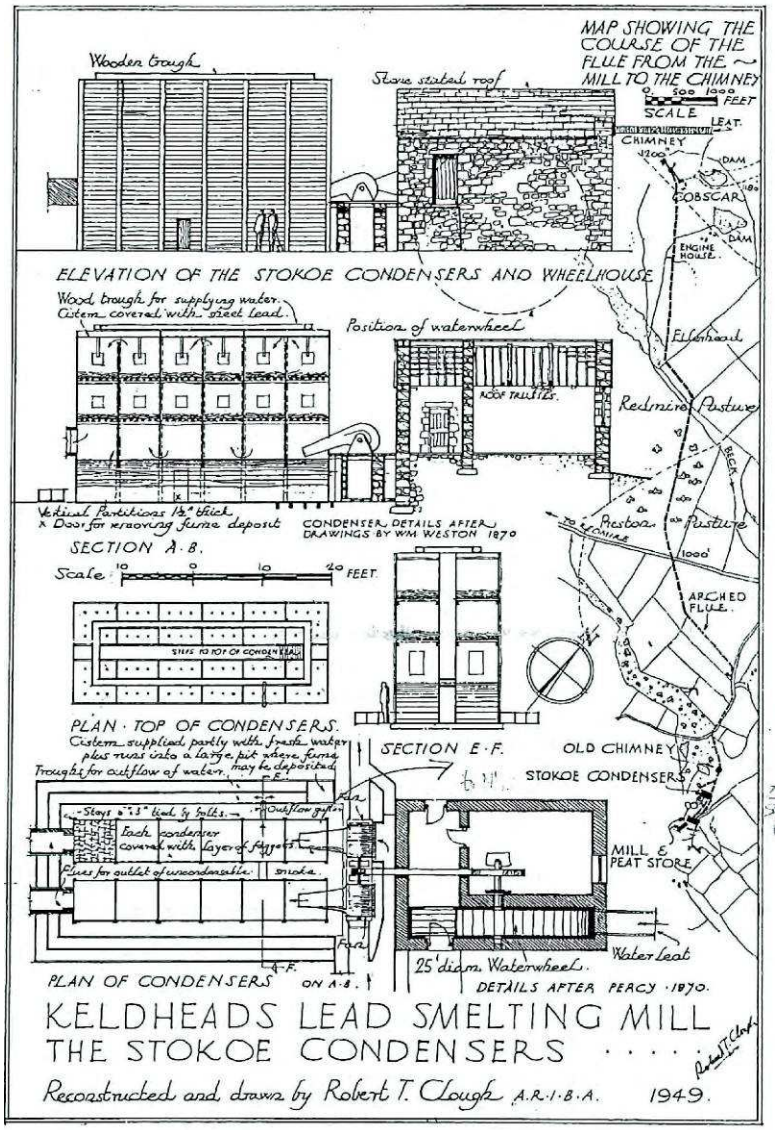

Plate 45: Reconstruction of the Stokoe Condensers by RT Clough (1962)

8.3.6 The surviving rectangular stone structure (Site **102a**) is set into a steep south-facing slope south of the little annex (Site **102e**) and below the large platformed area (Site **102f**). It consisted of dressed stone wall foundations for a single rectangular room (5.7m by 3.7m internally). To the south was a large wheel-pit orientated east/west and set into the slope (Plates 46 and 47), and would have been supplied by the leat **108b**, taking water from Keldheads Gill, and at a later date the supply was augmented by launder **113**, taking water from the large reservoir **28**.The water wheel was intended to drive the fans of the 'fan house', which was housed in the stone half of the Condenser House and over the main Condenser Flues (Smith 1998, 55), and were intended to force the smelt gases into the Stokoe Condensers (Raistrick 1975, 102-3).

Plate 46: The southern side of the Condenser House wheel-pit (Site **102a**)

Plate 47: The Condenser House wheel-pit looking west (Site **102a**)

8.3.7 The site of the timber Stokoe Condenser building, west of the stone Condenser House, has left very little visible evidence, except for a well-defined and deep rectangular depression (Site **102d**) cut into the hillside, extending westwards, across the modern path, close to the eastern edge of Reservoir **116** (Plate 48). Within the building, the condensers themselves, mostly made of wood, comprised eighteen chambers through which water was continuously sprinkled (probably directly from the reservoir (Site **28**). The smoke from the hearth flues of the Smelt Mill brought into the condensing flue was forced or injected (by means of a fan) through each chamber or condenser, creating steam, which was then condensed, holding the lead fumes in suspension. The solid materials were collected from the basal layer of the chambers (Percy 1870, 442-3) via a door at the bottom of the condenser (Smith 1998, 56). The earlier survey (Smith 1998, Fig 5) recorded an elongated trough on the southern edge of building **102d** opening into the store building **117** to the south, which may have been the route for the heavier lead solids into the store.

Plate 48: The western face of the Condenser House (Site **102a**), where the Stokoe Condenser formerly butted (Site **102d**)

8.3.8 ***The Settling Pits (Figs 15, 17 and 24):*** the suspension of lead fumes in water was then channelled out to the large settling pits (installed by the time of the 1866 plan) which are to the south-west of the Condenser House (Sites **100**) (Plate 49). On the 1866 plan these are depicted as two large trapezoidal features, and Clough reported them as 'two large open stone flagged settling pits' (Clough 1962, 101). The settling pit to the south (Site **100**) had well-constructed drystone, internal retaining walls visible with an aperture in the centre of the southern retaining wall; the settling pit to the north survives only as a sub-square sunken feature with one wall at the eastern side. The NMRS photograph of the Condensing House (Plate 50) showed that the northern settling pit was connected by a channel from the Condenser House (Smith 1998, 58).

Plate 49: The settling pits (Site **100**) looking south-west

8.3.9 The 1886 plan also marked, to the south of the settling pits (Site **100**), another small reservoir with the north-west corner cut by the tramway. This was interpreted by Smith as being a small rectangular pond (Smith 199, 56), surviving as a shallow U-shaped earthwork (Site **99**), and was probably the fragmentary remains of a small pond to provide a further cleaning process for the outflow from the settling tanks (Smith 1998, 57-8).

8.3.10 ***Photograph from the Clough Collection, NMRS*** (Plate 50) (*c* 1908): this photograph recorded the stone-built half of the Condenser House **102a**, with a door on the west side of the windowless southern elevation (and another door opposite it on the northern elevation). The south wall also had a chimney on the southern corner eastern gable. West of this were the considerable remains of the Condensing Flue **6f**, which was built of regular well-constructed stone work. Behind this was the wheel-pit for the water wheel, which had evidently been dismantled.

Plate 50: The Condenser House *c* 1908 (Photo of J Backhouse, from the Clough Collection, NMRS). The photograph is taken from approximate grid reference 40774 49113, and was orientated north-east

8.3.11 West of the Condensing Flue was a deep rectangular pit, the site of the timber building **102d** housing the Stokoe Condensers. On its southern edge was, at an angle, the channel, which may perhaps have held a wooden launder taking the water in which the lead particles were suspended down to the settling pits. The visible doorway may be the partition door between the northern and southern tanks. The tanks were large, shallow, stone-flagged areas, providing a large surface area for the evaporation of the water and drying of the lead.

8.3.12 At the corner, where the channel is observed leaving the south-eastern edge of where the Stokoe Condenser building was sited, and south-east of the channel, can be seen the remains of what was a stone structure (Site **117**). The deep drop to the south of this (and the growth of the trees) suggests that the stone structure had been landscaped in to the slope, forming a partially underground structure, accessible from ground level on the southern side.

8.3.13 ***Reservoir 116:*** to the west of the Condenser House was a large structure or pond clearly marked on the 1866 map (Fig 36); however it is not clear what it was used for. The markings between Reservoir **116** and the Stokoe Condensers observed on the 1866 map, suggest that it accommodated the drainage of surplus water from the condensers. The reservoir was above the settling pits and may have entailed the cleaning and refreshing (Smith 1998, 56) of the fume filled water.

9. WATER SUPPLY

9.1 EARLY WATER SUPPLY FEATURES

9.1.1 Water was the key to the whole lead working operation. Water provided the power for the Smelt Mills, it provided power for the Condenser House and for the winding gear of the shafts. It was used to wash the ore on the dressing floor, as well as provide power for the buddles. It is perhaps, therefore, not surprising that the area is covered with the complex remains of water channels, canalised streams, reservoirs, launder bases, and also the wheel-pits. Because there was such a high demand for water in all aspects of the lead production operation, all available sources of water were used, and included available springs, the main Keldheads Gill, and the drain outfall from the adits. Making full use of water flow, even in low water conditions, meant that there was an increasing reliance on reservoirs to store and regulate the water supply, which became steadily larger, culminating with the construction of reservoir **28**.

9.1.2 ***Old Smelt Mill Water Supply (Figs 13 and 15):*** the earliest water features related to the Preston Smelt Mill (Old Smelt Mill), which possibly dated to 1650-5 (*Section 3.2.7*), and was first depicted on the 1723 estate map (Plate 1). It was, however, more clearly depicted on the 1778 map, which at first glance appears to be fairly schematic, but in reality is actually relatively accurate, and can be used to provide an indication of the locations of the key water features, as well as the Smelt Mill (Fig 15). From close comparisons between it and the present survey mapping it would appear that the Old Smelt Mill was on the site of the later Condenser House (Site **102**). The 1778 map shows a water channel extending into the area from a higher pond or reservoir (outside the study area), leading to a tear drop-shaped reservoir, and from this was a head race leading to the 'L' shaped Smelt Mill, beside Keldheads Gill. The water channel above the reservoir survives as a small stream feature (Site **145**) and feeds into a former reservoir on the site of Quarry Site **5**. Much of the reservoir has been cut by the later quarry, but the north-eastern edge survives as an earthwork (Site **145**), and the continuation of this leads into a linear earthwork, on the eastern side of the quarry, which may be a survival of a launder base; it certainly corresponds in position and orientation with the outflow channel from the reservoir shown on the 1778 map. This earthwork is orientated with a linear, flat-topped bank (Site **108b**) on top of an artificially flat platform (Site **102f**), and this would appear to be the elevated launder base for a head race feeding a wheel-pit in the Old Smelt Mill which would have either corresponded to the location of the wheel-pit in the later Condenser House (and which was potentially re-used for the Condenser House) or been in an approximately similar location (Site **144**). The raised embankment (Site **108b**) was later re-used as part of the leat (Site **108**) that had a take off from Keldheads Gill.

9.1.3 The position and shape of the Old Smelt Mill corresponds with the outline of the Condenser House and its eastern edge is approximately coincident with the tail race earthwork **102b** and adjacent platform **102c**., which leads down to Keldheads Gill (as does the representation on the 1778 map). The 1778 map also shows a channel or leat extending from the south-west corner of the Site **145** reservoir leading down to a building to the west of the Old Smelt Mill. There are no surviving indications of this channel, but it does lead through an area that has been much disturbed by later activity.

9.1.4 ***Mid-Nineteenth Century Water Supply:*** the 1828 estate map showed little change from that of the 1778 map; however, by the time of the 1856 OS first edition map there had evidently been very considerable change in the landscape. By this time the new Keldheads Smelt Mill (New Smelt Mill) had been constructed to the south, probably in about 1851 (*Section 3.3.18*), and a Condenser House had been established on the site of the Old Smelt Mill. Both of these required considerable water power and necessitated the establishment of a complex of water features drawing on natural hillside springs, Keldheads Gill and drainage adits.

9.1.5 The water supply for the Condenser House (Site **102**) used the same embankment (Site **108b**) (supporting a launder) as the earlier Smelt Mill suggesting that the condenser wheel-pit was in the same location as that of the underlying Old Smelt Mill. However, instead the water was drawn from Keldheads Gill rather than the small reservoir (Site **145**), and necessitated the construction of a leat (Site **108a**; Plate 51) that was terraced into the slope. A very substantial tail race extended south from the eastern end of the wheel-pit and led into a stone-revetted canalised section of Keldheads Gill.

Plate 51: The headrace leat (Site **108a**) extending between Keldheads Gill and the Condenser House

9.1.6 The water supply for the Condenser House was augmented by a leat (Site **123a**) that diverted water off a drainage channel extending out from Adit **19**. The leat sloped down to the east, extending to the north of a large shaft (Site **111**) and was terraced into the hillside; it had a substantial embankment on the downslope side representing the upcast from the excavation of the leat.

9.1.7 The southern line of the drain from Adit **19** was shown on the OS 1856 map extending south and leading to an oval reservoir (Site **90**) near the Keldheads Smelt Mill. A substantial part of this drainage channel had been lost when the large reservoir (Site **28**) was constructed. However, there is an extant section (Sites **26b**

and **97**) flowing into the former reservoir (Site **90**), and is a 1m wide stone-revetted channel for much of its length.

9.1.8 The oval reservoir (Site **90**) is located just north of the New Smelt Mill and was fed by Keldheads Gill and the drain from Adit **19**. The reservoir is mostly infilled and is poorly defined on the ground, with only the curving eastern end clearly visible. It would have measured 36m by 21m, and had a large east/west orientated earth and stone-constructed dam on its southern side; this has, however, been breached in the centre. The dam is 37m by 15m and is over 2m high (Plate 52), and has a lattice of iron bracing posts protruding from the gap. The outfall of the reservoir was either the main Keldheads Gill, which flowed through a conduit underneath the Smelt Mill, and would have served as a bypass, or exiting via a leat (Site **92**) from the south-west corner of the reservoir. This leat would have led around the western side of the Smelt Mill to a water wheel on the western side of the mill; however, it presently stops short of the mill and it is not certain if it originally continued as a launder or if it has been partially infilled. A further outfall channel was shown on the 1856 OS map extending from the south-eastern corner of the reservoir and led to a small structure / pond then near Tullis Cote Farm, but is now underneath the existing farm buildings. There is only limited survival of this channel and comprises a broad leat (Site **76**) which is overlain by the Condenser Flue and the main track. It evidently only had a short life, as it was not depicted on the 1866 mine plan.

Plate 52: The extant section of the dam (Site **90**) which has been breached

9.1.9 The water supply for the New Smelt Mill was augmented by a network of streams (Site **22**) which are often canalised in places and which are sourced from a series of springs surfacing on the hillside at the north-western edge of the study area. In the 1856 OS map only two springs were exploited, but in subsequent mapping (1866 and 1899) a greater number of springs were used. The lower sections of the stream channel had clearly been canalised and had stone-revetted sides. At the south-east end of the channel it was shown (on the OS 1856 map) merging with the (Site **76**) to the south of the reservoir (Site **90**); however, there is no sign of this section of the

canalised stream on the ground and instead it was observed to extend straight into the reservoir (Site **91**).

9.2 THE WATER SYSTEM IN 1866 (FIGS 14, 15, 16, 17, 18, 20, 34 AND 36)

9.2.1 ***1866 Mine Map:*** by the time of the 1866 map, some 10 years after the OS first edition map, there had been some notable changes, principally the construction of a number of reservoirs which would have provided a more reliable water supply. The most substantial of these was the large reservoir (Site **28**; Plate 53) in the northern/central part of the area of upper workings, and which would have powered both the New Smelt Mill and the Condenser House. This is a large, sub-rectangular reservoir cut into the hillside, which measures approximately 82m long by 41m wide and has a large, well-defined dam surrounding all except the upslope side. The dam had battered stone walls on both sides and a flat top and was a very substantial earthwork; its proximity to adits **16**, **19** and **20**, suggesting that it used spoil from these adits in its construction. It was fed by a canalised stream (Site **14**) and by drains leading from three drainage adits **16**, **19** and **20**. There are outflows on both the western and eastern sides (the latter being via a now-collapsed culvert). The westernmost of these (Site **24**) is a canalised channel and at the time of the 1866 map merged with that from the springs to the north-west, and then bypassed the lower reservoir (Site **90**) before feeding the New Smelt Mill water wheel via a launder. The easternmost outfall re-used the channel (Site **26**) that had formerly led directly between Adit **19** and the lower reservoir (Site **90**). Extending from the eastern outfall of the reservoir was a line of five, small rectangular stone-constructed bases (Site **113**) running for approximately 15m west-north-west/east-south-east (Plate 54). These are the surviving remains of a foundation for a wooden launder that led downslope to launder base **108b**, and which fed the Condenser House. The 1866 map shows this launder, but no longer shows a direct connection between launder **108b** and Keldheads Gill, which may suggest that the supply from Reservoir **28** had completely replaced the supply from the gill. However, the 1891 OS map shows the leat (Site **107**) to Keldheads Gill in place, and it is possible, therefore, that its omission on the 1866 map was a cartographic error rather than an indication that it was no longer in use.

Plate 53: The dam of the large reservoir (Site **28**) looking south-west

Plate 54: Two of the rectangular stone bases (Site **113**) supporting a launder that would have taken water from the large reservoir (Site **28**) to the Condenser House (Site **102**)

9.2.2 A further reservoir (Site **71**) had been constructed by the time of the 1866 map to the south of the New Smelt Mill and entailed the construction of a dam across the narrow valley containing Keldheads Gill. The reservoir is mostly silted-up and extends across the entire width of a large, narrow, north/south gully, and measures 65.5m by 36m. It was fed from Keldheads Gill which is in a subterranean culvert running beneath the New Smelt Mill (Site **134**), via two apertures in a small retaining wall

(Site **71b**). The dam (Site **71a**) had stone retaining walls on both sides, with the downslope being battered back, but has now been breached. There is a brick-founded overflow channel on the western side of the reservoir. The reservoir was intended to provide a head of water, via a series of leats (Sites **68**-**70**) that would supply the wheel-pit (Site **65**) for the adjacent airshaft in the main adit, and also provide a supply of water for the dressing floors.

9.3 THE WATER SYSTEM AT THE END OF THE MINES LIFE

9.3.1 ***1898 Mapping:*** by the time of the 1898 OS mapping, the water system had not changed significantly. A bypass channel (Site **17**) had been constructed around the north and west sides of the large reservoir (Site **28**), linking the drainage adits to the western canalised channel (Site **24**). This would probably also have been supplied by a leat (Site **14**) that extended from the north-western limits of the study area. The lower end of the Site **24** canalised stream had, by this date, been modified so that it fed directly into the Site **90** reservoir, rather than bypassing it, as it previously had done.

9.3.2 A further leat (Site **123a**) was established between the drain from Adit **19** and leat **107**, and was evident as a slight linear depression that was, in places, embanked up on its southern side. It would have provided a supply for the Condenser House that bypassed the large reservoir and was at a higher altitude so providing a greater head of water to drive the condenser wheel. In addition, another leat (Site **121**) ran from Adit **19** to the sunken building adjacent to the Condenser House (**Site 117**). It skirted the east side of the large reservoir (Site **28**) as a gully and continued downslope as an embanked feature. It is possible that this feature pre-dates the large reservoir as the north-east corner of the reservoir seems to respect the alignment of the leat.

10. ANCILLARY STRUCTURES

10.1 TWENTIETH CENTURY QUARRYING ELEMENTS (FIGS 12, 13, 15 AND 34)

10.1.1 The Five Yard limestone and sandstone beds were both quarried extensively around Preston under Scar. Preston-under-Scar limestone quarry, located north-west of the property, was started in the 1890s in a piecemeal manner, with owners who combined both farming and quarrying. It was not until 1920 that the site was worked on a truly commercial scale by the Wensley Lime Co Ltd, to supply high grade stone to steelworks of the parent company Cargo Fleet Iron Co Ltd of Middlesborough (Johnson 2002, 155). As part of the extraction process, the stone was manoeuvred from the crushing plant to storage bunkers immediately north of the quarry. It was then transported, via a 1000 yard aerial ropeway (Site **141**) running down through the area of Keld Heads lead mine, to a loading station (Site **140**) (just east of the Preston under Scar Wastewater Treatment Works (WwTW) on a siding of the North Eastern Railway (N.E.R.) railway near Wensley Station (*ibid*). The only other quarry related feature found within the property is the explosives store (Site **2**) which was necessarily placed a significant distance away from the active quarry workings. After several changes in ownership the quarry ceased extraction in 1972.

10.1.2 ***Aerial Ropeway:*** the alignment of the aerial ropeway (Site **141**), first depicted upon the 1953-58 OS mapping, runs diagonally downslope through the study area. The extant sites include three concrete bases, each consisting of four square concrete supports, for the foundations of the aerial ropeway towers (Sites **1**, **4** and **103**; Plate 55). In addition, broken sections of twisted metal rope litter the floor along the alignment of the ropeway. The aerial ropeway was originally a single rope system that carried 52 buckets (Johnson 2002, 155).

Plate 55: Concrete Aerial Ropeway Base (Site **4**)

10.1.3 ***Explosives Store (Site 2):*** this is a single-storey, two-celled rectangular building (Plate 56). It is 9m long by 4m wide with mortared stone construction and has a slightly pitched concrete slab roof. There is a doorway in the south gable end and a window/hole in north gable.

Plate 56: Preston-under-Scar Quarry Explosives Store (Site **2**)

10.1.4 ***Other Commercial Quarrying:*** another un-named small-scale commercial quarry located to the west of Tullis Cote farmstead had begun by 1946. This is depicted upon the 1953-8 OS mapping and replaced an area of allotment gardens depicted upon earlier mapping. The quarry waste, forming large spoil heaps from the enterprise, was tipped onto the ruins of the Keld Heads Smelt Mill (Spensley 2014, 147). Aerial photographs from the English Heritage Archives demonstrated the extent of quarrying in the 1940s and 1950s in this area.

10.1.5 There are several other small-scale surface quarries which were once used for local needs throughout the undulating terrain of the study area. There is one large cliff face located behind the Engine House (Site **110**). The quarries are all cut into the natural craggy hillsides, for the most part in the upper workings (Sites **98** and **119**), and one example has been quarried through the earliest reservoir on the property, which was originally used to power the Old Smelt Mill (Site **5**)

10.2 TWENTIETH CENTURY POWER HOUSE (FIGS 21 AND 29)

10.2.1 In the early twentieth century the mine buildings at Keld Heads were remodelled, and a red brick power house was built (Spensley 2014, 147). This is what is now the Old Powerhouse Garage located in the area of the earlier bouse teams (Site **48**; Plate 57). The structure is rectangular, single-celled and is open to the roof. The red brick constructed walls are very thick, and it has an internal concrete floor. There is an RSJ on the door in the south elevation and above it a pitched slate roof. A wooden louvered ventilation system is present on the apex of the roof. Three large windows are present

on the eastern wall elevation. Local knowledge states that the original engine base was present before the concrete floor was laid down for the garage in the 1980s. A concrete flue heads north from the structure and is attached to the chimney adjacent to the Boiler House (Site **53**).

10.2.2 A modern RSJ-framed lean-to with corrugated walls is located on the west of the power house (Site **49**). Local knowledge states that it once housed two boilers to power the engine for the aerial ropeway and would have provided electrical power for the limestone quarry. The structure has an inspection pit for the garage, but there is no surviving evidence of footings for the boilers.

Plate 57: Electricity generating house (Site **48**)

11. MANAGEMENT RECOMMENDATIONS

11.1 INTRODUCTION

11.1.1 Recommendations for ongoing management, conservation and interpretation of the archaeological resource has been identified for each heritage asset within the study area, and in the following sections are set out thematically in line with the various elements discussed in the previous descriptive chapters (*Sections 4-10*).

11.1.2 ***General Threats:*** there are a number of threats and issues that have an impact across the whole lead mining complex, and these are described here, but are elaborated on in the individual sections. The basic management needs, as discussed with Historic England, are to stabilise the existing structures and monuments, to prevent the decline in the condition, but not necessarily to implement more costly and time consuming restoration works to the monuments. There is also a need to provide targeted opportunities for outreach, which would entail improving the visitor experience in some areas, but to restrict access in other. It is proposed that this would mean opening up the area around the Engine House and Main Adit, ensuring that the sites are safe for visitors, and to provide information panels on the site for the visiting public. At the same time, paths would be rationalised across the northern area to restrict access.

11.1.3 One of the most notable threats across the overall area and particular to the north, is the woodland. This is recent scrub, and while the immature growth will not have a significant impact at present, as the trees rapidly grow to maturity the root damage will steadily increase with the potential to damage underlying archaeological deposits and also destabilise structures. Where the trees are growing from the archaeological monuments, there is a need to cut them back (without disturbing the extant root structure), and to poison them to prevent regrowth. While the trees need to be removed from the monuments, they can be used constructively to restrict the movement of visitors. By keeping trees off the main footpaths, but allowing rapid tree growth adjacent to the footpaths will in effect create corridors that will concentrate visitor pressure along the footpaths,

11.1.4 The structural remains, which include the Smelt Mill, Condenser Flue, Condenser House, Engine House, Boiler House, chimney, and wheel-pit are in a fragile state, and have the potential to rapidly deteriorate. Any stabilisation works on these structures can be time consuming and costly, and there may be a need to prioritise consolidation works to those structures with greatest need. It is therefore recommended that a structural survey is undertaken of these buildings and structures to define its condition and to establish priorities.

11.2 EARLY ACTIVITY - SHAFTS AND ADITS

11.2.1 The early activity on the property is a relatively stable archaeological resource, comprising, for the most part, earthworks associated with shaft workings, some quarrying and ancillary sites. There should be some tree management, particularly where root action is directly encroaching onto the shafts and other sensitive earthwork sites, and this would entail the selective removal and thinning of the trees.

11.2.2 Casual visitor access to the upper workings may need to be actively discouraged. This would be to limit further site erosion and, in some cases, on health and safety grounds where there is steep/uneven terrain and dangerous shafts/adits. Tree management could be used to keep relatively dense screens of undergrowth near to the pathways running through the upper workings to discourage casual rambling through the area; however, this woodland should be in areas away from extant monuments.

11.2.3 The stone entrances of each drainage adit located in the upper workings may need to be consolidated to stop further erosion (Sites **16**, **19** and **20**). One of the adits (Site **20**) has been partially rebuilt in the past but is becoming dilapidated and would benefit from further consolidation. There is only limited access into the adits, either because of partial collapse or because there is a deep flow of drainage waters out from the adit mouths. Any access to the adits would require specialist equipment and would discourage the casual visitor. There would, though, be a case for erecting fencing around the adits to prevent visitor access to the adits and to limit any public liability.

11.3 MAIN ADIT AREA

11.3.1 Associated with the main adit is the largest number of standing buildings associated with the lead mines. Some of these, such as the Agents House and Workshops are occupied, and have accordingly been maintained and are in good condition. Other structures are unroofed and in a state of decay, and includes the wheel-pit, the Engine House, the Boiler House, the main adit vault, and the chimney pit (Sites **52**, **53, 55, 65** and **68**). These buildings are inherently fragile and could be subject to rapid deterioration, and even collapse, if they are not maintained. With further deterioration they may also become a health and safety risk to the general public who visit and use the site, warranting either expensive repairs or demolition. It is recommended that a structural survey is undertaken of all the standing buildings, to assess the needs for consolidation and to prioritise the stabilisation works.

11.3.2 In addition it is recommended that Level 3 building surveys (English Heritage 2006b) be undertaken of these Grade II Listed structures as this would provide a mitigative record of the buildings in advance of any consolidation or decay.

11.3.3 Vegetation clearance directly upon, and immediately adjacent to, the Engine House, Boiler House and chimney may be required followed by a scheme of consolidation work in light of any structural surveys. There is clear cracking on some wall elevations and, as the structures are covered in vegetation and are unroofed, they are clearly under threat of erosion. At the very least, future management of the sites may require capping on top of standing wall elevations to limit further erosion, but this would be subject to the structural survey.

11.3.4 The roof of the vaulted tunnel (Site **67**) leading into the Engine House is partially collapsing; this needs to be assessed and subject to the structural survey and may need consolidating. The concrete flue (Site **51a**) leading up to the chimney is fractured and is a hazard, and may need capping with concrete.

11.3.5 The wheel-pit (Site **65**) is in danger of collapse as it is no longer underpinned and has been temporarily braced with a series of wooden supports. Consolidation work here should focus on filling the aperture half full with rubble to support the structure from

future collapse, but would also necessitate the stabilisation of the exposed masonry above the fill level. Leaving the wheel-pit half full would not necessarily mask the original form/function of the structure, but would minimise the pressures on it and would pose an economical means to preserve the integrity of the structure.

11.3.6 Consolidation work is required to stabilise the retaining wall and railings on Keldheads Lane (Site **54**) running past the Engine House. The wall has been eroded by trees growing through the top, displacing the stones, and the railings have also been dislodged.

11.3.7 The main adit vault (Site **55**) is open and is internally accessible for a distance, although the condition of the adit vault needs to be assessed by a structural survey; it is likely that there would be a need to restrict visitor access for health and safety reasons. This should entail the erection of a grill, inserted a little way into the adit tunnel so that the barrier is not visible from outside. Consolidation work is also needed on the stonework of the main adit mouth and surrounding retaining walls (Site **55**).

11.3.8 There is little surface evidence surviving for the mine shaft (Site **127**) located between the wheel-pit and Engine House, and there is a need to ascertain if this has been infilled or capped; if the latter, the strength and resilience of such a cap over what could be a substantial void would need to be investigated. Probing may be required to identify the structure/nature of any capping over the shaft.

11.3.9 Public access to this area is particularly sensitive because of the relatively high footfall of visitors passing through on the footpath. Visitors themselves may cause some minimal damage to what are relatively sturdy archaeological structures in this area. The main concern is health and safety from visitor access to unsafe structures/areas. At the simplest/cheapest level fencing is required to limit/discourage access. This should be undertaken west of the adit mouth to stop access to the area of the wheel-pit (Site **65**), infilled shaft (Site **127**) and the tunnel (Site **67**) into the Engine House. Fencing is also required on the north-west corner of the Engine House (Site **68**), as there is a steep drop into the structure. Fencing may also be required on the west side of Keldheads Lane (Site **54**) where it passes the Engine House depending upon any remedial consolidation repairs to the retaining wall on the west side.

11.3.10 This area contains the most visible and, to the general public, easy to understand archaeological remains on the property. Given the relatively high footfall of visitors passing through the area along Keldheads Lane, this would provide the ideal location to place an interpretation panel, which would explain the history and visible archaeology of the mines.

11.4 SPOIL HEAPS AND DRESSING FLOOR

11.4.1 The spoil heaps are extensive and robust features with little impact from ongoing erosion. One end of spoil heap **42** has been quarried away for hardcore/aggregate extraction, an activity which should be actively discouraged in future; however, fly-tipping, adding new layer of rubble, seems to presently be of greatest concern for the management of this area.

11.4.2 There are some fragile remains of the section of railway running east/west through the spoil heaps (Site **41**) consisting of two areas of wooden sleepers (Site **41a** and **b**);

however, these elements are of relatively low importance given their later date. The mine wagon in the same area (part of Site **41b**) should be moved from it's present location and could be renovated and be placed at the main adit mouth (Site **55**) to aid future interpretation on the site.

11.4.3 The fragmentary remains of the dressing floors (Sites **33** and **38**) are particularly important, and they survive almost entirely as sub-surface remains covered with fine silt waste. Tree clearance may be required if they are on top of known archaeological structures (the wheel-pit and buddles). The area has not previously been identified as containing significant archaeological remains, and fine silt waste covering sub-surface features is particularly fragile to surface erosion. There is some potential future threat of dumping, earth movement and storage of materials from surrounding businesses in this area. The area should be demarcated and fenced off to protect the remains.

11.4.4 Vegetation clearance, followed by consolidation work, may be required on the extant, but fragmentary, retaining walls for the dressing floors (Sites **44** and **50**) and on the adjacent bouse team walls in this area (Sites **48b** and **48c**).

11.5 NEW SMELT MILL AND PEAT STORE

11.5.1 This area contains some of most important archaeological elements surviving on the site, but they are in turn very fragmentary and fragile in nature and visibly little is exposed at the surface as most of the mill is buried under later quarrying spoil. Consequently, there is little need for an interpretation panel at this location.

11.5.2 The structural integrity of the culverted tunnel (Site **134**), carrying Keldheads Gill beneath the Smelt Mill and down south to the outflow at reservoir **71b**, needs to be ascertained. Visible damage is limited to part of the ore bin wall at the north end of the New Smelt Mill, which has collapsed into the tunnel. Any future collapse of this tunnel may lead to a backflow of water that could result in flooding/erosion of the site, and could have a catastrophic impact upon the Smelt Mill and any structures up stream. Specialist inspection of the full length of the culverted tunnel is recommended. Some consolidation works will be required after a structural survey of the culverted tunnel on the north elevation wall of the ore bin (Site **75a**) where it has collapsed into the underlying tunnel beneath, and is a clear health and safety issue.

11.5.3 There is a need to clear tree cover on, and immediately surrounding, the structures/walls of the New Smelt Mill ore bins (Sites **75a**-**75d**) and on the individual Condenser Flues (Site **6g**).

11.5.4 A screen of vegetation should be retained near to the public footpath leading north from Keldheads Lane in order to discourage casual public access onto the fragile and, in some cases, unstable remains in this area. Unstable capping stones and side walls of some of the Condenser Flues channels (Sites **6f** and **6g**) will need to be consolidated or, if that is not possible, removed, as they pose a clear health and safety hazard. The structure of the Grade II Listed peat store (Site **73**) is intact and has been re-roofed; at present, there are no obvious issues with it.

11.6 OLD SMELT MILL, CONDENSING FLUE AND CONDENSER

11.6.1 The Condenser Flue is a very visual and important part of the complex, and should be consolidated and opened up to enable visitor inspection, where it is in proximity to the main path. Vegetation removal should be undertaken primarily directly on, or adjacent to, the extant built archaeological structures and earthwork (Sites **6e**, **102** and **117**) so as to minimise root damage. However, tree removal should also be considered across the wider area containing the Old Smelt Mill/Condenser House, so as to open up the area, up for public view. In the wider area the Condenser Flue sections are less well-defined, so vegetation clearance should only be undertaken where the trees directly impact the structure.

11.6.2 Following on from vegetation removal, further consolidation works should be undertaken upon the built structures, so as to prevent or minimise future decay, but this would also enhance the interpretation of the site. Consolidation or rebuilding of the one extant well-defined section of double Condenser Flue by the Condenser House should be undertaken (Site **6e**), and the west elevation wall of the Condenser House needs repointing.

11.6.3 An interpretation panel could be located here at the junction of two footpaths where it would be useful to identify the significant, well-preserved archaeological remains and to highlight the significance of the condensing flue and the early adits in the immediate vicinity.

11.6.4 There is potential for a programme of community excavation and geophysical survey in the area of the Condenser House (Site **102**) and adjacent sunken building (Site **117**) to try to elucidate the chronology of structures on the site; this may find surviving sub-surface elements of the Old Smelt Mill (Site **144**).

11.7 WATER SUPPLY

11.7.1 An assessment should be made of the fluid dynamics of the water catchment running through the property, as today all phases of water supply eventually concentrate in a pinch point at the culverted tunnel under the Smelt Mill (Site **134**). Future flooding may be an issue, as is the structural integrity of the tunnel itself (*Section 11.5.3*).

11.7.2 There is clear damage to the north of the study area in the upper area of workings where two deep channels have been created by tributary streams, and surface run-off. They have impacted upon various earthworks, in particular some elements of the Condenser Flue (Site **6b**). In addition, there are some modern drainage channels cutting above the drainage adits (Sites **19** and **20**).

11.7.3 There is little need to clear vegetation from water supply elements, although areas of extant retaining walls on tributary streams should be cleared and retained. In addition, the structural integrity of both large extant reservoirs with unbreached dams (Sites **28** and **71**) should be assessed, and future tree clearance may be needed upon the dam edges themselves to stop further deterioration.

11.8 ANCILLARY QUARRY STRUCTURES

11.8.1 The surviving quarrying elements on the property are relatively robust features and includes the concrete bases for the aerial ropeway (Sites **1**, **4** and **103**) and the

explosives store (Site **2**). As individual features they have relatively little archaeological value, given their late date and they post date the lead working. The explosives store may need securing with a new door and an opening in the north wall elevation needs infilling.

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APPENDIX 1: PROJECT BRIEF

ENGLISH HERITAGE

SPECIFICATION

Archaeological and condition survey of Keld Heads lead mine and smelt mill, Preston-under-Scar, Wensleydale, North Yorkshire.

SUMMARY

English Heritage is inviting quotations for an archaeological survey and investigation at Level 2 and 3 standard (Ainsworth et al 2007) to record and interpret the earthworks and remaining above-ground structures of the Keld Heads lead mine and smelt mill complex. This work is required to guide and support English Heritage and the Bolton Castle Estate in the development of a long-term management plan for the scheduled monument. The main product of this investigation will be an analytical report, including both schematic and detailed plans of the physical remains, supported by documentary research.

1 BACKGROUND

1.1 Location

The Keld Heads lead mine and mill complex is located some 800m east of the village of Preston-under-Scar in Wensleydale (Figure 1). Two areas of the site, north and south of Tullis Cote, are designated as a scheduled monument (NHLE 1014763). The larger, northern part is centred at SE 0774 9114, the smaller southern part at SE 0793 9077. Two buildings within the complex are also Listed, both at Grade II: the engine house (with chimney) located in the southern scheduled area (NHLE 1179229) and the peat store (NHLE 1130869) in the northern area.

1.2 Circumstances leading to the Requirement

The Keld Heads complex was scheduled in 1996 primarily to protect the significant remains of the 19th-century lead mine and processing works, including several structures regarded as the most technologically advanced in the country for the time. The site is also important as the only mine in Wensleydale with a documentary presence in the medieval period.

The present condition of the complex is a matter of considerable concern. Planted and self-seeded woodland has taken over much of the site, and the built structures, some abandoned, others largely demolished, have deteriorated to a serious degree. The scheduled monument with its integral Listed Buildings (specifically the engine house) is noted as priority on the Heritage at Risk Register (English Heritage 2013). A recent Options Appraisal for the landowner, the Castle Bolton Estate, looked at potential reuse of the Listed Buildings (the engine house and peat store), and a conservation assessment and building survey record for both of these exists (Atkins 2012). There is, however, currently no measured survey of the wider site, which includes nationally significant remains of the smelt mill, the condenser house, the adjacent flue system and many other features.

In order to inform better management it is essential that a complete survey of the whole of the site is undertaken. This will enable the creation of a long term management plan which will allow English Heritage, in partnership with the Bolton Castle Estate, to address the range of current management problems.

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1.3 Description of the site

Lead was mined from the Keld Heads area in the 12th century and in the 13th century the mines provided material for the roof of Jervaulx Abbey. By the early 19th century the accessible veins had become exhausted, but a series of long levels driven into the hillside after 1823 brought the mine back to prosperity. A smelt mill complex built in the early to mid-19th century was extended in 1855 to become what was considered at the time to be the most advanced example in the country. In the latter part of the 19th century the cost of pumping the lower levels combined with the fall in the value of lead to render the mine uneconomical, and finally forced its closure in about 1888.

A large part of the Keld Heads complex is designated as a scheduled monument (NHLE 1014763) in two areas which encompass the more visible and obviously significant aspects of the site (Figures 1 and 2). To the south, the smaller scheduled area contains a standing chimney and a roofless engine house with adjacent stables/boiler house (both Listed Grade II), a tunnel for the connecting rods descending to the mine, a water wheel pit and the lower adit entrance.

The larger scheduled area to the north, within Condenser Wood, contains the footings and other remains of the smelt mill, originally measuring some 20m by 10m, which housed a bellows and water wheel at the west end, and two ore hearths on the north-east wall. This was extended in 1855 to include a third ore hearth on the north side. Stone vaulted or capped built flues run north across the site from these works, beyond the wood (and the area of present interest) for a further 3km to a chimney at Cobscar. Within the scheduled area, about 100m north of the smelt mill, the combined flue entered the condenser house where lead particles were removed from the fumes. Parts of the stone building which housed a water wheel and pumps for drawing the fumes survive alongside various settling tanks and watercourses. The formerly attached Stokoe Condenser (a timber structure containing a series of dampened screens and partitions) has left only slight traces. The northern area also contains a substantial reservoir and a series of smaller tanks used to collect water from mine drains, natural stream and springs, as well as various leats which supplied the water wheel at the smelt mill and condenser house. A peat store (Listed Grade II), roofed and still in agricultural use, stands within the northern scheduled area c.30m south of the mill.

The scheduled areas cover approximately 6.6ha, but while these areas encompass most of the more important archaeological remains, they do not equate to the whole area relevant to the site's history and development. The survey is therefore required to cover a somewhat larger area (10.3ha) as shown on Figure 2 and described below. The required level of survey in each part of the site varies according to the nature of the archaeological remains and the requirements for the management plan. This is also defined below.

2 SURVEY SPECIFICATIONS

The survey levels referred to below are those described in Ainsworth et al 2007, unless stated otherwise.

2.1 Area A

A level 2 survey is required to encompass the area south of the track to characterise the extensive spoil heaps deposited toward the railway line. The spoil heaps do not require detailed survey, merely outlines sufficient to depict their general composition, extent, sequence and mass (i.e. a broad calculation based on extent and height)

2.2 Area B, including smaller scheduled monument area.

The scheduled area within Area B requires a detailed Level 3 survey (1:1000 scale) to provide accurate locations and extents of the structures (chimney, wheel-pit, engine house and stables/boiler house) as well as a hachured earthwork survey of the adit approach and details of the associated leats and conduits. The lines of communicating features such as the flat rods tunnels (where detectable) must be included. The plan should also provide an indication of the general fall of ground; broad contours are acceptable.

The engine house must also be planned to a larger scale (1:100 or larger) to capture details of the internal engine bed. All the buildings must be photographed and described in terms of their date, purpose and evolution (to the Historic Building level 3 standard defined by Menuge et al 2006). Elevations drawings are not required for the present project.

Outside the scheduled area, within Area B, a Level 2 survey (1:2,500 scale, schematic rather than hachured) is required to mark the positions of water courses and tracks, including the various leats and conduits which supplied the water wheel from the Wensley brook, and may also have served the later engine. The Level 2 survey should also include an outline plan of the adjacent house (presently roofed and tenanted) and associated outbuildings and workshop, which appear to have formerly served a purpose within the mining complex. These buildings require a photographic record as well as a written description/ interpretation, but their investigation is not expected to be particularly detailed.

2.3 Area C

This small triangle of woodland (Area C) requires a Level 2 survey to locate and mark the extent of at least two shaft mounds or shafts, and any other related industrial remains.

2.4 Area D, including the larger scheduled area

The entire area, including the scheduled part, extending from the peat store to the south to the explosives store to the north, requires a Level 2 survey: identifying the position, orientation and extent of all industrial features. These include several shaft mounds and dressing areas, two reservoirs (one water filled), a complex of leats, drains and other channels (some draining from an adit in the northern part of the area to feed a 20th-century water supply system), several building footprints, a limestone quarry and areas of quarry waste. The area also includes the remains of stanchions and other evidence relating to an aerial ropeway which formerly linked a quarry further north with the railway to the south. A photographic record and a written record detailing date, function and condition is required for each of the above. The courses of the Wensley Brook and the Keldheads Gill should also be plotted, together with the routes of present and former footpaths and trackways.

The explosives store at the north of Area D and the peat store (Listed Grade II) to the south require photographic records, accurate outline plans (Level 2), and descriptions and interpretation to historic building Level 3 (Menuge et al 2006) .

The smelt works, to the north of the peat store, is perhaps (with the condenser house) the most significant structure in the northern part of the works. A Level 3 survey (1:500 scale or better) is required to identify the position/function of those parts of the building which remain visible amongst the overburden of dumped quarried stone, and to identify particular areas of conservation concern where erosion and collapse are particularly noticeable and consolidation and other repairs are required. The quarried stone piles need not be surveyed in great detail, although it is important to mark their extent and character.

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The same level of detail is required for the condenser building with a view to comparing the structure's plan with any surviving records (the Stokoe Condenser patent application perhaps?) and to provide material which may in future assist with an elevation/cut-away reconstruction drawing for interpretation purposes. Again, condition issues must be noted, as the masonry remains of the condenser house are to be repaired.

The section of flue immediately adjacent to the condenser house should be included in the Level 3 survey, as far south as short roofed section (also due for repair). Elsewhere Level 2 survey is sufficient for the sections of flue between the smelt works and the condenser house and its continuation to the north-west. However, it is important to identify changes in the character of the flue, including those sections where it appears as a double flue, and to scrutinise the points where it intersects with other features. Photographs and written descriptions are required to note good survival and areas of particular conservation concern.

2.5 Documentary research

The project must include primary and secondary documentary research in order to place the lead mine remains in context with their known historical development. In addition to the standard works on Yorkshire lead mines and smelt mills, by authors such as Arthur Raistrick Mike Gill, the investigators must consult original plans, records and photographs of the site held by the North Yorkshire County Record Office and the Northern Mines Research Society (NMRS). The archives of The Northern Institute of Mining and Mechanical Engineers (Newcastle) may also repay investigation.

2.6 Collaboration

It is most important that the project involves the assistance and collaboration of the NMRS and their researchers/authors with particular knowledge of this site. The NMRS (http://www.nmrs.org.uk/contact/index.html) should be contacted for discussions at the outset of the project and encouraged to participate in the survey and the interpretation of the results. The NMRS should be able to provide information about a forthcoming British Mining report on mining in Wensleydale which includes some mention of Keld Heads. They may also be able to supply information concerning a recent survey of part of the unscheduled area to the south carried out in advance of works related to the railway.

With the assistance of English Heritage the project must engage with the Bolton Castle Estate, and in particular with their woodland management staff, who should be invited to participate in the latter stages of survey with a view to formulating an effective and sympathetic felling regime related to areas of particular conservation concern (notably the smelt mill, flue and condenser house) .

3 SITE CONDITIONS AND ACCESSIBILITY

3.1 Conditions

Area A is covered in light self-seeded woodland with a fringe of mature sycamore. The scheduled area within Area B is open rough grass with patches of dense undergrowth. The buildings were cleared by North Yorkshire County Council volunteers in 2005 to assist with the condition survey, but considerable regeneration has taken place and access to the rear (north) of engine house is particularly difficult. The area between the Wensley Brook and the path to Tullis Cote is dense deciduous woodland. Area C is mixed woodland, mainly deciduous. Area D (Condenser Wood) is a mixture of planted and self-seeded deciduous

woodland with some small coniferous areas particularly to the west. (See Figure 3 for overall woodland coverage).

The site contains many difficult surfaces, obstacles, drops and unstable masonry, the hazards being particularly acute in the in the vicinity of the smelt works, wheel pit and engine house. No underground investigation is required or advised. The site also contains at least one body of deep water (the northern reservoir).

3.2 Accessibility

Given these conditions, the survey can only be carried out in winter when the foliage and undergrowth is least dense Even so, GNSS reception will be poor at best and largely unobtainable, and the survey is likely to be carried out using Total Station or EDM, perhaps supplemented by tape and offset. The survey must be tied to the Ordnance Survey grid as described in Section 4.4.4 below. This will require GNSS locations to be established on the margins of the survey area.

Vehicle access to the site is possible along existing roads and tracks, although not within Condenser Wood. The land is all part of the Bolton Castle Estate, although access may need to be negotiated (particularly around the southern site) with individual tenants.

4. REQUIREMENTS

4.1 Quotations

English Heritage is seeking short quotation documents from prospective contractors, providing details as set out below and in the accompanying invitation to quote letter. All responses will be assessed in terms of cost, quality and timetable.

4.1.1 The following information must be supplied:

- A price for the work (excluding VAT).
- A timetable for the project, specifying duration of key stages such as research, fieldwork, analysis and report creation.
- A profile of the project team stating who will act as project manager and who will be responsible for key aspects of the fieldwork, research and report production. The profile should include brief statements of the team members' relevant qualifications and experience.
- A brief method statement indicating the approaches and equipment which will be employed to achieve the required project outcomes (see 4.3 below). This statement may also include (if thought appropriate) suggestions to improve the original project specifications

4.2 Available guidance

In preparing your quotation you should refer to the English Heritage's guidance publications *Understanding the Archaeology of Landscapes: a guide to good recording practice* (Ainsworth et al 2007) and *Understanding Historic Buildings: a guide to good recording practice* (Menuge et al 2006), both of which can also be downloaded from the English Heritage website.

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4.3 Essential products and tasks:

4.3.1 An **analytical field survey** of the structures and earthworks within the areas marked on Figure 2 (or an agreed variation of this area), to Levels 2 and 3 standard as determined in Section 2 above and defined in *Understanding the Archaeology of Landscapes: a guide to good recording practice* (Ainsworth et al 2007) and *Understanding Historic Buildings: a guide to good recording practice I*(Menuge et al 2006). The survey product will include an overall schematic (Level 2) plan at 1:2500 scale as well as more detailed (Level 3) hachured surveys shown as inserts or otherwise included in the project report. The main plan must also be supplied in digital AutoCAD 2012 (or earlier) format (*.dwg or *.dxf). For the digital archive the earthworks may be depicted either by hachures, or by linework which differentiates between the top and bottom of slopes and makes explicit the stratigraphic relations between features. There is no requirement for full ground modelling of the earthworks, although depiction of contours at an appropriate interval to show the relationship of the remains to the natural topography is generally advisable.

4.3.2 A descriptive and **analytical report** integrating the results of the field survey with documentary research, to be completed to English Heritage Level 3 standard (Ainsworth et al 2007) incorporating surveys at levels 2 and 3 as described in Section 2 above. Ten hard copies of the report are required, plus a print-resolution PDF version.

4.3.3 The survey should identify on the 1:2500 plan areas which require active tree management in order to safeguard archaeological remains, and identify locations where the condition of standing remains and buildings (described in the report) gives cause for concern.

4.3.4 The project timetable must allow time for staff involved in the survey to discuss progress with representatives from English Heritage. These will typically involve three occasions: an initial site visit to discuss the scope of the survey, a second visit to review findings at or near completion of fieldwork, and a final discussion when the report reaches an advanced draft (see attached *Specifications and Guidance for Contractors* section 1.3).

4.3.5 In the latter stage of the fieldwork it will be necessary to collaborate with English Heritage and the Bolton Estate staff in the identification and recording of areas where tree management is required to safeguard elements of the site (notably the smelt mill, condenser house and flue system). This may be combined with the second discussion point mentioned in 4.3.5 above.

4.4 Additional points

4.4.1 **Site visits**. Contractors may wish to make an initial site visit to gather information prior to formulating a quote. If a contractor chooses to submit a quote without the benefit of a field visit English Heritage will not accept responsibility for any difficulties encountered subsequently which could have been anticipated had a visit been undertaken in advance. Areas B and D are reasonably accessible via public and permissive paths, including a woodland walk in D). Visits to other areas will require advance notification to the landowners, via English Heritage.

4.4.2 English Heritage is able to provide low resolution Lidar imagery of the site in order to assist in the broad location of features within woodland (see Figure 4). This is

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provided under licence and may not be retained or used for any purpose other than the present project

4.4.3 The survey report must include a methodology statement, preferably as an appendix, briefly outlining (a) the equipment used to compile the earthwork survey plans (b) the method used to calibrate these surveys to the OS national Grid (c) a description of the software used to compile the survey and the report including illustrations.

4.4.4 English Heritage reserves the right to include appropriate reports in its Research Department Report Series.

4.4.5 It is the policy of English Heritage to reserve reproduction rights on all Intellectual Property produced in the course of an English Heritage contract. However, we will seek agreement with the contractor to extend or share those rights should the material be required for purposes other than those envisaged in this *Specification* (academic publication, for example).

4.4.6 There is no requirement for permanent survey markers to be established on site. However, the successful contractor should locate their survey within the National Grid (OSTN02) to minimum accuracies of 20mm in plan and 30mm in height.

5 TIMESCALE

- Quotation documents, submitted by e-mail, are required by 5pm Friday 28th November 2014.
- An advanced copy of the draft report must be submitted no later than Tuesday 10th March 2015. The final report and other digital products must be submitted by 15th April 2015.

6 HEALTH & SAFETY

As mentioned in the site conditions above (Section 3.1) the complex presents numerous hazards, including dense undergrowth, uneven surfaces, surface rubble, unguarded drops, unstable masonry and open water. Work in and around the site should be undertaken cautiously, and special care should be taken in the vicinity of the smelt mill, engine house, wheel pit and reservoir. It remains the responsibility of the appointed contractor to carry out a full risk assessment before commencing the fieldwork.

7 LIABILITY

The successful contractor will be required to provide proof of public/employers liability insurance in relation to the fieldwork activities outlined in this *Specification*.

8 ENGLISH HERITAGE CONTACTS

Further inquiries regarding the project should be addressed to Yvonne Luke, Heritage at Risk Project Officer, English Heritage, 37 tanner Row, York YO1 6WP, 07770 568097, yvonne.luke@english-heritage.org.uk

Quotations should be e-mailed to Yvonne Luke in the manner specified in the accompanying invitation to quote letter.

7

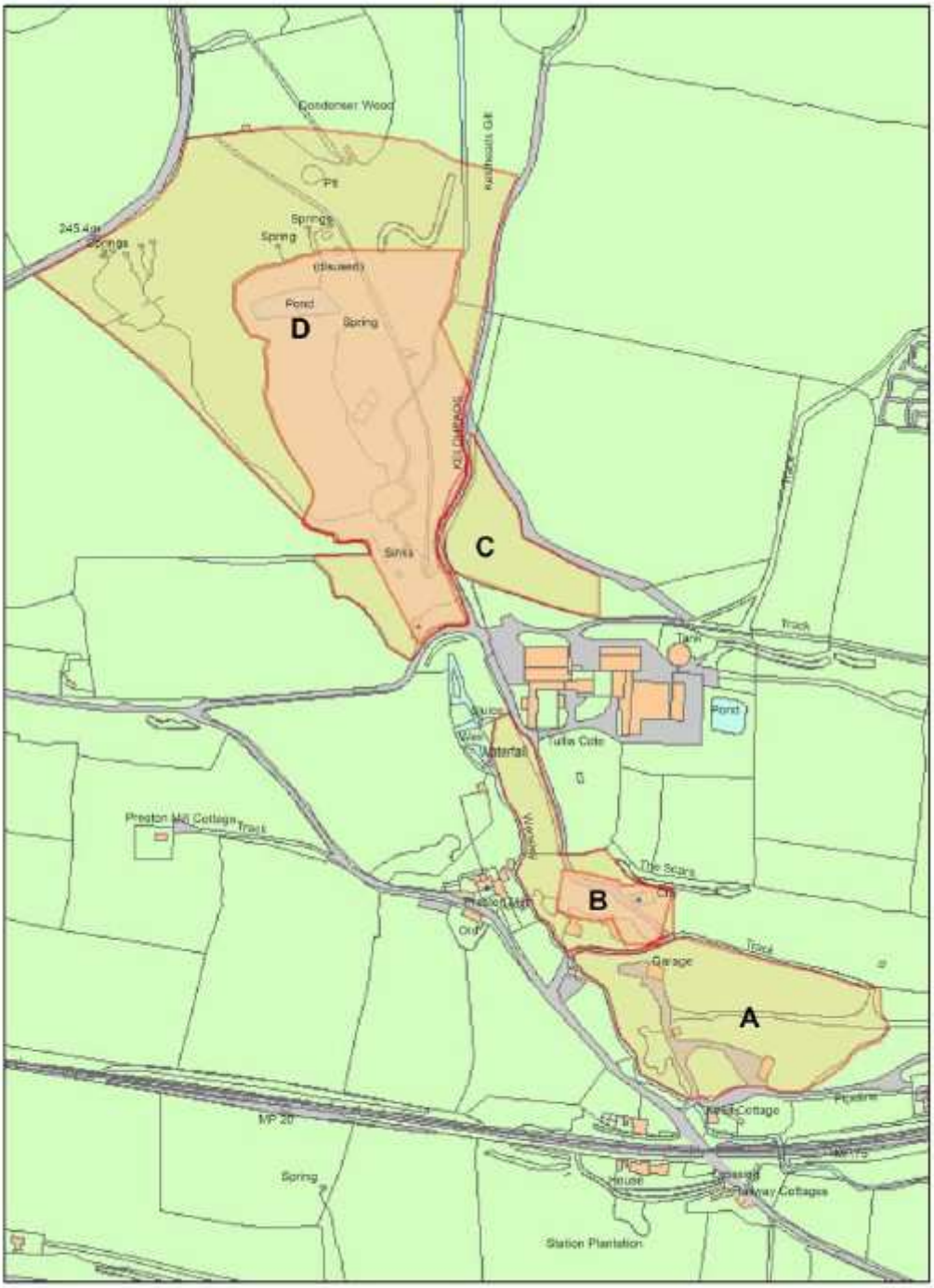

Figure 2. Areas (A-D) with specific survey requirements (yellow) and scheduled areas (pink).

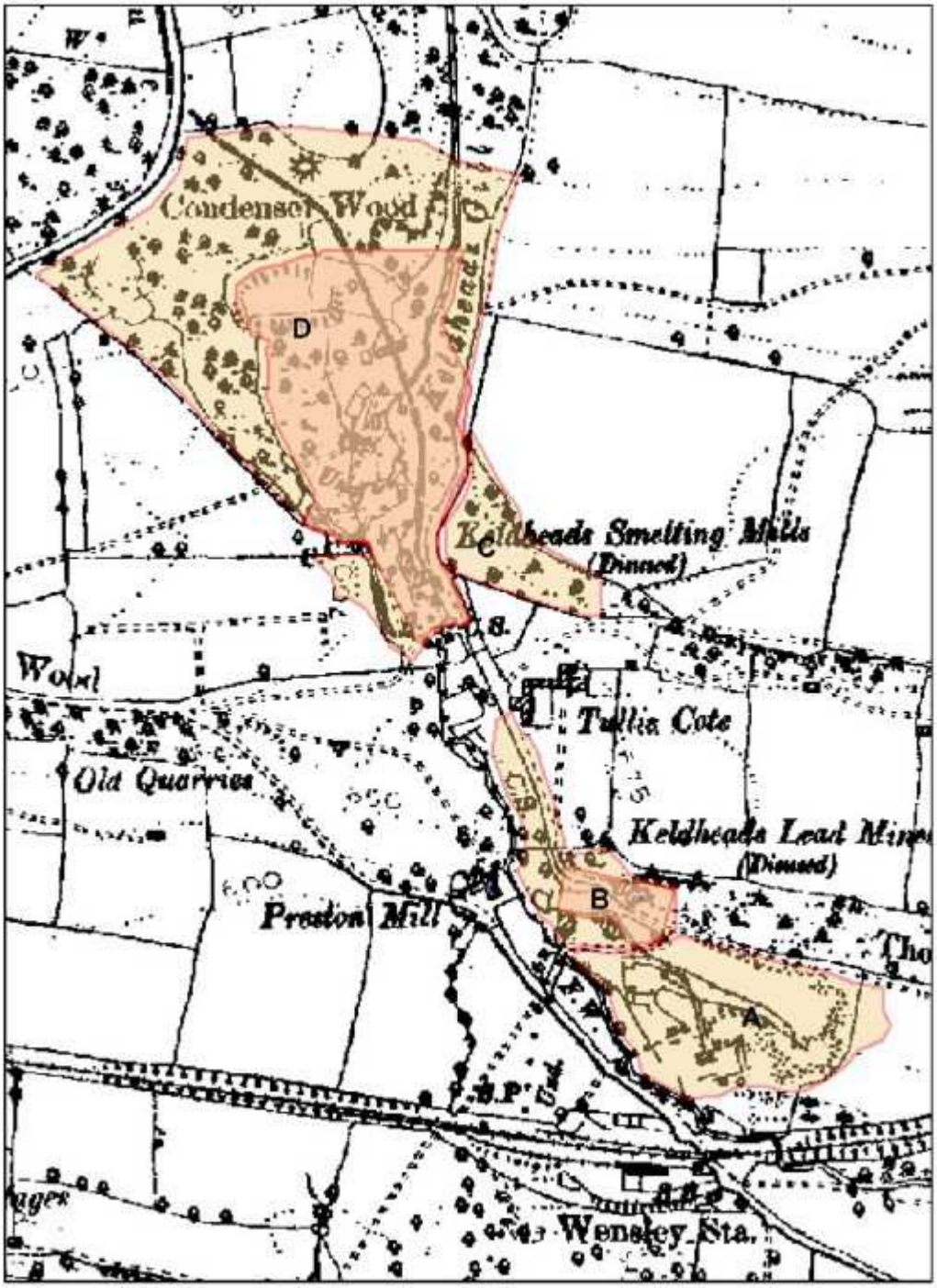

Figure 5. Extract from 2nd edn. Ordnance Survey c.1893.

APPENDIX 2: PROJECT DESIGN

1. INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1 English Heritage have requested that OA North submit proposals for an archaeological and condition survey of the Keld Heads lead mine and Smelt Mill complex (SE 0793 9077). The survey is required to inform a management plan for the scheduled monument. Parts of the Keld Heads complex are scheduled (NHLE 1014763); within the scheduled areas are two listed buildings: the Engine House and chimney (NHLE 1179229) and the peat store (NHLE 1130869). It is intended that the survey provides the basis for a future programme of conservation works and site management.

1.1.2 English Heritage has issued a brief for the survey that is required to undertake Level 2 or Level 3 surveys (English Heritage 2007) of the overall landscape, with the more detailed surveys concentrating on the scheduled areas which have the greater complexity including areas of Smelt Mill and Engine House complex. There is also a requirement for a detailed documentary study which encompasses previous work on the site. The main output will be an analytical report, survey drawings, and gazetteer.

1.2 ARCHAEOLOGICAL BACKGROUND

1.2.1 ***Keld Heads:*** lead was first mined here from the twelfth century and had an extended life continuing into the post-medieval period. By 1823 the mines were becoming exhausted but a series of long adit levels were driven into the hillside that were able to restore prosperity to the mine. The Smelt Mill complex was built in the early to mid nineteenth century and was extended in 1855, and at the time was considered to be the most advanced in the country. Towards the end of the nineteenth century flooding of the lower levels of the mine added significant pumping costs, which, combined with a fall in the value of smelted lead, resulted in the closure of the mine and mill in *c*1888. The peat store and lead mine buildings are Listed Grade II.

1.2.2 The Keld Heads lead Smelt Mill and mine complex comprises a mine, with associated engine house, and a Smelt Mill with a condensing flue and condensing chamber extending north. The mine complex includes the remains of an engine house, chimney, stables, and a wheelpit. The Engine House had connecting rods extending down the mine shaft and served to pump and drive winding gear.

1.2.3 The remains of the Smelt Mill building are now mostly buried by quarry waste, and from it the condensing flue extended northwards to a chimney on the hillside above. In 1855 the Smelt Mill was extended with the addition of a further hearth. About 120m from the Smelt Mill was a Condenser House, comprising a stone building, housing a water wheel, and a wooden structure with the flue extending between them. The heavy lead material was condensed in Stokoe Condensers. The wheel house survives as a ruined building, partly built into the hillside, and the tail race survives as a stone culvert extending south to discharge into the beck. The wooden condenser building no longer survives above ground level.

1.2.4 The peat store stands as a roofed building near to the Smelt Mill, and is a stone rubble structure with four arched entrances at the front.

1.2.5 ***Previous Archaeological Works***: some limited documentary research has been undertaken of the site (Gill 1992) and an options appraisal has been undertaken by Atkins Heritage (2012); however, no archaeological survey has been undertaken of the site.

1.3 OXFORD ARCHAEOLOGY NORTH

1.3.3 ***Industrial Landscapes:*** OA North has considerable experience of survey and analysis of industrial landscapes in Northern England, and in particular lead mining landscapes. Examples include Grassington Moor smelting mill, Sargill Smelt Mill, Gunnerside Gill mine and Hunger Hill mine in North Yorkshire (LUAU 1994b; 1997a and 1999). Further afield, work has been undertaken at Nenthead, Wythburn and Greenside lead mines in Cumbria (LUAU 1997a; 1998b and OA North 2003), along with a survey of Paddy End dressing floors at Coniston copper mines (OA North 2007); as well as work at Snailbeach lead mines and smelter in Shropshire (LUAU 1990) and Rimington lead mines in Lancashire (LUAU 1998a). OA North's has undertaken surveys of Grassington lead mines, and included a detailed topographic survey of the Lead Smelting Cupola Mill and its surrounding

environs (LUAU 1993 and 1994a). OA North has recently undertaken a new survey of the Greenside lead mines in Ullswater using photogrammetric techniques, and is currently undertaking a survey of the Bolton Gill mines and Smelt Mill near Grassington (by the same techniques). With the exception of the Gunnerside Gill mine, all surveys have been directed or managed by Jamie Quartermaine (Senior Project Manager).

2. AIMS AND OBJECTIVES

2. AIMS

2.1 The aims of the project are as follows

i) Identify and gather sufficient information to establish the extent, nature, character, condition, quality, date, significance and functional relationships of the surviving archaeological and historical features within the survey area;

ii) Undertake a documentary study into the development of the complex based on primary and secondary sources;

iii) Undertake an archaeological survey at Levels 2 and 3 of the Keld Heads mines and Smelt Mill complex;

iv) Provide a basic structural assessment of the remains of the Keld Heads complex to be compiled in a report.

3. METHOD STATEMENT

3.1 THE PROJECT TEAM

3.1.1 The project will be under the management of **Jamie Quartermaine** BA Hons (OA North senior project manager) to whom all correspondence should be addressed. Jamie has been recording industrial landscapes across the north-west since 1986 both as project officer and as project manager. Jamie will undertake the aerial survey, and will also implement the processing of the photogrammetric survey.

3.1.2 Following the processing of the survey data, plots will be taken back to the site for draughting. This will be undertaken by **Peter Schofield** BA (OA North Project Officer) who has considerable experience of field survey work, including prehistoric and medieval landscapes, and has undertaken considerable survey work throughout Cumbria and was a team leader on the recent major survey of the Northern Welsh Uplands. In particular he has considerable involvement in the recording of industrial landscapes including Coniston copper mines, Greenside lead mines, and Bolton Gill lead mines. He has considerable familiarity with the photogrammetric and instrument survey techniques that are being proposed.

3.1.3 The survey will also be undertaken by **Chris Wild** BSc (OA North Project Officer). Chris has extensive of experience in the recording and analysis of historic textile mills and industrial landscapes throughout the North West. The documentary study will be undertaken by Chris Wild and the report will be written by Chris Wild and Peter Schofield.

3.2 DOCUMENTARY STUDY

3.2.1 There is both secondary and primary information available for Keld Heads. At the outset consultation on available documentary sources will be undertaken with Mike Gill, and the Northern Mines Research Society (NMRS) and it is hoped that this will establish pertinent sources of archival and secondary source material. As much as is possible the intention is to draw upon existing knowledge and expertise. Pertinent secondary sources will be drawn upon and will include any information abstracted for the proposed British Mining report on mining in Wensleydale. The outstanding archaeological archive material and secondary sources will be collated, and the study will include investigation of primary sources to establish the chronological history and to obtain cartographic and illustrative material that will be invaluable in reconstructing the development of the site.

3.2.2 An examination will be undertaken of the archives held at the North Yorkshire County Record Offices (Northallerton), the Yorkshire Dales National Park Authority HER, NMRS archives, Listed and

Scheduled Monument Records, British Geological Survey, OA North library, the National Monuments Record (for air photography).

3.2.3 The study will examine historic cartographic sources, place and field name evidence, other photographic material held in the record office, published and unpublished sources, museum catalogues, oral evidence (as available), geological surveys.

3.2.4 It is assumed that copies of all pertinent information held by English Heritage will be provided and will include the options appraisal, any survey plans, LiDAR data, NMP data, and modern OA mapping

3.2.5 An inclusive map regression, which would include georeferenced vertical air photographs, will be compiled for the sites to demonstrate the changing character of the site. Historic mapping will be geo-referenced into a CAD system, then superimposed with modern mapping and the aerial photographs.

3.2.6 Research will be undertaken of secondary sources relating to other lead extraction and processing sites in the country to provide a body of comparative material for the assessment of the sites significance. This will draw upon the MPP Step 2 reports for the Minor Metals Industry.

3.3 TOPOGRAPHIC SURVEY

3.3.1 ***Introduction:*** it is proposed that a detailed topographic survey be undertaken of the study area to English Heritage Level 2 and 3 (Ainsworth *et al* 2007), and will provide for a general topographic survey of the study area and also detailed recording of selected areas and buildings. The output of the whole survey area is required to be at 1:2500, but selected areas will be at 1:1000 or 1:500 scale. It is proposed that the wider topographic survey be undertaken using a combination of total station survey and photogrammetry using aerial photographs taken from a UAV (Unmanned Aerial Vehicle). The survey control will be established using survey grade GPS. The survey will be undertaken by a team of two.

3.3.2 There are four areas requiring survey at different levels - Areas A-D and extend over 10.3ha. Level 2 survey (Ainsworth *et al* 2007) provides a basic descriptive and interpretative record of the archaeological features, and produces mapping that is metrically accurate and depicts the landscape context of the features. However, it will show only the outline of the features, rather than detailed hachures, and is at a level of record pertinent for a 1:2500 scaled output. A Level 3 survey is an enhanced and integrated record of the site that incorporates a quality of description, interpretation, graphical depiction and analysis beyond the scope of Level 2 (*op cit*, 24). The graphic output will include hachured surveys of earthworks and would be appropriate for a 1:1000 scaled output.

- ***Area A:*** Area A comprises an area of mainly spoil heaps and a Level 2 survey is required. The area is relatively open, containing for the most part only a limited number of scattered trees. As such it is possible to record the site by means of photogrammetry using a UAV and it is therefore proposed to use this as the primary technique, although there will also be a requirement for instrument survey in the northern part of the area which is obscured by trees. The photogrammetry technique is capable of generating very accurate 3D models of the topography, and also detailed contours, and while the primary data will be used as the source, it will be drawn up to level 2 in accordance with the requirements of the brief.

- ***Area B:*** Area B includes a smaller scheduled area, for which there is a requirement of a Level 3 survey and a larger area for which there is a requirement for a Level 2 survey. The scheduled area is largely open but is encroached by trees and woodland at the periphery of the area. It is proposed to record this area by means of photogrammetry using a UAV to capture the photography. This will generate precise 10cm contours for the topography and the earthworks, and will provide the basis for both the 1:1000 survey and the 1:100 scale survey of the Engine House (the latter will require lower altitude photography to generate the detail). In addition detailed ground photography will be undertaken to satisfy the requirements of the Level 3 building survey record. The rest of the area (Level 2 survey) is obscured by trees and will be undertaken by total station survey.

- ***Area C:*** Area C is a small triangle of land which requires a Level 2 survey. It is obscured by trees and will be recorded by instrument survey.

- ***Area D:*** Area D is the largest of the four areas and for the most part requires a Level 2 survey. However, there is also a requirement for a Level 3 survey of the Smelt Mill (in the southern part of the area) and the Condenser House and the associated section of Condenser Flue; both of these

would be appropriate for a 1:500 scale output. The area is covered by trees and the proposed method of recording is total station survey for both Level 2 and 3 surveys.

3.3.3 ***GPS Survey Control***: the control for the photogrammetric survey will be surveyed by means of survey grade GPS. The GPS that will be used is a Leica 1200 differential system and uses Ordnance Survey base stations in conjunction with a roving station to correct the raw data with corrections transmitted by mobile phone. The OA North GPS system is capable of accuracies of +- 0.02m and provides for an effective means of recording the detail of the features and also establishing survey control. The GPS stations will be located in areas outside the woodland or in clearings but as close as possible to the areas requiring archaeological survey. The survey control will be extended around the rest of the wood covered areas by means of closed traverse, using a total station, and will extend between the GPS located control points. Accuracies of the control will be maintained to 0.02m spatially and 0.03m vertically.

3.3.4 ***Detailed Topographic Survey:*** it is proposed to map the extent of the study area by a combination of photogrammetry and instrument survey; the former will be used to map features that are clearly visible from above (Areas A and B) and the instrument survey will be used to map features obscured by trees (Areas B, C and D).

3.3.5 *Photogrammetry:* photogrammetry is a long established technique which has been updated and refined such that it is now an extremely simple, cost effective and very accurate means of recording features and landscapes in three dimensions. It uses aerial photographs taken from a small electrically powered model helicopter (UAV) which has the ability to carry a light weight camera up to altitudes of 200 feet. The advantage of the UAV is that it can take photographs from variable altitudes to suit the level of recording required of the survey; low level photographs provide a very high resolution of ground features sufficient to be able to distinguish pebbles, whereas higher level photographs provide overall control across larger areas. Typically a survey model would entail the use of photographs taken from multiple altitudes, such that there is good ground resolution but which is accurate across a larger area.

3.3.6 Survey control is introduced to the photographs by the placement of survey control targets across the site which are located by means of the survey grade GPS / instrument survey. Additional survey points are obtained in order to test the accuracy of the photogrammetric model, which will typically vary from +- 20mm to 100mm depending upon the extent of the survey model.

3.3.7 The photogrammetric processing is undertaken using Agisoft Photoscan software which provides detailed modelling using the overlap of up to 300 photographs, and creates a very detailed DTM (Digital Terrain Model) across the site. The photographs are then digitally draped over the model to create an accurate three dimensional model of the ground surface. The primary output, however, is an accurate two dimensional image, overlying a DTM, which can be used to generate accurate plans and detailed contours across the extent of the scheduled area. However, the 3D model can also be output as a tool to visualise the site from any perspective and can be viewed in Adobe Acrobat.

3.3.8 OA North is CAA licensed to undertake commercial aerial survey work with a UAV (BNUC0S 0478-13-02-01).

3.3.8 ***Instrument Survey:*** the majority of the survey areas will be recorded by total station instrument survey and will include the Level 3 surveys of the Smelt Mill and Condenser House in Area D. The total station survey will be generated by EDM tacheometry using a total station linked to a pen computer running TheoLT software. The digital data is transferred onto the pen computer for manipulation and transfer to other digital or hard mediums. The survey data will be accurate to +- 0.01m.

3.3.9 ***Manual Survey:*** following the generation of the photogrammetric / instrument survey plots, they will be taken back to the field so that an experienced archaeologist can undertake a detailed inspection of the site, drawing up by manual survey those parts of the site that are clearly evident on the plots and using additional instrument survey techniques for those features that are obscured. On completion of the field survey the drawings will be enhanced within the CAD environment to produce the final drawings.

3.3.10 The survey will record all pertinent archaeological detail. The results of the survey will be superimposed upon modern OS mapping, the historic Ordnance Survey mapping, LiDAR, the orthophotos from the photogrammetry and the photogrammetric contour data.

3.3.11 ***Photography:*** in conjunction with the archaeological survey a photographic archive will be generated, which will record significant features as well as aspects of the general landscapes. It will be undertaken in accordance with guidelines in the English Heritage guide to recording landscapes (Ainsworth 2007) and will include scale bars and identifiers for general shots. However, photography used to generate the

3D models will exclude scale bars but will include survey targets. This photographic archive will be maintained using a digital SLR camera with 16 mega pixel resolution. The photographic record will include detailed coverage of all elevations and all the structures will be viewed from multiple vantage points. Photographs will generally be archived as Tiff files although those used to generate the 3D models will be in JPG format.

3.3.12 ***Site Description and Assessment:*** it is intended to create a descriptive record of the individual elements and components that make up the wider site. It is proposed that the data be directly input on site into a palm computer. The data will be incorporated into an Access 97 compatible database, and will be backed up daily onto a portable computer running Access 97. The input into the system will be guided by a proforma to ensure uniformity and consistency of input, and will provide input for all the relevant fields, and will be compatible with the YDNPA HER. The description will incorporate a provisional interpretation of the function and purpose of a site, where possible, and similarly will provide a provisional interpretation of the site's chronology where possible. This data will be formatted and topped and tailed within word to produce the gazetteer volume for the survey project. The gazetteer entry will provide a preliminary interpretation, links to relevant documentary or historic cartographic sources and a statement of condition and threats.

3.3.13 ***Condition Assessment:*** a condition assessment of each feature will be made and will entail applying the concept of Low, Medium and High Risk of potential adverse impacts to each of the broad site areas and individual monuments. The condition will be determined according to the English Heritage Scheduled Monuments at Risk methodology (Darvill and Fulton 1998, 265).

3.4 REPORT

3.4.1 ***Digital Presentation:*** the survey data would be collated within a CAD environment and would combine the topographic and photogrammetric data. A digital copy of the archive can be provided in shape file format alongside the final report. Digital photography would be provided, and would be appropriately indexed. PDF copies of all drawings will be provided as well as the base AutoCAD files (2011 format).

3.4.2 The survey data would include a series of metrically accurate orthophotos covering the study areas recorded photogrammetrically and the individual structures. In addition detailed contour plots would be provided for the Level 3 survey areas at an appropriate contour separation.

3.4.3 ***Reporting:*** a descriptive and analytical report will be compiled which would present, summarise, and interpret the results of the programme. The survey report will include a summary historical development of the study area to provide an appropriate context for the sites development. It will summarise and interpret the results of the programme, and will include a full index of archaeological features identified in the course of the project. The report will include:

- Clients name and frontispiece;
- Acknowledgements;
- A concise, non-technical summary of the results;
- Contents;
- An introduction summarising the brief and project design and any agreed departures from them will be included as well;
- Project aims and objectives;
- A description of the project and methodology, including software and georeferencing techniques;
- Historical and Archaeological background;
- Results of the documentary research;
- Survey results;
- Analysis and interpretation of the remains in conjunction with the results of the documentary study;
- An interpretative account of the development of the historic landscape from its inception to the present;

- Assessment of the condition of the historic environment remains; highlighting those where there is cause for concern;
- Structural assessment of the built structures;
- Recommendations for the management of the heritage, including areas requiring tree management;
- Bibliography;
- Copies of the project brief and project design;
- Gazetteer of all identified monuments and historic features;

3.4.4 ***Illustrations:***

- A site location plan related to the Ordnance Survey national grid;
- Orthophotographs of each of the photogrammetrically recorded study areas
- 1:2500 survey drawings of the whole study area
- 1:1000 and 1:500 survey hachure survey drawings of detail areas
- 1:1000 and 1:500 survey contour survey drawings of detail areas
- Contour survey drawings superimposed with hachure drawings
- Detailed plans

3.4.5 The site mapping would be based upon the CAD base. The report would be accompanied by photographs and historic illustrations illustrating the principal elements of the landscape.

3.4.6 ***Editing and submission:*** the reports would be subject to the OA North's stringent editing procedure and then a draft would be submitted to the client for consultation. Following acceptance of the report ten bound copies of the report would and a PDF copy would be submitted.

3.4.7 ***Output:*** ten hard and one digital copies and of the reports would be submitted to the client, and a bound copy of the reports would be submitted to the English Heritage. Each report would be illustrated by a selection of prints and maps.

3.5 ARCHIVE

3.5.1 An archive for the project will be prepared during and following the fieldwork programme and a summary forwarded to the YDNPA Historic Environment Record and English Heritage. The results of the excavation will form the basis of a full archive to professional standards, in accordance with current English Heritage guidelines (*Management of Research Projects in the historic Environment*, 2006). The project archive represents the collation and indexing of all the data and material gathered during the course of the project. The deposition of a properly quantified, ordered, and indexed project archive in an appropriate repository is considered an essential and integral element of all archaeological projects by the Institute for Archaeologists.

4. OTHER MATTERS

4.1 ACCESS

4.1.1 It is assumed that English Heritage will obtain permission for access to undertake the survey from land owners and tenants.

4.2 PROJECT MONITORING AND TIMETABLE

4.2.1 ***Timing:*** it is intended that the field survey and documentary study would be undertaken at the earliest opportunity once it has been commissioned.

4.2.2 An advance copy of the draft report will be submitted by 10th March 2015. The final report will be submitted by 15th April 2015.

4.2.3 ***Project Management:*** once adopted, there will be close collaboration with English Heritage and the Bolton Castle estate and in particular the woodland management team. The English Heritage contact will be the Heritage at Risk project Officer.

4.2.4 ***Monitoring Meetings:*** it is anticipated that there will be three meetings with EH staff, at the outset, during the fieldwork, and to review the report.

4.3 HEALTH AND SAFETY

4.3.1 ***Health and Safety:*** full regard will be given to all constraints during the survey, as well as to all Health and Safety considerations. The OA North Health and Safety Statement conforms to all the provisions of the SCAUM (Standing Conference of Unit Managers) Health and Safety manual and the Health and Safety at Work Act 1974. Bespoke risk assessments based upon first-hand site visits are undertaken as a matter of course for all projects, and will be used to identify and mitigate against the potential hazards arising from the project. As part of the initial stages of the project an overarching Health and Safety management plan will be created and reviewed throughout the course of the preparatory stage until the project is implemented. After this the review process and daily monitoring will take place on site. A detailed Risk Assessment and Method statement will be produced in conjunction with EH, with individual focus on the survey area, highlighting the specific risks and issues associated with the site.

4.4 INSURANCE

4.4.1 The insurance in respect of claims for personal injury to or the death of any person under a contract of service with the Unit and arising in the course of such person's employment shall comply with the employers' liability (Compulsory Insurance) Act 1969 and any statutory orders made there under. For all other claims to cover the liability of OA North in respect of personal injury or damage to property by negligence of OA North or any of its employees there applies the insurance cover of £10m for any one occurrence or series of occurrences arising out of one event.

4.5 PROGRAMME KELD HEADS SURVEY

Task	***Resources***
Documentary Study	9 days (PO)
Site Meetings	3 PM
Photogrammetric /Instrument Survey	27 man days (PO and PS)
Draughting	20 PO
Reporting	12 PO

PM = Project Manager

PO = Project Officer

APPENDIX 3: SURVEY GAZETTEER

Site Number **1**
Site Name Concrete Base, Keld Heads, Preston-under-Scar
NGR 407765 491277
Type Aerial Ropeway
Period Twentieth century
Photo Ref 1_1.jpg
Sources OS map 1:10,560 1953-58; Peter Schofield, OA North Survey 2015
Description Concrete foundations for the north-west/south-east running quarry aerial ropeway. The site consists of three surviving concrete plinths (Sites **1**, **4** and **103**). The Aerial ropeway terminated by building (outside study area) adjacent to the railway (Site **139**).

Site Number **2**
Site Name Explosives Store, Keld Heads, Preston-under-Scar
NGR 407741 491319
Type Explosives Store
Period Industrial
Photo Ref 2_1.jpg-2_3.jpg
Sources Peter Schofield, OA North Survey 2015
Description A single storey, two celled, rectangular building. It is 9m long by 4m wide with mortared stone construction and has a slightly pitched concrete slab roof. It has a doorway on the south gable end and a window/hole on the northern end.

Site Number **3**
Site Name Quarry ,Keld Heads, Preston-under-Scar
NGR 407755 491310
Type Quarry
Period Industrial
Photo Ref 3_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A small, curvilinear quarry located on the top break of the hillslope. It measures approximately 50m by 6.5m and is overlain by a partially collapsed enclosure wall.

Site Number **4**
Site Name Concrete Base, Keld Heads, Preston-under-Scar
NGR 407765 491277
Type Aerial Ropeway
Period Twentieth century
Photo Ref 3_1.jpg
Sources OS map 1:10,560 1953-58; Peter Schofield, OA North Survey 2015
Description The concrete foundations for the north-west/south-east running quarry aerial ropeway. The site consists of three surviving concrete plinths (Sites **1**, **4** and **103**). The aerial ropeway terminated by a building (outside study area) adjacent to the railway (Site **139**).

Site Number **5**
Site Name Quarry/Reservoir, Keld Heads, Preston-under-Scar
NGR 407780 491254
Type Quarry
Period Industrial
Photo Ref 5_1.jpg, 5b_1.jpg-5b_2.jpg
Sources Peter Schofield, OA North Survey 2015

Description A large, semi-circular, quarry cut into the hillside. It measures approximately 35m long by 27m wide and has a quarried face on the northern side and upcast banks to the south. The quarry face continues further east following a steep gully towards a nearby stream. The quarry contains a stone-revetted ramp which was possibly used for access, or was associated with the aerial ropeway (Site **5b**), and a possible building platform (Site **5a**).
Part of the site (Site **145**) is interpreted as a disused reservoir for the earliest Preston Smelt Mill, but has been substantially disturbed by the quarry working. There is a small stream running into the site but it disappears underground within the quarry.

Site Number **6**
Site Name Condensing Flue, Keld Heads, Preston-under-Scar
NGR 407747 491271 to 407797 491014
Type Condensing Flue
Period Industrial
Designations The southern part is inside scheduled area 1014763
Photo Ref 6a_1.jpg-6a_3.jpg, 6c_1.jpg-6c3.jpg, 6e_1.jpg-6e_13.jpg, 6f_1.jpg-6f_6.jpg, 6g.jpg-6g_9.jpg
Sources OS map 1:10,560, 1856; OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,500 1913; OS map, 1:10,560 1919; OS map, 1953-58, 1:10,560; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Raistrick 1975,Vol 2, 102; The Archaeological Practice 1995; EH Scheduled Monument Entry; Peter Schofield, OA North Survey 2015

Description The Condenser Flue which initially terminated at a chimney (Site **7**), but then shortly after it was built, in 1855, the flue was extended 3.3km to the Cobscar Mill Chimney (Atkins 2012, 12). The seven flues on the north side of the Smelt Mill joined into two flues 'by placing a wall parallel to the west wall of the original flue as far as the Condenser House' (Raistrick 1975, 75). From there to the north it was a single main flue (*ibid*). It was 40 inches wide and had short vertical walls c 1.5 feet thick, standing to a height of 1.5 feet above ground level. The walls had springing for an arched roof (The Archaeological Practice 1995, 2) or in places had a stones flagged roof (EH Scheduled Monument Entry).
The remnants of the condensing flue run roughly north-north-west from Keld Heads Smelt Mill. The surveyed section measures over 400m in length but continues onto the commons further to the north. The general built is rectangular in section and is of mortared stone construction with a stone slab roof. In several places this is replaced by an arched vaulted roof. The southern section of the flue (Site **6g**) consists of two damaged pairs of conjoined flues running into the north end of the Smelt Mill buildings (under the spoil heap). There is, in addition, a flue bypassing to the east running to a separate building, and a flue branching off of the main flue further to the north (Site **6h**). There are two conjoined sections of flue running north from here (Site **6f**) and at the northern end of this section there is a vaulted arch roofed section running under a trackway (Site **23e**). Further north the best preserved section of double flue (Site **6e**) runs up to the site of the Condenser House (Site **102**). The western flue does not continue past the Condenser House, but more damaged sections of single flue are evident (Sites **6d** and **6c**). At the northern end of 6c the flue changes alignment at a small platform (Site **7**) which is probably the location of the original condensing chimney which was superseded when the flue was extended up onto the open moors. From here the flue changes alignment onto a more north-west orientation and extends towards a road (Site **6b**); this section is also poorly preserved. The northern end of the surveyed part of the flue (Site **6a**) has an extant vaulted roof on the north end immediately beneath the road.

Site Number **7**
Site Name Site of Condensing Chimney, Keld Heads, Preston-under-Scar
NGR 407723 491276
Type Condensing Chimney
Period Industrial
Designations within scheduled area 1014763
Photo Ref 7_1.jpg
Sources OS map 1st edition, 1:10,560, 1856; ZBO (L) 21, 1878; Peter Schofield, OA North Survey 2015

Description A chimney terminating the Condenser Flue as marked on the 1856 and 1878 map (This area was not part of the 1866 map). As the flue was extended the chimney was no longer required and was presumably demolished and thus not marked on the 1891-3 map. It survives as a rectangular earthwork adjacent to the Condenser Flue.

Site Number **8**
Site Name Shaft Mounds, Keld Heads, Preston-under-Scar
NGR 407713 491305
Type Shaft Mounds
Period Industrial
Designations within scheduled area 1014763
Photo Ref 8_1.jpg-8_2.jpg
Sources OS map 1st edition, 1:10,560, 1856; ZBO (L) 21, 1878; OS map, 1:2,500 1891-3, OS map, 1:2,500 1913; OS map, 1:10,560 1919; OS map, 1953-58, 1:10,560; Peter Schofield, OA North Survey 2015
Description A series of four shaft mounds located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. There is a large central shaft mound with three smaller subsidiary depressions surrounding it. Overall the site measures approximately 38m by 20m. Two of the shafts, which were very close to the chimney (Site **7**), were marked as *Old Shafts* on the 1891-3 map and thereafter.

Site Number **9**
Site Name Boundary Bank, Keld Heads, Preston-under-Scar
NGR 407706 491321 to 407569 491261
Type Boundary Bank
Period Post-Medieval to Industrial
Photo Ref 9d_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description Linear earthworks of four disjointed sections of boundary bank running in a roughly east-north-east/west-south-west orientation through the northern end of Keld Heads. The site measures over 150m in length.

Site Number **10**
Site Name Shaft Mound, Keld Heads, Preston-under-Scar
NGR 407684 491331
Type Shaft Mound
Period Nineteenth Century
Designations outside scheduled area
Photo Ref 10_1.jpg-10_2.jpg
Sources OS map 1st edition, 1:10,560, 1856; ZBO (L) 21, 1878; OS map 1:10,560 1895; OS map, 1:10,560 1919; Peter Schofield, OA North Survey 2015
Description A single large shaft mound located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. The shaft mound is overlain by a later enclosure wall and measures approximately 21m by 18m. It was shown on the OS 1856 map.

Site Number **11**
Site Name Trackway/Embankment, Keld Heads, Preston-under-Scar
NGR 407619 491320 to 407678 491324
Type Trackway
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015

Description An east/west orientated trackway or embankment running west from a large shaft mound towards the road (Site **10**). It measures 60m long by 8m wide. The route connects this shaft with more extensive workings on the opposite site of the road (not surveyed).

Site Number **12**
Site Name Barn/Byre, Keld Heads, Preston-under-Scar
NGR 407667 491337
Type Barn
Period Post-Medieval to Industrial
Photo Ref 12_1.jpg-12_5.jpg
Sources Atkins, *Appendix B,* 2012; Peter Schofield, OA North Survey 2015
Description A small, single storey rectangular stone field barn/byre. It is of mortared stone construction, and measures 4.7m by 4.5m with doorways on the west and north elevations. The trusses of a pitched roof are extant but it is missing it's roof slates. Internally there are several stone slab stalls on the south side. The structure is inset within a field wall.

Site Number **13**
Site Name Reservoir?, Keld Heads, Preston-under-Scar
NGR 407667 491325
Type Reservoir
Period Industrial
Photo Ref 13_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A small, rectangular boggy depression measuring 23.5m by 6.5m. It is located to the west of a shaft mound (Site **10**) and is backed up against the barrier of a trackway (Site **11**). Drainage water exiting the Condenser Flue to the west (Site **6a**) and surface run-off from the north collects in this area, but it is uncertain if it is a deliberately constructed reservoir.

Site Number **14**
Site Name Stream/Leat, Keld Heads, Preston-under-Scar
NGR 407612 491302 to 407675 491239
Type Leat
Period Industrial
Photo Ref 14_1.jpg-14_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description An 88m long, linear, section of canalised stream, orientated roughly north-west/south-east. It is draining water from extensive mine workings further north (not surveyed). The stream is part of the water management system supplying Keld Heads Smelt Mill. It joins a lateral stream (Site **17**) that bypasses a large reservoir (Site **28**).

Site Number **15**
Site Name Shelter, Keld Heads, Preston-under-Scar
NGR 407619 491271
Type Shelter
Period Post-Medieval to Industrial
Photo Ref 15_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A small sub-rectangular shelter located on top of an earlier field boundary bank (Site **9d**). It consists of foundations for two side walls and is open on the other ends. It measures 5.3m by 3.5m.

Site Number **16**
Site Name Adit, Keld Heads, Preston-under-Scar
NGR 407689 491252

Type Adit
Period Industrial
Photo Ref 16a_1.jpg-16a_5jpg, 16b_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A mine adit accessing a drift within Keld Heads lead mine. This is not simply a drainage adit as there are relatively large spoil heaps downslope to the south (Site **16b**). It consists of a vaulted stone portal with flanking retaining walls to the south. There is a slumped depression to the north suggestive of collapse within the tunnel. Water bypasses the adit further upslope but there is water still coming from the adit itself. There are fittings for a metal sluice in the channel to the south of the adit.

Site Number **17**
Site Name Leat/Stream, Keld Heads, Preston-under-Scar
NGR 407715 491249 to 407678 491184
Type Leat
Period Industrial
Photo Ref 17_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A canalised stream or leat running from several adits (Sites **16**, **19** and **20**) and bypassing around the north and west sides of a large reservoir located downslope of the adits (Site **28**). Overall the site measures over 110m long. The site continues downslope as a canalised stream (Site **24**) towards Reservoir 90 and Keld Heads Smelt Mill.

Site Number **18**
Site Name Shaft Mounds, Keld Heads, Preston-under-Scar
NGR 407730 491254
Type Shaft Mounds
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A pair of shaft mounds located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 29.5m by 19m.

Site Number **19**
Site Name Adit, Keld Heads, Preston-under-Scar
NGR 407723 491267
Type Adit
Period Industrial
Photo Ref 19_1.jpg-19_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A mine adit accessing a drift within Keld Heads lead mine. This may be a drainage adit but there are relatively large spoil heaps downslope to the south-west (Site **16b**). It consists of a slumped depression at the entrance with flanking retaining walls to the south-west. The adit is running into the mine laterally rather than perpendicular to the hillslope and lies adjacent to another adit (Site **20**). There is currently no water coming from the adit itself.

Site Number **20**
Site Name 407713 491260
NGR Adit, Keld Heads, Preston-under-Scar
Type Adit
Period Industrial
Photo Ref 20_1.jpg-20_3.jpg
Sources Peter Schofield, OA North Survey 2015
Description A mine adit accessing a drift within Keld Heads lead mine. This may be a drainage adit but there are relatively large spoil heaps downslope to the south-west (Site **16b**). The adit mouth

has been modified for modern drainage purposes and has embanked wall foundations enveloping the adit mouth except downslope to the south. A wooden screen is placed on top of the adit mouth and a bypass channel has been cut above it to redirect a stream upslope away from the opening. There are fittings for a metal sluice in the channel to the south of the adit.

Site Number **21**
Site Name Quarry/Reservoir, Keld Heads, Preston-under-Scar
NGR 407610 491254
Type Quarry
Period Industrial
Photo Ref 21_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A sub-rectangular quarry or possible reservoir. It measures 42m by 16.5m and has a quarried face on the north side with upcast bank downslope to the south. A spring wells up within the depression and joins the stream network (Site **22a**) associated with Keld Heads Smelt Mill.

Site Number **22**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407580 491271 to 407722 491053
Type Leat
Period Industrial
Photo Ref 22a_1.jpg-22a_2.jpg, 22c_1.jpg
Sources OS map 1:10,560, 1856; OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,500 1913; OS map, 1:10,560 1919; OS map, 1:10,560, 1953-58; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Peter Schofield, OA North Survey 2015
Description A network of streams, that are often canalised in places and which service Keld Heads Smelt Mill. The upslope end of the system consist of two separate groups of spring heads (Sites **22a** and 22b) that meander downslope in deeply cut gullies and then into a combined channel (Site **22c**) which is guided diagonally across the hillside for a short distance by upcast banks downslope of it. Further south one section of the stream is clearly canalised and had revetment walling on the sides in places (Site **22d**). At its southern extent the stream joins another stream running downslope from mine adits located further east on the hillside (Site **17**/**24**).and feeds into the first of a pair of reservoirs (Site **91**) above the Smelt Mill.

Site 22a is a leat or canalised stream flowing, from the springs north-west in Area D and on the west edge of the enclosed woodland, extending southwards towards the western end of the Smelt Mill (Site 75). Just north of the Smelt Mill it is joined by another south flowing leat (Site **13**). On the 1866 and 1895 maps the main leat is depicted as a meandering stream, although in 1919 and 1853-8 it was drawn as a wider, straighter leat.

Site Number **23**
Site Name Pipeline Bridge, Keld Heads, Preston-under-Scar
NGR 407583 491207
Type Pipeline Bridge
Period Industrial
Photo Ref 23_1.jpg-23_10.jpg,
Sources Peter Schofield, OA North Survey 2015
Description A small visible section of linear pipeline orientated roughly west-south-west/east-north-east. It measures approximately 53m long and consists of two sections of stone footings/ bridge supports running over two streams (Site **22**). The supports are of drystone construction with some stone slabs and iron rails/plates laid as a superstructure on top.

Site Number **24**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407680 491184 to 407718 491059
Type Leat

Period Industrial
Photo Ref 24_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A section of linear, canalised stream running roughly north/south downslope to service Keld Head Smelt Mill.. The stream takes water from a stream/leat collecting water out of several mine adits (Site **17**) and bypassing a large reservoir (Site **28**). The stream may in fact predate the construction of this reservoir. At its southern extent the stream joins another stream running downslope further west on the hillside (Site **22**).and feeds into the first of a pair of reservoirs (Site **91**) above the Smelt Mill.

Site Number **25**
Site Name Leats, Keld Heads, Preston-under-Scar
NGR 407727 491175 to 407753 491066
Type Leat
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description Two sinuous dried-up streams/leats running downslope to the south of a large reservoir (Site **28**). The courses may reflect several phases of water management, possibly predating the reservoir. The westernmost stream (Site **25a**) feeds into the lower of two adjacent reservoirs immediately north of Keld Heads Smelt Mill. (Site **90**). The lowest section of this western leat has water in it. The eastern stream is fragmentary and may be associated with a further leat (Site **26**).

Site Number **26**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407741 491203 to 407745 491112
Type Leat
Period Industrial
Designations The southern part is inside scheduled area 1014763, but it is mostly outside the scheduled area
Photo Ref N/A
Sources OS map 1:10,560, 1856; OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,500 1913; OS map, 1:10,560 1919; OS map, 1953-58 1:10,560; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Peter Schofield, OA North Survey 2015
Description A leat flowing from the springs in the central part of Area D southwards, through the site of a reservoir (Site **90b**) and towards the western end of the Smelt Mill (Site 75) via leat **97**. On the 1866 and 1895 maps the leat is depicted as a meandering stream flowing south from the reservoir (Site **90b**), although in 1919 and 1853-8 it was drawn as a wider, straighter leat.
The top part of this leat is a sinuous channel running downslope from the east side of a large reservoir. It exits as a collapsed tunnel in the side of the reservoir dam wall and runs downslope in places as a canalised stream with a partial retaining wall on the sides. The stream continues south (as Site **97**) and feeds into the lower of two adjacent reservoirs immediately north of Keld Heads Smelt Mill (Site **90**).

Site Number **27**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407742 491196 to 407752 491172
Type Leat
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A small leat/canalised stream running south downslope from an outfall in the east side of a large reservoir (Site **28**). It no longer contains any water and measures approximately 30m long. It runs south before turning south-east and would have fed water into a smaller reservoir (Site **116**) near to the Condenser House for Keld Heads Smelt Mill (Site **102**).

Site Number	**28**
Site Name	Reservoir, Keld Heads, Preston-under-Scar
NGR	407698 491210
Type	Reservoir
Period	Industrial
Designations	inside scheduled area 1014763
Photo Ref	28_1.jpg-28_3.jpg
Sources	OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map, 1:10,560 1919; OS map 1:10,560 1953-58; ZBO (L) 19, 1866; ZBO (L) 21, 1878, Smith 1998, 49; Peter Schofield, OA North Survey 2015
Description	A large sub-rectangular reservoir cut into the hillside at Keld Heads lead mine. It is associated with water management for both the Smelt Mill and the Condenser House at the mine, and supplied leat Site **26** and Reservoir Site **90**. It measures approximately 80m long by 40m wide and has a large, well-defined dam surrounding all except the upslope side. The dam is constructed of battered back stone walls on both sides with a flat top. There are outflows on both west and east ends (the with latter a collapsed tunnel) which both served streams providing water down to the Smelt Mill (Sites **24** and **26**). There is a bypass channel running around the west side (Site **17**) running from several adits located above the site. In addition the reservoir served the Condenser House and a small adjacent reservoir via a small leat (Site **27**) and a wooden launder (Site **113**).

Site Number	**29**
Site Name	Stone culvert, Keld Heads, Preston-under-Scar
NGR	407998 490602
Type	Culvert
Period	Nineteenth century
Photo Ref	29_1.jpg- 29_2.jpg
Sources	ZBO (L) 19, 1866;Peter Schofield, OA North Survey 2015
Description	A stone culvert situated on the west side of the Keldheads Gill and to the south-west of the dressing floor. The culvert is made from angular quarried and dressed stones. It is 0.75m wide and, from what is visible, at least 0.5m high. A water wheel was shown on the 1866 estate map, and was close to the Gill. The wheel and the culvert were intended to drive the flat rods of a power system (running north/south) under the railway to the mines south of the main complex (Spensley 2014, 62). Although the culvert survives there is no evidence of the putative wheel-pit to the north that was said to have powered the system.

Site Number	**30**
Site Name	Agent's house, Keld Heads, Preston-under-Scar
NGR	408006 490613
Type	House
Period	Industrial
Photo Ref	30_1.jpg- 30_5.jpg
Sources	OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,500 1913; OS map, 1:10,560 1919; OS map, 1953-58, 1:10,560; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Peter Schofield, OA North Survey 2015
Description	The Agent's house, located on the southern boundary of the study area, and is now Keld Cottage. This was intended for the Surface Agent who was responsible for the above ground works. It has two stories and has been constructed using lime mortar and angular quarried stones. Large stone lintels have been used above the doors and windows, some of which have been blocked. The house is L-shape in plan with a slate roof and two stone chimneys. A smaller two story lean-to is present on the west side.

Site Number **31**
Site Name Boundary wall, Keld Heads, Preston-under-Scar
NGR 408013 490611
Type Boundary wall
Period Industrial
Photo Ref 31_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description The wall surrounding the southern Agent's House (Site **30**), creating a small yard/garden. The wall is made from angular stones, ranging in size. It has been constructed using lime mortar and has flat coping stones on the top. The wall abuts the lean-to on the north west and south west corners. It stands at 1m high and 0.5m wide. There is a gate on the north with two moulded stone tops. Part of the wall on the eastern side has been rebuilt.

Site Number **32**
Site Name Privy, Keld Heads, Preston-under-Scar
NGR 408028 490610
Type Privy House
Period Industrial
Photo Ref 32_1.jpg- 32_3.jpg
Sources Peter Schofield, OA North Survey 2015
Description The privy associated with the southern Agent's House (Site **30**). The privy has two cells of differing heights; the western cell stands at 2.5m high while the eastern cell is smaller standing at a height of 2.1m. A door is wooden door is present on the northern side of the western cell with a wooden shuttered window adjacent to it on the eastern side. The privy is made of rough angular stones held together with lime mortar. Part of the yard wall (Site **31**) abuts the privy on the south. On the west is a small gate. Overall the building measures 3.5m long and 2m wide.

Site Number **33**
Site Name Dressing floor, Keld Heads, Preston-under-Scar
NGR 408002 490650
Type Dressing floor
Period Industrial
Photo Ref 33_1.jpg- 33_3.jpg
Sources OS map, 1:2,500 1891-3; OS map 1:10,560 1895, ZBO (L) 19, 1866; Spensley, 2014, 62; Peter Schofield, OA North Survey 2015
Description A large yard or building labelled as Dressing Floors and surrounded by revetment walls (as the spoil heaps were close by to the south and east). The yard was depicted on the larger scale maps as containing a series of machines or container and a mechanised crusher; these were mechanised Hotching tubs and Trunk Buddles with their own water wheel at the centre of the yard (Spensley 2014, 62).

The areas of fine silt waste are now mostly covered in moss. There are several possible surviving features. There is a distinct patch of orange moss (Site **33a**) covering a pile of fine silt waste. The patch measures 1m by 2m and is located towards the south of Site **33**. The colour of the moss may indicate the location of a buddle. There are also three low, parallel linear banks (Site **33b**). The banks run east/west and stand up to 0.3m high and 1m wide. They are spaced 0.75m apart and may be the remains of walls associated with the dressing floors. There is a line of five small vertical bolts (Site **33c**) running between the north and middle linear banks (Site **33b**); they have square tops measuring 0.015m by 0.015m and a diameter of 0.01m. They rise 0.35m out of the ground and run in an east/west direction. There is a mound with a tree in the centre (Site **33d**) that contains three large retaining bolts, possibly representing the remains of the wheel-pit or crusher marked on the 1866 map. Two of the bolts still stand upright at 1.25m tall with a distance of 0.95m between them. A third bolt lays displaced within the spoil heap close by. The bolts are 0.03m in diameter with rounded tops. To the south of the bolts lies a mound of spoil measuring 5m by 3m, which may be the remains of the wheel-pit. A rabbit

warren to the north of this site has brought fine silts to the surface. Lastly there is a small sub-square platform with slight gully on the north-west side (Site **33e**).

Site Number **34**
Site Name Square Platform, Keld Heads, Preston-under-Scar
NGR 407957 490652
Type Platform
Period Industrial
Photo Ref 34_1.jpg- 34_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A square platform built using angular revetting stones. The platform is 2m square and stands 0.3m high. It is located adjacent to the east bank of a stream. There is no evidence of a structure on the opposite side of the stream so it was probably not a bridge abutment.

Site Number **35**
Site Name Modern bridge, Keld Heads, Preston-under-Scar
NGR 407991 490626
Type Modern bridge
Period Industrial
Photo Ref 35a_1.jpg-35a_2.jpg, 35b_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A modern bridge built to access the garage located within the old power house. The bridge was first built using old railway sleepers in the 1980s and was demolished and replaced with a concrete slab bridge in 2015. The stream on either side of the bridge has a revetted walls. On the eastern side is a section of wall with a small outflow channel presumably running from the dressing floors immediately north of it (Site **35a**). To the west of the bridge is a section of wall foundation running east/west that is set in the base of the stream (Site **35b**). It is 0.5m by 0.3m and 0.15m high. The purpose/function of the foundation is unclear.

Site Number **36**
Site Name Brunton buddles, Keld Heads, Preston-under-Scar
NGR 408047 490612
Type Buddle
Period Nineteenth century
Photo Ref 36a_1.jpg-35- 35a_2.jpg, 36b_1.jpg
Sources ZBO (L) 19, 1866; Spensley 2014, 62; Peter Schofield, OA North Survey 2015
Description A D-shaped area of fine tailings associated with buddles (Site **36a**). A series of north/south banks are located to the east of the Agents House. The banks are moss covered and stand up to 0.7m high and 1.7m wide. The area is marked on the 1866 map and have been interpreted as 'Brunton buddles'. Further to the east are two curvilinear banks spaced 2.5m apart. The banks are 0.6m wide by 0.3m high and run in a north/south direction. The banks may be the remains of a trackway shown on the 1866 OS map or are part of the Brunton buddles.

Site Number **37**
Site Name Railway bridge, Keld Heads, Preston-under-Scar
NGR 408056 490593
Type Bridge
Period Industrial
Photo Ref 37_1.jpg- 37_2.jpg
Sources Peter Schofield, OA North Survey 2015

Description A small railway bridge over a stream. The bridge is made from large angular stones and mortar with large blocks of ashlar masonry. It has a single arch and has been culverted on the north side. The bridge is associated with the railway embankment, which stands 2.5m high on the north side and a level crossing, situated to the south west.

Site Number **38**
Site Name Gateposts and Field Boundary, Keld Heads, Preston-under-Scar
NGR 408067 490604 to 408104 490606
Type Field Boundary
Period Industrial
Photo Ref 38a_1.jpg- 38a_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A pair of stone gateposts (Site **38a**). The posts are made from quarried and dressed stone and have rounded tops. They are associated with the north/south field boundary shown on historic OS mapping. They are each up to 1m high by 0.4m wide and 0.25m thick. In addition, there is an east/west running gully (Site **38b**) below the railway embankment. The gully may also be associated with the field boundary shown on the historic OS mapping, but alternatively may be associated with drainage for the railway embankment.

Site Number **39**
Site Name Pipeline, Keld Heads, Preston-under-Scar
NGR 408137 490633 to 408056 490625
Type Pipe
Period Industrial
Photo Ref 39_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description An east/west orientated pipeline associated with Preston-under-Scar waste water treatment works. The east end of the pipe runs outside of the study area. The exposed section is raised 0.5-0.6m above ground level on small square brick stanchions.

Site Number **40**
Site Name Spoil heap, Keld Heads, Preston-under-Scar
NGR 408131 490677 to 407963 490706
Type Spoil heap
Period Industrial
Photo Ref 40_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description An extensive area of spoil heaps/finger dumps of spoil material running east-south-east from the mouth of the main adit. The spoil heaps (Sites **40** and **42**) are in two tiers downslope of the main adit and was originally a single spoil heap but was then cut by the establishment of a railway line (Site **41**) forming a cutting through the spoil heap. The southern spoil heap is over 165m by 60m in extent and is a minimum of 20m high on the eastern end and then peters down to only 1m-2m high at the western end.

Site Number **41**
Site Name Disused railway, Keld Heads, Preston-under-Scar
NGR 408010 490699 to 408068 490689
Type Railway
Period Twentieth century
Designations Outside scheduled area
Photo Ref 39_1.jpg, 40_1.jpg
Sources OS map 1:10,560 1953-58; Peter Schofield, OA North Survey 2015

Description A railway siding, orientated east/west coming in from the east and terminating close to the later power house (Site **48**). This overlies all the original infrastructure, buildings and has a substantial cutting through the main spoil heap (Sites **40** and **42**). As a consequence there are high, undulating spoil heaps on either side of the railway line. Several wooden sleepers are still *in situ* along the route. The sleepers are 2m long, 0.4m wide with a thickness of 0.06m (Site **41a**), along with one mine wagon and several axles Site (**41b**), which lie near to the power house. The wagon is approximately 0.7m wide, 1.2m long and 0.5m deep.

Site Number **42**
Site Name Spoil heap, Keld Heads, Preston-under-Scar
NGR 408106 490703 to 407953 490752
Type Spoil heap
Period Industrial
Photo Ref 42_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description An extensive area of spoil heaps/finger dumps of spoil material running east-south-east from the mouth of the main adit (Site **55**). The spoil heaps are in two tiers downslope of the adit (Sites **41** and **42**) and were cut by a later railway line (Site 41). The northern spoil heap is over 165m by 35m in extent and are a minimum of 7m-10m high on the eastern end and peters down to only 1m-2m high at the western end.

Site Number **43**
Site Name Mine building, Keld Heads, Preston-under-Scar
NGR 407981 490678
Type Building
Period Industrial
Photo Ref 43_1.jpg- 43_2.jpg
Sources OS 1:10,560 1856; OS map 1:2,500 1891-3, OS map 1:10,560 1895, OS map, 1:2,500 1913, OS map 1:10,560, 1919, OS 1:10,560 1953-8, ZBO (L) 19, 1866; Peter Schofield, OA North Survey 2015
Description A small, square building shown on the 1856 map. This was joined in 1866 by a second smaller square building which terminated a tramline. Both buildings were still extant by 1953-7.
The mine building is small, stone built, and located to the south of the power house. The building has been constructed using rough angular stones and lime mortar. It has a slate roof and two doors on the south side. The building measures 5m by 4.5m and stands to full single storey height. The remains of two walls flank either side of the building, but these low wall stubs remain standing up to 0.4m wide and 0.6m tall. The flanking structures butt up against the main structure suggesting that they are of later date. The mine building is of unknown function.

Site Number **44**
Site Name Retaining wall, Keld Heads, Preston-under-Scar
NGR 407994 490679
Type Retaining wall
Period Industrial
Photo Ref 44_1.jpg-
Sources Peter Schofield, OA North Survey 2015
Description A fragmentary section of curvilinear retaining wall exposed on the south side of a spoil heap (Site **40**), and to the east of mine building (Site **43**). The wall is standing up to 0.5m wall by 0.4m wide. There is at least one wall stub surviving for a further building, which was shown on historic OS mapping.

Site Number **45**
Site Name Water Channel/Buddles, Keld Heads, Preston-under-Scar
NGR 407947 490680
Type Water channel
Period Industrial
Photo Ref 42_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A small water channel diverted to the east side of the main stream. The channel is approximately 1.5m wide by 0.5m deep but only the southern outflow is clearly visible on the ground, situated in a slightly sunken channel that is now covered in wild garlic. There is no obvious surviving earthwork evidence of any buddles.

Site Number **46**
Site Name Bouse team, Keld Heads, Preston-under-Scar
NGR 407960 490710
Type Bouse team
Period Industrial
Photo Ref 42_1.jpg , 44_1.jpg, 46b_1.jpg- 46b_2.jpg, 46c_1.jpg- 46c_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description An area marked as bouse teams on the 1866 mapping. The site is now used as part of the current garage forecourt in front of the power house. There are two parallel concrete pads (Site 46a) that were probably the remains of the floors of two buildings shown on the 1866 map. The east pad measures 3m by 4m and the west pad is slightly larger at 4.5m by 3m. Both pads are flush to the current ground surface. The level foundation of a north/south dividing wall measuring 0.5m wide is present between the two pads. A partially extant L-shaped retaining wall (Site **46b**) forms the south-west corner of the bouse team where it is cut into a large embankment (Site **47**). The wall is made from rough angular stones with lime mortar and it stands at 1.3m high and 0.4m thick. There are remains of a concrete pad/skim exposed on top of the wall and to the west onto the embankment. A retaining wall (Site **46c**) runs on the north and east sides of the later power house (Site **46c**). Whilst this may relate to the power house it could be part of the north and east sides of the bouse teams. The retaining wall stands up to 1.5m high and 0.4m wide and is made from angular quarried stone. At the south end is a flight of six stone steps which measure 1.2m wide and each 0.2m deep.

Site Number **47**
Site Name Embankment , Keld Heads, Preston-under-Scar
NGR 407945 490712
Type Embankment
Period Industrial
Photo Ref 47_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A linear east/west orientated embankment situated on the west side of the bouse teams (Site **46**). The embankment measures 25.5m by 15m and is 1.75m high

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Site Number **48**
Site Name Engine house, Keld Heads, Preston-under-Scar
NGR 407969 490719
Type Engine house
Period Modern
Photo Ref 48_1.jpg- 48_4.jpg
Sources OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,5001913; OS map, 1:10,560 1919; ZBO (L) 19, 1866; Peter Schofield, OA North Survey 2015

Description A two storey power house associated with the limestone quarry that dates from the early twentieth century. The site is presently a vehicle repair garage. The structure is rectangular, single celled and is open to the roof. The red brick constructed walls are very thick ,and it has an internal concrete floor. There is an RSJ on the door in the south elevation and above a pitched slate roof. A wooden louvered ventilation system is present on the apex of the roof. Three large windows are present on the eastern wall elevation. Local knowledge states that the original engine base was present before the concrete floor was laid down for the garage in the 1980s.
The building is on the site of a walled yard or building where the bouse teams stored the ores with perhaps a building or rooms in the south-west corner (Spensley 2014, 62). The 1913 and 1919 maps showed that only the remainder of the north and west walls of the bouse teams had survived.

Site Number **49**
Site Name Lean-to Garage , Keld Heads, Preston-under-Scar
NGR 407963 490721
Type Garage
Period Modern
Photo Ref 49_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A modern lean-to is located to n the west of the power house. The lean-to has an RSJ frame with a sloped roof and corrugated iron walls. Local knowledge states that it once housed two boilers to power the engine for the limestone quarry. The structure has an inspection pit for the garage, but there is no surviving evidence of footings for the boilers.

Site Number **50**
Site Name Retaining wall, Keld Heads, Preston-under-Scar
NGR 407952 490731
Type Retaining wall
Period Industrial
Photo Ref 50_1.jpg, 50a_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A large retaining wall to the north-west of the power house. Only fragmentary remains survive, the visible section stands up to 1m. The wall is the south-western side of the tramway and had a series bouse teams, or ore bins, constructed against it. The retaining wall lies 3m north of a further retaining wall which had a different orientation and was related to the later power house. A thick iron pipe (Site **50a**) is visible for approximately 1.2m and is located in the spoil heap to the rear of the power house. The pipe is oval at its end, which measures 0.15m by 0.08m with a 0.04m diameter hole. If in situ the positioning would suggest that the pipe was running from the mine area to the bouse teams or to the powerhouse.

Site Number **51**
Site Name Flue, Keld Heads, Preston-under-Scar
NGR 407963 490777 to 407969 490755
Type Flue
Period Nineteenth Century
Photo Ref 51a_1.jpg- 51a_2.jpg, 51b_1.jpg- 51b_3
Sources Atkins 2012; Peter Schofield, OA North Survey 2015
Description A linear, approximately 23m long, section of flue (Site **51a**) running north/south towards the area of the dressing floor from the Boiler House. The flue is constructed from angular stones with lime mortar and with a concrete capping on top. The capping is 0.3m thick and is flat with a split in the centre. The flu is rectangular in section and measures 1.2m wide and up to 1m high on the north end, becoming subterranean towards the south. The possibility is that the flue

was intended to carry an insulated pipe, taking steam to an engine in the area of the dressing floor.
At the north end of the flue is the Boiler House (Site **51b**), and where the flue (Site **53**) abuts the Boiler House there is a raised rectangular stone base with a circular setting for a concrete lined flue pipe. The pipe is no longer present, however, it would have once run to a hole in the base of the chimney (Site **52**). The setting base is approximately 1.2m by 1m and 0.5m high, tapering to ground level. The hole for the pipe is approximately 0.4m wide.

Site Number **52**
Site Name Chimney, Keld Heads, Preston-under-Scar
NGR 407969 490783
Type Chimney
Period Industrial
HER number see MNY 14691
Designations Inside scheduled area 1014763 and part of Listed Building 1179229 (Grade II)
Photo Ref 52_1.jpg- 52_3.jpg
Sources OS map 1:2,500 1891-3; OS map 1:2,500 1913; Listed Building 1179229; Atkins 2012; Peter Schofield, OA North Survey 2015
Description The chimney was marked on the map as a tiny square underneath the scars or cliffs to the north-east of the Boiler House and Engine House (Site **66**). It is 2.5m x 2.5m in plan *c* 12m high (EH Scheduled Monument entry). This may have been built alongside the Engine House and Boiler House after 1878; it is also marked on the map of 1913 as *Chy*. When the lead mine was closed the chimney was used in conjunction with a coal fired electricity generating plant. The Atkins report cited a height of 16.5m and mentioned the circular opening at the south side of the base of the chimney, where the flue once joined.
The chimney is associated with the flue (Site **51b**) and the Boiler House (Site **53**). The Chimney stands to full height. It is square and slightly tapered, narrowing towards the top, where there is an over hanging band of capping stones. It is well constructed with coin stones up to half way from the base. There is a hole close to the base to take the flue pipe from site **51b**.

Site Number **53**
Site Name Boiler house, Keld Heads, Preston-under-Scar
NGR 407953 490775
Type Boiler house
Period Industrial
Photo Ref 53_1.jpg- 53_16.jpg
Designations Within scheduled area 1014763 and Listed Buildings 1179229 (Grade II)
Sources OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map 1:10,560 1919; OS map 1:10,560 1953-58; NMRS records; Spensley 2014, 62; Listed Building 1179229; EH Scheduled Monument entry; Atkins 2012; Peter Schofield, OA North Survey 2015
Description A Boiler House was first shown on the 1895 map, and provided the steam for the adjacent Engine House which was built in 1879 (Spensley 2014, 62). The building has two stories with a loft. The south side has one window and two doors on ground floor level, the east door has been made smaller. It was once possibly a larger opening for the purposes of getting the boilers into the building. The building has three cells. The gable wall in the eastern end has holes for floor beams. It also holds a brick archway, which is attached to Site **51b** to ventilate the building. The windows and doors have concrete faced lintels and stone window sills.
The dividing wall between the central and eastern cells has four holes, most likely to fit a piece of machinery. There are also three larger holes in the northern wall of the centre cell that go through to the neighbouring Engine House. The building has no roof although some of the beams survive. In the centre cell six bolts hang from the central beam which lies on top of the southern wall and runs to the Engine House. The internal walls butt against the external walls suggesting the space was divided at a later date.

The western cell also has a beam surviving at roof level. There is evidence of partial concrete skin render and lime mortar in this cell that has been later patched with a darker mortar. Holes for floor joists are present in the western gable, which also has a pair of double height openings on the first and second floor levels. The western gable abuts the Boiler House.

Site Number **54**
Site Name Path, Keld Heads, Preston-under-Scar
NGR 407898 490810 to 407971 490747
Type Path
Period Industrial
Photo Ref 54_1.jpg- 54_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A sinuous path running up the hill past the Boiler House and Engine House. The path is 1.5m wide with a metalled surface. It runs flush with the retaining wall with metal railings to the west and winds up the hill past a small quarry behind the Engine House to a gateway at the head of the woods. The retaining wall is 1.6m high with metal railings measuring 0.8m high. As the path winds past the quarry a retaining wall appears on the eastern side and the western retaining wall becomes an upright wall. This was stands up to 0.7m high and 0.4m wide and is constructed from angular quarried stones.

Site Number **55**
Site Name Main mine adit, Keld Heads, Preston-under-Scar
NGR 407944 490761
Type Adit
Period Nineteenth Century
Photo Ref 55_1.jpg- 55_5.jpg
Sources OS map 1st edition, 1:10, 560, 1856; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Schofield, OA North Survey 2015
Description The main mine adit, which on the 1856 map was marked as a small rectangular structure. It is to the east of the Workshops (Site **58**) and described on the 1866 map as '*Level'* (Site **55**). No level or entrance was observed on the 1891-3 OS map.
The adit can be seen to go back at least 30m into the hillside. It is stone lined and has a stone arch at the entrance, which stands at approximately 2m tall, and 1.3m wide. A retaining wall is present to the west of the arch heading across the front of the adit; this stands up to 1m high. There are also retaining walls to the east and the west. The western retaining wall is heavily collapsed measuring up to a maximum of 0.7m high. The eastern wall stands at 1.8m tall close to the adit entrance, however, it starts to collapse after a short distance from the aperture, approximately 3m,where the wall butts out forming the remains of possible steps. All the walls have been constructed using angular stones. The adit has also been lime mortared.

Site Number **56**
Site Name Building foundations, Keld Heads, Preston-under-Scar
NGR 407941 490748
Type Site of building
Period Industrial
Photo Ref 56a_1.jpg- 56a_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description The foundations of a rectangular building (Site **56a**) shown on the 1866 map and historic photographs. The northern gable of the building survives, standing up to 3m tall. It has been rebuilt and repointed on the north end. A partial section of the north wall survives in the western corner and a small stub of the southern wall is attached to the south end of the western gable. No traces of any other walls survive. The only evidence is a slight internal platform, which stops before the retaining wall associated with the main mine adit (Site **55**).

A sunken area to the rear of the building (Site 56b) is possibly the remains of a small yard, although on the 1866 map it is depicted as part of the 'workshops' buildings. The area is approximately 5m by 6m and is 0.5m lower than the surrounding ground level. It stops at the bank of the retaining wall associated with the main mine adit (Site **55**).

Site Number **57**
Site Name Small lean-to, Keld Heads, Preston-under-Scar
NGR 407938 490745
Type Building
Period Industrial
Photo Ref 57_1.jpg- 57_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A single story lean to which would at one time have butted against the western gable end of Site **56a**. The north end abuts Site **58**. The walls of the lean-to have been mostly rebuilt apart from a small stub of wall on the south-west end which has been constructed using lime mortar. The structure has also been re-roofed with new slates. There is an open door on the south side with a wooden lintel.

Site Number **58**
Site Name Mine workshops / Barn, Keld Heads, Preston-under-Scar
NGR 407933 490754
Type Mine workshops / Barn
Period Industrial
Photo Ref 58_1.jpg- 58_6.jpg
Sources OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map, 1:10,560 1919; OS map 1:10,560 1953-58; ZBO (L) 19, 1866; Peter Schofield, OA North Survey 2015
Description The workshops was a complex of around six buildings, rooms or halls built onto each other; now it is a long rectangular barn. The top of the walls have been rebuilt and new slates have been put on the roof. There is a window on the south side with a large stone lintel and a door on the eastern side. A large arched barn door is present on the western side along with three windows, two of which have wooden lintels, the third has a stone. The original part of the barn has lime mortar.

Site Number **59**
Site Name Small lean-to, Keld Heads, Preston-under-Scar
NGR 407927 490761
Type Building
Period Industrial
Photo Ref 59_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A rectangular building abutting the west side of Site **58**. Part of the walls and roof have been rebuilt. Lime mortar survives on the original part. A doorway with a stone lintel is present on the south side and a window can be seen on the north.

Site Number **60**
Site Name Agent's house, Keld Heads, Preston-under-Scar
NGR 407905 490753
Type Building
Period Nineteenth Century
Photo Ref 60_1.jpg- 60_4.jpg

Sources OS map 1:10, 560, 1856; OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map 1:10,560 1919; OS map, 1:10,560 1953-58; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Peter Schofield, OA North Survey 2015

Description This is the northern Agent's House, and was the original house for agent who was responsible for the below ground workings. The other agents house was the Surface Agent responsible for the dressing floor and above ground workings.. The house is close to the workshops (Site **58**) and is by the main adit (Site **55**). This was depicted on the 1856 map as a simple east/west orientated building; by the time of the 1866 map it had been enlarged to a square building with an extension on the north-east side. This configuration remained unchanged until the time of the 1953-8 OS mapping. Associated with the house, lying to the north, was an enclosed feature which may have been the agent's garden.

This Agent's House is grander than the one to the south. It has two stories with a small extension on the north. It has a slate roof with two chimneys. The western gable has two large windows on the first floor and two windows and a door on the ground floor. The main entrance is located on the southern side. The front door is situated off centre, to the east and is flanked by two windows. On the western end of the south side is a double door with a large window above. This end of the building may originally have been a stable or barn. All the windows are sash, which may have been replaced. They all have stone lintels.

Site Number **61**
Site Name Bridge, Keld Heads, Preston-under-Scar
NGR 407902 490733
Type Bridge
Period Industrial
Photo Ref 61_1.jpg- 61_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A small bridge adjacent to the northern Agent's House. The bridge was rebuilt in 2007 but was the original route into the mine. The bridge is made from a concrete slab measuring 3.5m by 4m. The parapet walls are made from angular stones and stand up to 0.6m high 0.4m wide with a stone slab top.

Site Number **62**
Site Name Stable, Keld Heads, Preston-under-Scar
NGR 407902 490720
Type Stable
Period Industrial
Photo Ref 61_1.jpg- 61_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A single story stable or small barn shown on the 1866 map. The roof of the stable is made from stone slabs. There is an open window on the north side and a door on the east. A possible tacking or mounting block can be seen to the west of the building. There are holes in the top of the walls, possibly for floor joists suggesting that it may have once had a loft, perhaps for the purpose of storing hay.

Site Number **63**
Site Name Drainage Adit, Keld Heads, Preston-under-Scar
NGR 407904 490767
Type Adit
Period Industrial
Photo Ref 63_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A narrow drainage adit located behind the Agent's House (Site **60**). It consists of an open adit mouth with surrounding curvilinear retaining walls which extend to the east. The working floor and spoil heaps further to the east are also enclosed on the south end by a retaining wall.

Site Number	**64**
Site Name	Walled Garden/Reservoir?, Keld Heads, Preston-under-Scar
NGR	407887 490771
Type	Garden
Period	Nineteenth century
Photo Ref	64_1.jpg-64_2.jpg
Sources	OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map 1:10,560 1919, OS map 1:10,560 1953-58, ZBO (L) 19, 1866; Peter Schofield, OA North Survey 2015
Description	A trapezoidal walled enclosure adjacent to the Agent's House. It is presently a disused garden with a derelict greenhouse in the north-west corner. It measures up to approximately 11m by 10m. The site may potentially have once functioned as a reservoir. There is a small flight of steps external on the south-east corner which abuts both the garden wall and a small outhouse. To the east is a drainage adit (Site **63**) which may have formed an outflow from the reservoir.

Site Number	**65**
Site Name	Wheel-pit, Keld Heads, Preston-under-Scar
NGR	407907 490776
Type	Wheel-pit
Period	Industrial
Photo Ref	65a_1.jpg-65a_7.jpg, 65b_1.jpg-65b_2.jpg, 65c_1.jpg
Sources	OS map 1:10, 560, 1856, OS map; 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map 1:10,560 1919; OS map, 1:10,560, 1953-8 ZBO (L) 19, 1866; Atkins 2012; Peter Schofield, OA North Survey 2015
Description	A wheel-pit and leat marked and depicted as *Walls* on the 1856 map, although only the *Water Wheel* is marked on the 1866 map to the north of workshops (Site **58**). Both wheel-pit and leat were depicted on the 1891-3 and 1919 maps as an east/west orientated section of walls. The wheel would have controlled the winding and pumping on the mine before the Engine House was built *c* 1879. The wheel-pit is now a stone trough 12m in length and 1m wide (EH Scheduled Monument Entry). A large wheelpit orientated east/west running along a steep south-facing slope. Large well-constructed walls are evident around the edges and the structure measures up to 13m by 2.7m and over 1m high on the west side (Site **65a**). Internally, the retaining wall is braced and underpinned by wooden posts to stop collapse and there is a metal pipe internally. Socket holes for various fixings including two opposing axle pads in the centre of the structure are evident. The wheel-pit would have been fed by several leats (Sites **68**-**70**) coming downslope south from a reservoir. To the north of the main stone structure are two small sub-rectangular depressions that may relate to other structures (Site **65d**). On the east end there are the fragmentary remains of another structure consisting of wall stubs offset south from the wheelpit and several iron pipes protruding from the hillside (Site **65b**). This may be the remains of another wheel-pit, or part of a structure associated with the infilled shaft (Site **127**). This fragmentary structure is separated from the main wheelpit by a flight of steps running upslope to the north (Site **65c**).

Site Number	**66**
Site Name	Engine House, Keld Heads, Preston-under-Scar
NGR	407946 490782
Type	Engine House
Period	Industrial
Photo Ref	66_1.jpg-66_32.jpg
Designations	within scheduled area 1014763 and Grade II Listed Buildings 1179229 (Grade II) of
Sources	OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map 1:10,560 1919; OS map 1:10,560 1953-58; NMRS records; Spensley 2014, 62; Listed Building 1179229; EH Scheduled Monument entry; Atkins 2012; Peter Schofield, OA North Survey 2015
Description	The Engine House and Boiler House was not marked on the 1856, 1866 and 1878 map but was denoted on the 1891-3 and 1895 maps; the date of building of the Engine House is 1879

(Spensley 2014, 62). These were large east/west aligned rectangular buildings adjacent but offset to each other. There is a plan of the Keld Heads Engine House held by the NMRS but it has not been possible to view this. The large Engine House was 20m x 10m in size and partially below ground level with round arched openings. The engines were a horizontal steam engine for pumping water and a winding engine, which were installed in 1878-9 (Gill 2000, 84).
When the Lead Mine was closed this building was used by the quarry. The Listed Building entry refers to the 'adjacent stables and stores building with timber roof structure'; these were a building 20m x 10m sharing a party wall with the Engine House, and were probably latterly used as stables and stores.
An engine house shown on the 1866 map. The building is cut into the south-facing slope and is over two storeys in height. The walls are of quarried and mortared stone courses and is single celled and rectangular in plan with the south-west corner cut off to accommodate the adjacent pathway. The structure is unroofed and contains a large stone platform running the entire length of the north side of the structure. This would have accommodated the engine and there are parts of the engine bed surviving on the eastern end of the platform. The platform is not flush with the north wall elevation of the structure; there is a small gap, which is crossed by flying buttresses, which brace the wall, and which is retaining the hillside. To the south of the platform is a deep pit, which descends below ground level in the adjacent Boiler House (Site **53**). There are various apertures in the south wall elevation for machinery access and/or fixings associated with the engine and the boilers, and supports for a wooden floor level with the platform are evident. Several of the apertures have been blocked up in a later period with stones/brick with grey mortar. this includes a large doorway in the centre of the elevation. There is a large brick arched doorway at the west end of the south elevation, which would have given access to the pathway outside. Similarly there is a large arched window on the west gable end wall almost at the apex of the roof; and is probably where the engine was inserted into the structure. The western end of the platform has several steps which lead up and into a barrel-vaulted tunnel (Site **67**) to accommodate the drive shaft connecting the engine the pumps and machinery for the mine shaft to the west.

Site Number **67**
Site Name Tunnel to West of Engine House, Keld Heads, Preston-under-Scar
NGR 407935 490780
Type Tunnel: to accommodate drive shaft
Period Nineteenth century
Designations Within scheduled area
Photo Ref 67_1.jpg-67_11.jpg
Sources Atkins 2012; Peter Schofield, OA North Survey 2015
Description A barrel-vaulted tunnel built to accommodate the drive shaft connecting the engine to the pumps and machinery for the mine shaft (Site **127**) to the west. It extended under the north/south track to the west of the Engine House and was *c* 7m in length, 1m in width and 1.5m in height.
The tunnel is stepped in the centre and the vaulting has partially collapsed. The mouth of the tunnel on the west side is housed within a tall angular retaining wall protruding out of, and beneath, the retaining wall for pathway above.

Site Number **68**
Site Name Leats, Keld Heads, Preston-under-Scar
NGR 407879 490804
Type Leat
Period Industrial
Photo Ref 68_1.jpg-68_7.jpg
Sources OS map 1:10, 560, 1856; OS map 1:2,500 1891-3; Peter Schofield, OA North Survey 2015
Description Several small sections of leat are located at the head of two large leats (Sites **69** and **70)**, that run south from a reservoir (Site **71**). The narrow leats (Sites **68a-c**) are on the top of a break of slope and originally distributed water, from both Sites **69** and **70** to either go towards, or bypass a waterwheel located on the hillside beneath (Site **65**). The leats are partially shown on the early OS mapping.

Site Number	**69**
Site Name	Leat, Keld Heads, Preston-under-Scar
NGR	407846 490889 to 407891 490804
Type	Leat
Period	Industrial
Photo Ref	69_1.jpg-69_2.jpg
Sources	OS map 1:10, 560, 1856; OS map 1:2,500 1891-3; Peter Schofield, OA North Survey 2015
Description	A slightly curvilinear leat running roughly north-north-west/south-south-east from a reservoir (Site 71) down towards the wheelpit (Site **65**). It is the uppermost of two leats running parallel along a west-facing break of slope. It measures approximately 100m long and is a well-defined platformed route over 1.8m wide on top. There is evidence for stone capping for an underground channel visible at various locations along its length. The water was taken off from the east side of the dam but there is no extant earthworks/structure for the takeoff point. At the south end the leat splits into several smaller leats (Site **68a-c**) to either go towards, or bypass a waterwheel located on the hillside beneath (Site **65**).

Site Number	**70**
Site Name	Leat, Keld Heads, Preston-under-Scar
NGR	407861 490856 to 407876 490810
Type	Leat
Period	Industrial
Photo Ref	70_1.jpg
Sources	OS map 1:10, 560, 1856; OS map 1:2,500 1891-3; Peter Schofield, OA North Survey 2015
Description	A slightly curvilinear leat running roughly north-north-west/south-south-east from a reservoir (Site **71**) down towards the wheelpit (Site **65**). It is the lower of two leats running parallel along a west-facing break of slope. It measures over 50m long and is a well-defined platformed route over 1.7m wide on top. There no evidence for stone capping along its length. The water was taken off somewhere beneath the dam but there is no extant earthworks/structure for the takeoff point. At the south end the leat splits into several smaller leats (Site **68a-c**) to either go towards, or bypass a waterwheel located on the hillside beneath (Site **65**).

Site Number	**71**
Site Name	Reservoir, Keld Heads, Preston-under-Scar
NGR	407813 490937
Type	Leat?
Period	Nineteenth century
Photo Ref	71_1.jpg-71_7.jpg
Sources	OS map 1:10,560 1895; OS map 1:2,500 1891-3; OS map 1:2,500 1913; ZBO (L) 19, 1866; Peter Schofield, OA North Survey 2015
Description	The area south of the Smelt Mill appeared to be bounded by an east/west field boundary against which, on the northern face, were two or three enclosures of varying sizes. One of these (Site **71**) may be part of the leat beside Keldheads Gill (and coloured blue on the later 1895 map) flowing from a covered part of the leat to the north and then released into a dam (Site **71a**) to the south of the field edge and from there continuing southwards as the Keldheads Gill. The dam (Site **71a**) fed the dressing floors and water wheel further south. The water-filled reservoir and dam were not depicted before the 1866 mapping. The extant site consists of a mostly silted-up reservoir covering the entire width of the north end of a large, narrow, north/south gully located west of Tullis Cote Farm. Overall it measures 65.5m by 36m. At the northern end the subterranean stream (running beneath the Smelt Mill (Site **75**)) outflows into it via two apertures in a small retaining wall (Site **71b**). The reservoir is held in by a largely intact dam (Site **71a**), which has stone retaining walls on both sides, with the downslope external side being battered back. There is a brick-founded overflow channel on the west side and a deeply cut channel/breach on the east side. There is a small wall stub externally to the south that may relate to a structure.

Site Number	**72**
Site Name	Spoil Heap, Keld Heads, Preston-under-Scar
NGR	407827 490950
Type	Spoil Heap
Period	Industrial
Photo Ref	72_1.jpg-72_2.jpg
Sources	Peter Schofield, OA North Survey 2015
Description	A pile of ash, slag and smelting waste located on the west-facing valley side to the west of Tullis Cote Farm. It measures 11m by 9m and up to 1.5m high. The spoil heap has been eroded by water as it lies on the edge of the east side of a reservoir (Site **71**).

Site Number	**73**
Site Name	Peat House, Keld Heads, Preston-under-Scar
NGR	407790 490972
Type	Peat House
Period	Nineteenth century
Photo Ref	73_1.jpg-73_10.jpg
Sources	OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map, 1:10,560 1919; OS map 1:10,560 1953-58; NYCRO ZBO (L) 19, 1866; ZBO (L) 21, 1878; EH Scheduled Monument Entry; Smith 1998, 50; Atkins 2012; Peter Schofield, OA North Survey 2015
Description	A building, *c* 18m x 4m, of rubble stonework, originally with stone slate roofing. It was supported on seven tie-beam trusses of wood (Clough 1962, 101) and of two storeys and has four bays. At ground level were four cart openings with plain rectangular openings above; the gables are both blind. The west elevation has four square windows above to match those at the front of the building. Photographs are included in Clough and Raistrick showing that it had stone slate roofing; the roof has now been replaced with corrugated steel. The structure is double height with no second storey and open to the roof. It is trapezoidal in shape and in total measures 17.4m by 6.1m. Internally the north gable end elevation is buttressed to first floor level. Externally this side of the structure would have adjoined another ancillary building, and was part of a range of buildings associated with the Smelt Mill (Site **75**), the foundations of which are now beneath a large quarry spoil heap.

Site Number	**74**
Site Name	Water Wheel, Keld Heads, Preston-under-Scar
NGR	407992 490614
Type	Site of Water Wheel
Period	Industrial
Photo Ref	N/A
Sources	ZBO (L) 19, 1866, Peter Schofield, OA North Survey 2015
Description	Site of a water wheel located west of the Agent's House (Site **30**) and close to the Gill. It was used to drive a flat rod system to power mine workings south of Keld Heads (Spensley 2014, 62). No surviving evidence was identified during the present survey. There is an extant culvert to take the flat rods beneath the road to the south (Site **29**).

Site Number	**75**
Site Name	Smelt Mill, Keld Heads, Preston-under-Scar
NGR	407794 491003
Type	Mill Building
Period	Nineteenth Century
Photo Ref	75a_1.jpg-75a_13.jpg, 75c_1.jpg, 75d_jpg

Sources OS map 1:10, 560, 1856; OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1913, 1:2,500; OS map 1:10,560 1919; OS map 1:10,560 1953-58; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Smith 1998, 48-51; Atkins, 2012, 12; EH Scheduled Monument Entry; Clough 1962, 96; Atkins 2012; Peter Schofield, OA North Survey 2015

Description The main building of the Smelt Mill was built on a large rubble platform which spanned the valley and Keldheads Gill. Through the platform were two culverts, one of which was for the supply of water for the water wheel (Atkins 2012, 12). The other culvert is perhaps that cited in the Atkins report as carrying water underground emerging south of the Peat Store (Site **73**). The earlier (east/west) mill building was reported as being '60 feet long, 30 feet wide with a water wheel 27 feet in diameter at one end' (Clough 1962, 96). The water wheel was at the west end alongside a bellows (EH Scheduled Monument Entry). Within the earlier building were up to three ore hearths sited adjacent perhaps to arched openings for the flues. By 1866 the Smelt Mill comprised two main buildings; to the south was the east/west orientated building shown on the 1856 map with a similar sized (18m x 10m) new north/south orientated building attached to the west side of the north face. Emerging from the north side of the smelting mill was a series of perhaps three flues from the north face of the earlier east/west building with two flues emerging from the east side of the new north/south building. Clough reports these flues as being 2' 3" wide and 5 feet 5" high (Clough 1962, 97). There was an additional flue from the small building to the east (Site **128**). A seventh flue was clearly marked as leaving from the west side of the new north/south extension building leading to the main Condenser Flue (Site **6f**) R. Smith has suggested a total number of seven flues: two roasting hearths, 4 ore hearths, and 1 slag hearth (1998, 48).

Relatively little of the structure now survives as surface evidence as large amounts of quarry waste, comprising mainly large boulders, have been dumped upon the southern remains of the Smelt Mill; however, it is probable that the foundations still survive beneath this overburden. Those elements that could be recorded comprised the northern elements of the Smelt Mill and the flues. The main building of the Smelt Mill was built on a large rubble platform which spanned the valley and Keldheads Gill. Through the platform were two culverts, one of which was for the supply of water for the water wheel (Atkins 2012, 12) and the other a bypass channel. The most visible element of the mill are two small rectangular cells at the northern end of the mill, which correspond with two ore stores. The eastern most of these (Site **75a**) is the most exposed, and has earth retaining walls on its western, northern and eastern sides, and a standing wall to the south; it is 4.45m in width by 3.7m and its maximum depth is 1.7m. It has a large hole in the northern wall revealing the vaulted culvert for the gill which passes underneath the Smelt Mill. Adjacent to its north-western corner is a sloping chute where the dressed ore was deposited into the ore store. The westernmost of the two ore stores is largely filled with collapse but there is up to 0.5m in height of earth retaining wall visible, particularly on the western side. There are indications of the western side of a chute feeding through the northern wall of the ore store and this is comparable, albeit in worse condition, to the chute extending into the eastern store. The western wall of the ore store is in line with a section of retaining wall (Site **75c**) to the south which corresponds with the western wall of the mill building. To the west of the mill is a small fragment of east/west orientated walling (Site **75d**) which survives to five courses; this corresponds in position with a cross wall on a structure shown on the 1866 mine plan, which was shown to butt onto the western side of the Smelt Mill building.

Associated with the Smelt Mill were two main Condenser Flues, which split into five separate flue-ends that converge on the different elements of the Smelt Mill. The southern and western terminals of these flue arms; however, have been obscured by the quarry waste. The easternmost of the flue-terminals (Site **6g.1**) curves around the eastern end of the original Smelt Mill building and leads up to what is believed to have been the original roaster house (Site **128**). It clips the corner of the Smelt Mill building, as defined on the 1866 map. and it is possible that it extended beneath the building. This flue ultimately connects to the easternmost of the parallel flues (Site **6f**), but there is no extant evidence of the point of connection, and this was probably become obscured. The easternmost of the conjoined flues splits up into two terminals (Sites **6g.2** and **6g.3**) which both extend towards the original east/west Smelt Mill building. These both have the survival of one capping stone each.

The westernmost of the conjoined flues (Site **6f**) splits up into two flue-terminals (Sites **6g.4** and **6g.5**), with the easternmost of these leading towards the southern (earlier) mill building, and the westernmost flue-terminal has a marked east/west dog leg where it joins with the main

flue, and then extends towards the south-eastern corner of the northern (later) mill building, as is represented on the 1866 mill plan.
A further flue-terminal (Site **6h**) is depicted extending out from the eastern side of the conjoined flues, around the northern end of the later mill building (Site **75**) and over the large culvert of Keldheads Gill. It is then shown on the 1866 plan converging on the later, small, roaster house on the west side of the mill.
On the basis of the observed evidence and the cartographic mapping it is evident that there were seven flues, and these would have led to seven hearths. The easternmost was the early roasting hearth in building **128**. With the expansion of the Smelt Mill, this roasting hearth went out of use, being replaced by one on the western side of the new mill building, and its flue-terminal was Site **6h**. Three flue-terminals (Sites **6g.2**, **6g.3** and **6g.4**) led into the northern side of the southern mill building, and it is probable that these provided the exhaust for three ore hearths. Two of the flues fed into the eastern side of the northern Smelt Mill building, and it is probable that at least one of these serviced a slag hearth; the other may have been for a further ore hearth.

Site Number **76**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407787 491046 to 407820 491026
Type Leat
Period Industrial
Photo Ref 76b_1.jpg
Sources OS map 1:10, 560, 1856; Peter Schofield, OA North Survey 2015
Description A short linear section of leat running diagonally downslope north-west/south-east. The visible sections measure up to 38.7m long and the route has been overlain by both the condensing flues (Site **6f**) and the walled road leading through the mine complex. This section of leat is an early feature that was depicted upon the early mapping (1856 OS map). It fed water from the main stream towards the site of a pond located west of Tullis Cote Farm.

Site Number **77**
Site Name Shaft Mound, Keld Heads, Preston-under-Scar
NGR 407820 491037
Type Shaft Mound
Period Industrial
Photo Ref 77_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A shaft mound located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 16m by 15.5m.

Site Number **78**
Site Name Shaft Mound, Keld Heads, Preston-under-Scar
NGR 407838 491014
Type Shaft Mound
Period Industrial
Photo Ref 78_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A shaft mound located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 17m by 14m.

Site Number **79**
Site Name Shaft Mound, Keld Heads, Preston-under-Scar
NGR 407875 491012
Type Shaft Mound
Period Industrial
Photo Ref 79_1.jpg

Sources Peter Schofield, OA North Survey 2015
Description A shaft mound located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 17m by 14m.

Site Number **80**
Site Name Shaft Mound, Keld Heads, Preston-under-Scar
NGR 407851 491021
Type Shaft Mound
Period Industrial
Photo Ref 80_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A shaft mound located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 12.5m by 10m.

Site Number **81**
Site Name Shaft Mound, Keld Heads, Preston-under-Scar
NGR 407887 490994
Type Shaft Mound
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A shaft mound located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 15.4m by 10.8m.

Site Number **82**
Site Name Quarry, Keld Heads, Preston-under-Scar
NGR 407903 491012
Type Quarry
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A rocky exposure on a north-west/south-east running scarped ridgeline located to the north of Keld Heads farm. The outcropping rock has been surface quarried on the exposure leaving angular spoil waste stones spilling downslope. The overall area measures over 105m by 10m.

Site Number **83**
Site Name Trackway, Keld Heads, Preston-under-Scar
NGR 407857 491022 to 407833 491087
Type Trackway
Period Industrial
Photo Ref 83_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A linear embanked trackway orientated roughly north/south and running for 70m on the west side of a series of shaft mounds (Sites **80** and **84**). There is some possible wall foundations in the bank on the south end of the trackway.

Site Number **84**
Site Name Shaft Mounds, Keld Heads, Preston-under-Scar
NGR 407838 491661
Type Shaft Mound
Period Industrial
Photo Ref 84_1.jpg
Sources Peter Schofield, OA North Survey 2015

Description A small group of shaft mounds located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 34.5m by 18.5m. The mounds on the west side of a trackway (Site **83**).

Site Number **85**
Site Name Trackway, Keld Heads, Preston-under-Scar
NGR 407820 491047
Type Trackway
Period Industrial
Photo Ref 85_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A short curvilinear section of sunken trackway measuring 24m long by 4m wide. It is located amongst shaft mounds and is on the east side of the walled road leading through the mine complex. The trackway section may be a section of the route which was later formalised when it was walled.

Site Number **86**
Site Name Shaft Mound, Keld Heads, Preston-under-Scar
NGR 407811 491068
Type Shaft Mound
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A small semi-circular scoop, probably associated with a shaft located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 8.2m by 5.5m.

Site Number **87**
Site Name Shaft Mounds, Keld Heads, Preston-under-Scar
NGR 407815 491102
Type Shaft Mound
Period Industrial
Photo Ref 87_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A small group of shaft mounds located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 50m by 20.5m. The mounds are partially overlain by the enclosure wall.

Site Number **88**
Site Name Shaft Mound, Keld Heads, Preston-under-Scar
NGR 407791 491062
Type Shaft Mound
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A shaft mound located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 9.5m by 8m.

Site Number **89**
Site Name Reservoir/leat, Keld Heads, Preston-under-Scar
NGR 407777 491042
Type Leat
Period Industrial

Photo Ref 89a_1.jpg-89a_2.jpg, 89b_1.jpg-89b_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A small area measuring 18.5m by 18m, sandwiched between a reservoir (Site **90**) and the Smelt Mill (Site **75**). It may have once been a reservoir but it has been heavily disturbed by outflow from the breached dam (Site **90b**) upslope. The area is slightly sunken and is bounded by the dam to the north, a leat to the west (Site **92**), and has a small curving retaining wall on the south side. The side may have been canalised to carry the main stream running through the mine and this is where the stream becomes subterranean. The flow of the stream may have been slowed by the insertion of a lateral stone wall (Site **89a**) across the channel, and there are two arched stone apertures in the southern curvilinear retaining wall (Sites **89b** and **c**). The latter channel visibly leads south in a vaulted tunnel running towards the ore bins on the north side of the Smelt Mill (where it is exposed by collapse), before dropping vertically to pass beneath the Smelt Mill buildings (Site **75**).

Site Number **90**
Site Name Reservoir, Keld Heads, Preston-under-Scar
NGR 407761 491061
Type Reservoir and dam
Period Nineteenth century
Photo Ref 90a_1.jpg-90a_2.jpg
Sources OS map 1st edition, 1:10,560, 1856; OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,500 1913; OS map, 1:10,560 1919; OS map, 1953-5, 1:10,560; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Smith 1998, 49; Peter Schofield, OA North Survey 2015
Description A former dam and reservoir sited north of the Smelt Mill and west of the Condenser Flue. Water flowed into this reservoir from the leat or stream (Site **26**/**97**) and then flowed out towards the west end of the Smelt Mill (Site **75**), probably via leat Site **92**. The outflow may, however, be associated with leat Site **137**, which ran south from the south-west corner of the dam, as depicted upon the historic OS mapping.
The reservoir (Site **90b**) is mostly infilled and is poorly defined on the ground, with only the curving eastern end clearly visible. Overall the reservoir would have measured 36m by 21m. The large east/west orientated earth and stone constructed dam located on the south side of the reservoir has been breached in the centre. The construction of the dam is evident with a lattice of iron bracing post protruding from the gap. The dam measures 37m by 15m and is over 2m high downslope to the south. The western end of the dam adjoins a wide platformed and revetted bank (part of Site **95**) which carried a later tramway.

Site Number **91**
Site Name Reservoir, Keld Heads, Preston-under-Scar
NGR 407735 491059
Type Reservoir
Period Industrial
Photo Ref N/A
Sources OS map, 1:2,500 1891-3; Peter Schofield, OA North Survey 2015
Description A small reservoir consisting of a north/south orientated dam which stored water from a leat (Site **22e**) running downslope towards the Smelt Mill (Site **75**). It is only depicted as full on the 1890s OS mapping. Overall the area measures 30m by 14.5m. The channel has been widened and is cut into the hillside with upcast banking on the south side (Site 91a). The dam, on the east side of the reservoir (Site **91b**), is well-defined, and has a revetted opening in the centre. The dam carried the route of a later tramway (Site **95**).

Site Number **92**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407768 491052 to 407770 491029
Type Leat
Period Industrial

Photo Ref N/A
Sources 1866 map; Peter Schofield, OA North Survey 2015
Description A short linear section of leat, orientated north/south and measuring approximately 23m long. It is shown on the 1866 map. It runs south from the dam of a reservoir (Site **90a**) towards the Smelt Mill (Site **75**). The southern end the leat presumably continues south underground. The section of leat is not depicted upon any historic mapping. This is presumably the leat that originally fed the waterwheel on the west side of the Smelt Mill.

Site Number **93**
Site Name Quarry ,Keld Heads, Preston-under-Scar
NGR 407746 491050
Type Quarry
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A small sub-oval quarry scoop measuring 13m by 10m. The northern end has an exposed bedrock face.

Site Number **94**
Site Name Spoil Heap, Keld Heads, Preston-under-Scar
NGR 407773 491004
Type Spoil Heap
Period Modern
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A series of large overlapping spoil heaps associated with mid-twentieth century stone quarrying immediately west of the Smelt Mill (Site 75). The flat-topped spoil heaps are tiered up into three levels with the earliest/lowest of them spreading across the majority of the site of the Smelt Mill, leaving only the northern edge exposed. The heaps also abut and surround all but the eastern side of the Peat House (Site 73) Overall the surveyed area measures 80m by 70m.

Site Number **95**
Site Name Tramway, Keld Heads, Preston-under-Scar
NGR 407745 491099 to 407762 491026
Type Tramway
Period Industrial
Designations Inside scheduled area 1014763
Photo Ref N/A
Sources OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map, 1:10,560 1919; OS map 1:10,560 1953-58; ZBO (L) 19, 1866; Peter Schofield, OA North Survey 2015
Description A tramway extending northwards from the west side of the main Smelt Mill (Site **75**) to the enclosures/settling tanks (Site **100**) and crossing a dam (Site **91b**). The tramway is shown as tracks on the 1919 map.

The north end of the tramway is only visible as a slight sinuous raised lynchet orientated north/south and just south of the settling tanks (Site **100**). In the centre it crosses the dam of a reservoir (Site **91b**) and presumably carried on towards the Smelt Mill on top of a large wide retaining wall measuring up to 2.8m wide by 0.7m high. Overall the visible portions measure up to 80m long. The south end is covered by later quarry waste. The retaining wall may have contained a leat/bypass channel for the reservoir (Site **90**) on the west side (Site **137**), although this is uncertain as it is unclear on the historic mapping.

Site Number **96**
Site Name Earthworks, Keld Heads, Preston-under-Scar
NGR 407758 491097
Type Earthwork mound

Period Unknown
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description Two small sub-oval earthwork mounds of unknown function each located either side of a leat (Site **97**). They each measure 11.5m by 5.3m and 8m by 4.5m respectively.

Site Number **97**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407748 491102 to 407769 491078
Type Leat
Period Industrial
Designations The southern part is inside scheduled area 1014763, but it is mostly outside the scheduled area
Photo Ref N/A
Sources OS map 1:10,560, 1856; OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,500 1913; OS map, 1:10,560 1919; OS map, 1953-58 1:10,560; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Peter Schofield, OA North Survey 2015
Description A leat flowing from the springs in the central part of Area D southwards, through the site of a reservoir (Site **90b**) and towards the western end of the Smelt Mill (Site 75) via leat **97**. On the 1866 and 1895 maps the leat is depicted as a meandering stream flowing south from the reservoir (Site **90b**), although in 1919 and 1853-8 it was drawn as a wider, straighter leat.
This is a short section of the leat visible on the north side of a reservoir (Site **90**), and is a continuation of the leat from the north (Site **26**). The leat is orientated north-west/south-east, it doglegs slightly, and measures approximately 31m long.

Site Number **98**
Site Name Quarry, Keld Heads, Preston-under-Scar
NGR 407785 491100
Type Quarry
Period Industrial
Photo Ref 98_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A linear quarry running along a steep west-facing slope/outcrop. It measures approximately 50m long and is a continuation of a quarry further north on the opposite side of the condensing flue (Site **86**).

Site Number **99**
Site Name Dam / reservoir, Keld Heads, Preston-under-Scar
NGR 407768 491115
Type Dam / reservoir
Period Industrial
Designations Inside scheduled area 1014763
Photo Ref 99_1.jpg-99_3.jpg
Sources OS map 1:2,500 1891-3; OS map 1:10,560 1895; NYCRO ZBO (L) 19, 1866; Smith 1998, 49. Peter Schofield, OA North Survey 2015
Description A pond south of the Condenser House, which was cited by Smith as D6; it is associated with Site **100**.
There are the fragmentary remains of a small dam structure, evident as a shallow U-shaped earthwork located immediately south of the larger settling tanks (Site **100**). Indeed, the settling tanks may overly this structure. The u-shaped earthworks measure 14.4m by 8.7m and are open on the north side. The site is crossed by a later track that has damaged it (Site **124d**).

Site Number **100**
Site Name Settling Tanks, Keld Heads, Preston-under-Scar
NGR 407755 491130
Type Setting Tanks

Period Nineteenth century
Designations inside scheduled area 1014763
Photo Ref 100_1.jpg-100_6.jpg
Sources OS map 1:10,560, 1856; OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map, 1:10,560 1919; OS map 1:10,560 1953-58; ZBO (L) 19, 1866, Atkins 2012, 18thC map from the Bolton Estate; Peter Schofield, OA North Survey 2015
Description Two large trapezoid enclosures terminating a tramway (Site **95**) extending from the west side of the main Smelt Mill (Site **75**) and associated with a building (Site **117**) and a pond (Site **99**). These were the soot settling tanks for the Condenser House (Spensley 2014, 194).
The extant structure consists of a trapezoidal enclosure measuring 32.5m by 18.5m. It has been cut into the hillside and the spoil used to create earthen embankments around broad retaining walls on the east and south sides that measure approximately 1m high. Internally there are well-constructed drystone retaining walls visible and a fragmentary sub-divisional boundary towards the northern end of the structure. There is an aperture in the centre of the southern retaining wall. These trapezoid features overlay a small narrow, rectangular feature south-west of the Condenser House that was marked on the 1856 map as a *Pit*, and which was the fore runner of the present settling tanks.

Site Number **101**
Site Name Trackway, Keld Heads, Preston-under-Scar
NGR 407815 491128
Type Trackway
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A short north-east/south-west section of embanked trackway running downslope and cutting into the hillside to the west of a series of shaft mounds (Site **87**). It measures over 45m long.

Site Number **102**
Site Name Condenser House, Keld Heads, Preston-under-Scar
NGR 407776 491175
Type Condenser House
Period Nineteenth century
Designations It is inside scheduled area 1014763
Photo Ref 102a_1.jpg-102a_11.jpg; 102b_1.jpg-102b_3.jpg; 102c_1.jpg-102c_3.jpg; 102d_1.jpg-102d_6.jpg; 102e_1.jpg-102e_2.jpg
Sources OS map 1st edition, 1:10,560; 1856, OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,500 1913; OS map, 1:10,560 1919; OS map, 1953-58, 1:10,560; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Atkins 2012, 12; Clough 1962, 99; Atkins 2012; Peter Schofield, OA North Survey 2015
Description The Condenser House comprises an east/west aligned building straddling the Condenser Flue north (upslope) of the Smelt Mill building (Site **75**). To the east it was built of stone and on the western half it was a timber structure with the flue for the mill between the two parts. The stone structure held the water wheel aligned east/west at the south of the building. In total the building was 70 feet long and 25 feet wide with a stone slated roof (Clough 1962, 99). In 1862 Stokoe Condensers were installed, and were a complex arrangement enabling water to go through the condensers to take up the fumes holding them in suspension. Lead was separated out from this suspension in the outdoor 30m x 10m settling tanks (Site **100**) and channels (EH Scheduled Monument Entry; Atkins 2012, 12). By the time of the 1919 map only the eastern part remained. The Atkins report cites the wheel-pit as being 8.3m in length, 1.3m width and 2.6m in depth.
The surviving rectangular stone structure (Site **102a**) is set into a steep south-facing slope below a large platformed area (Site **102f**). It consists of dressed stone wall foundations containing a single rectangular room (5.7m by 3.7m internally). There are slight traces of voids within the infilled demolition rubble in the room. To the south is a large wheelpit contained in a stone walled housing orientated east/west perpendicular to the slope. The axle pad is still evident in the centre of the opposing walls and iron screw threads run down through apertures

beneath the axle pads. The partially blocked outflow of the waterwheel is evident on the external, south-east corner of the south elevation of the wheelpit. The tailrace runs south as a well-defined cut channel 17m long by 5m wide (Site 102b) with a slight embankment on the west side, which runs south of a short distance before flowing into the canalised stream (Site **122b**). East of the tailrace is a small triangular platformed area/working floor measuring 10m by 8m (Site **102c**) which is defined by the canalised stream on the south and east sides. There is slight evidence for a stone retaining wall to the platform abutting up to the north wall on the stream. A U-shaped clearance pile is located on the west end of the platform.

The site of the Stokoe Condensers opposite the stone condenser building has left very little visible evidence, primarily due to it's perishable construction materials. There are wall scars and a slight wall stub poking out of the west wall elevation of the Condenser Flue but the main evidence is a rectangular depression cut into the hillside measuring 13.5m by 8m (Site **102d**). A linear embanked earthwork, probably a flue channel, runs diagonally upslope for 15m from the western end of the north side of the Stokoe Condenser towards the Condenser Flue. It was depicted as adjoining the Condenser Flue on the 1913 OS mapping..

North of the condensed building, the hillside has clearly been landscaped to form a large flat-topped earthen platform, measuring 40m by 30m (Site **102f**). Just north of the stone condenser building there is very slight evidence for a small rectangular annex (Site **102e**). It measures 7.6m by 5.25m, has short wall stubs on the south end, and is slightly platformed suggesting extant flooring close to the ground surface. It is at this location that all of the various leats feeding the Condenser House converge. The convergence of an extensive water management system at this point, with well-defined, and in some cases massively engineered leats may be indicative of this site being the location of the original Keld Heads Smelt Mill (Site **144**). It appears to have been located on the site of the extant Condenser House, indeed, the structure of the Condenser House may have re-used the footprint and/or some of the earlier structure of the original Smelt Mill, such as the wheel-pit.

Site Number **103**
Site Name Concrete Base, Keld Heads, Preston-under-Scar
NGR 407752 491306
Type Aerial Ropeway
Period Twentieth century
Photo Ref N/A
Sources OS map 1:10,560 1953-58; Peter Schofield, OA North Survey 2015
Description Concrete foundations for the north-west/south-east running quarry aerial ropeway. The site consists of three surviving concrete plinths (Sites **1**, **4** and **103**). The Aerial ropeway terminated by building (outside study area) adjacent to railway Site **139**.

Site Number **104**
Site Name Trackway, Keld Heads, Preston-under-Scar
NGR 407825 491208
Type Trackway
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A short north-west/south-east section of trackway running downslope and cutting into the hillside on between the enclosure wall and the ford (Site **106**). It measures over 44m long.

Site Number **105**
Site Name Washfold, Keld Heads, Preston-under-Scar
NGR 407811 491203
Type Washfold
Period Post-Medieval
Photo Ref 105_1.jpg
Sources Peter Schofield, OA North Survey 2015

Description A slightly curvilinear drystone wall measuring over 12.5m long and located on the easy bank of the stream downslope of the ford (Site **106**). The site is a washfold.

Site Number **106**
Site Name Ford, Keld Heads, Preston-under-Scar
NGR 407816 491219
Type Ford
Period Industrial
Photo Ref 106_1.jpg-106_2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A ford crossing the shallowest point of the stream running down the deep ravine. It carries a modern trackway across from farmland in the east and into the woods. The ground falls away to the south making a waterfall and the ford crosses where the bedrock naturally shelves. There is a metal pipe lain on the north side of the ford.

Site Number **107**
Site Name Stream/Leat, Keld Heads, Preston-under-Scar
NGR 407821 491236
Type Leat
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A canalised stream located running along the deep ravine. There is a retaining wall located on the east bank of the north/south running leat just north of the ford (Site **106**).

Site Number **108**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407860 491289 to 407841 491395
Type Leat
Period Industrial
Photo Ref 108a_1.jpg-108a_3.jpg, 108b_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A slightly curvilinear north/south orientated leat cut into the east-facing hillside at the base of a ravine. The leat originally fed water from the Keldheads Gill to the Condenser House/ Old Smelt Mill (Site **102**). The northern end of the leat survives as a well-defined embanked cutting with some retaining wall intact. There is no surviving evidence for a sluice or take-off next to the stream on the northern end. On the south end the leat survives as a shallow depression where it is a subterranean stone capped channel (Site **108b**). This then crosses a large platformed area (Site **102f**) behind the Condenser House/Smelt Mill, and is seen as a slight embankment just north of the structure. Overall the extant sections measure about 115m long.

Site Number **109**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407782 491206 to 407789 491184
Type Leat
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A pair of small fragmentary sections of leat (Sites **109a** and **109b**), consisting of linear depressions located on the north and east edges of a large platformed area (Site **102f**) and above the Condenser House/Old Smelt Mill. The features represent parts of a collapsed capped drain, possibly associated with the wheel-pit in the mill. They were presumably fed by one or two leats upslope (Sites **108a** and **121b**)

Site Number	**110**
Site Name	Quarry, Keld Heads, Preston-under-Scar
NGR	407938 490799
Type	Quarry
Period	Industrial
Photo Ref	110_1.jpg-110_2.jpg
Sources	Peter Schofield, OA North Survey 2015
Description	A large quarry excavated into a vertical cliff face in the steep south-facing slope immediately north of the Engine and Boiler Houses (Sites **53** and **66**). Overall it measures 47m by 25m and there are various earthworks including upcast banks and smaller scoops running further north and west.

Site Number	**111**
Site Name	Shaft Mounds, Keld Heads, Preston-under-Scar
NGR	407749 491222
Type	Shaft Mound
Period	Industrial
Photo Ref	N/A
Sources	Peter Schofield, OA North Survey 2015
Description	A small group of shaft mounds located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 31m by 22m. It is partially overlain by the Condenser Flue (Site **6c**).

Site Number	**112**
Site Name	Shaft Mound, Keld Heads, Preston-under-Scar
NGR	407759 491194
Type	Shaft Mound
Period	Industrial
Photo Ref	112_1.jpg
Sources	Peter Schofield, OA North Survey 2015
Description	A large semi-circular scoop, probably associated with a shaft located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 11.1m by 8.1m.

Site Number	**113**
Site Name	Launder Base, Keld Heads, Preston-under-Scar
NGR	407756 491200
Type	Launder
Period	Industrial
Photo Ref	113_1.jpg-113_4.jpg
Sources	Peter Schofield, OA North Survey 2015
Description	The remains of a launder running west-north-west/east-south-east from a large reservoir (Site **28**) towards the Condenser House/ Old Smelt Mill (Site **102**). It consists of a linear series of four, possibly five, small rectangular stone constructed bases running for approximately 15m. There is no surviving evidence for the wooden superstructure.

Site Number	**114**
Site Name	Shaft Mounds, Keld Heads, Preston-under-Scar
NGR	407748 491189
Type	Shaft Mound
Period	Industrial
Photo Ref	N/A
Sources	Peter Schofield, OA North Survey 2015

Description A pair of scoops, probably associated with shafts located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 19.4m by 6.7m.

Site Number **115**
Site Name Shaft Mound, Keld Heads, Preston-under-Scar
NGR 407753 491177
Type Shaft Mound
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A scoop, probably associated with a shaft located on the easternmost (north-west/south-east orientated) drift of Keld Heads lead mine. Overall the site measures approximately 19.4m by 6.7m.

Site Number **116**
Site Name Reservoir, Keld Heads, Preston-under-Scar
NGR 407756 491168
Type Reservoir
Period Industrial
Photo Ref 116_1.jpg
Sources OS map 1:2,500 1891-3; OS map 1:10,560 1895; NYCRO ZBO (L) 19, 1866; Smith 1998, 49; Atkins 2012; Peter Schofield, OA North Survey 2015
Description A sub-rectangular reservoir located to the immediately west of Keld Heads Condenser House (Site 102). It was cited by Smith as D4. It measures 8.6m by 7.3m and was fed by a small leat running south then kinking south-east from an outflow in a large reservoir upslope (Site **28**).

Site Number **117**
Site Name Store Building, Keld Heads, Preston-under-Scar
NGR 407770 491160
Type Reservoir
Designations inside scheduled area
Period Industrial
Photo Ref 117_1.jpg-117_4.jpg
Sources OS map 1st edition, 1:10,560, 1856; OS map, 1:2,500 1891-3; ZBO (L) 19, 1866; Peter Schofield, OA North Survey 2015; NYCRO ZBO (M) 1/1, 1723; ZBO (M) 5/1, 1778; Atkins 2012;
Description A sub-rectangular building located immediately to the west of Keld Heads Condenser House (Site **102**). It measures 11.5m by 10.9m with upcast banks surrounding, and is open on the south end. The building has some evidence for internal retaining walls and two also small rectangular voids in the base.
This site is in the same position as the small square building to the west of the western leat marked on the 1723, 1778 and 18th century Bolton Estate map. A small square building was also depicted as being on the same location south of the western half of the Condenser House on the 1856 and 1866 maps. It is thought that this building may have been a store, perhaps partially underground, but may also have functioned as a water tank or reservoir at some period. It was possibly marked as a ruin on the 1891-3 map.

Site Number **118**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407741 491163
Type Leat
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015

Description A short section of curvilinear leat running downslope from the east side of a large reservoir. It exits another leat (Site **26**) and heads north-west/south-east downslope for 27m towards two adjacent reservoirs (Sites **100** and **117**) located immediately west of Keld Heads Condenser House (Site **102**).

Site Number **119**
Site Name Quarry, Keld Heads, Preston-under-Scar
NGR 407849 491276
Type Quarry
Period Industrial
Photo Ref 119b_1.jpg
Sources Peter Schofield, OA North Survey 2015
Description A series of shallow quarry scoops cut into the steep west-facing hillside on the top break of slope on the east side of a ravine. They are located either side of a trackway passing through the enclosure wall (Site **120**). The quarry to the north (Site **119a**) and to the south of the track (Site **119b**). Overall the area of disturbance measures approximately 100m by 23m.

Site Number **120**
Site Name Trackway, Keld Heads, Preston-under-Scar
NGR 407860 491289 to 407841 491395
Type Trackway
Period Industrial
Photo Ref N/A
Sources Peter Schofield, OA North Survey 2015
Description A north/south orientated trackway cut into the steep west-facing hillside on the top break of slope on the east side of a ravine. The surveyed section measures over 100m long and runs from a gap in the enclosure wall on the south end and towards a large dam in the north (outside of the present study area).

Site Number **121**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407720 491243 to 407767 491166
Type Leat
Period Industrial
Photo Ref 121a_1.jpg-121a_3.jpg
Sources Peter Schofield, OA North Survey 2015
Description A leat running downslope from a drainage adit (Site **20**). It is evident as slight linear depression that in places is embanked up. The leat is orientated north-west/south east and runs for 88m to a small reservoir (Site **117**).

Site Number **122**
Site Name Tunnel/Leat, Keld Heads, Preston-under-Scar
NGR 407804 491173 to 40777 491132
Type Leat
Period Industrial
Photo Ref 122a_1.jpg-122a_3.jpg, 122b_1.jpg-122b_4.jpg
Sources Peter Schofield, OA North Survey 2015
Description A canalised section of stream (Site **112a**) located running down the deep ravine and to the south of the Condenser House/Smelt Mill. There is well-defined retaining walls located on both banks of the north-east/south-west running stream. Towards the southern end, the stream is carried through a narrow rectangular-sectioned tunnel (Site **122b**) beneath the best surviving part of the Condenser Flue (Site **6e**). There is an obvious tunnel mouth on the south side of the

flue and the retaining wall on the stream continues for a short section on the east bank of the stream. Overall the section of stream measures 52.9m long. The tunnel is 10.9m long by 2m wide.

Site Number **123**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407720 491243 to 407787 491215
Type Leat
Period Industrial
Photo Ref .N/A
Sources Peter Schofield, OA North Survey 2015
Description A leat running downslope from a drainage adit (Site **20**). It is evident as slight linear depression that in places is embanked up. The leat is orientated west-north-west/east-south-east and runs for 70m to join the main leat feeding the Condenser House/ Old Smelt Mill (Site **108a**).

Site Number **124**
Site Name Trackway, Keld Heads, Preston-under-Scar
NGR 407638 491198 to 407809 491054
Type Trackway
Period Industrial
Photo Ref 124e_1.jpg-124e2.jpg
Sources Peter Schofield, OA North Survey 2015
Description A trackway running sinuously downslope through Keld Heads lead mine. The upslope end is poorly preserved and consists a linear north/south section (Site **124a**). The route corners and turns east near a farm gate in the enclosure wall on the west side of Keld Heads (Site **124b**). A spur of track runs a short distance to the north-east of this gateway (Site **124c**). The main route continues and curves to the north-east (Site **124d**) to skirt the south side of a large reservoir/slime pit (Site **100**). It then doglegs south at the Condenser Flue (Site **6e**) to run as a well-constructed trackway (Site **124e**), with retaining wall on the west side, that climbs upslope to the south and then down to a walled track at Tullis Cote Farm

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Site Number **125**
Site Name Building, Keld Heads, Preston-under-Scar
NGR 407970 490694
Type Building
Period Nineteenth Century
Sources OS map 1st edition, 1:10, 560, 1856; Peter Schofield, OA North Survey 2015
Description A square building shown on the 1856 map near the former bouse teams, but not on the map ten years later in 1866. No structure was identified during the survey.

Site Number **126**
Site Name Field Boundary, Keld Heads, Preston-under-Scar
NGR 407998 490669
Type Building
Period Nineteenth Century
Photo Ref 124e_1.jpg-124e2.jpg
Sources OS map 1st edition, 1:10, 560, 1856; Peter Schofield, OA North Survey 2015
Description A wall or field boundary containing a pattern of three or four tracks associated with the main adit (Site **55**) and the dressing floor (Site **33**). No structure was identified during the survey.

Site Number **127**
Site Name Air Shaft, Keld Heads, Preston-under-Scar
NGR 407926 490773

Type Building
Period Nineteenth Century
Photo Ref 124e_1.jpg-124e2.jpg
Sources OS map 1:10, 560, 1856; ZBO (L) 19, 1866; Peter Schofield, OA North Survey 2015
Description This was marked as 'Air shaft. on the 1856 map, and was subsequently the main access shaft with winding and ventilation gear driven by the water wheel and then subsequently by the Engine House. It was located between the wheel-pit and the Engine House. No feature was identified during the present survey.

Site Number **128**
Site Name Mill Building, Keld Heads, Preston-under-Scar
NGR 407808 491005
Type Mill Building
Period Nineteenth Century
Sources OS map 1:10,560, 1856; OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,500 1913; OS map, 1:10,560 1919; 1:10,560; ZBO (L) 19 1866;.Peter Schofield, OA North Survey 2015
Description A small square building, with an enclosed unroofed feature attached to the south, sited on the south-east corner of the main Smelt Mill building. This was thought to be the Roasting House for the initial smelting of the ores (Smith 1998, 54). There was no building identified in this location during the survey, although there was a dog-leg in the field wall which would correspond to the former building.

Site Number **129**
Site Name Mill Building, Keld Heads, Preston-under-Scar
NGR 407812 490988
Type Mill Building
Period Nineteenth Century
Sources OS map 1:10, 560, 1856; OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map 1:10,5601919; OS map, 1953-58; 1:10,560; ZBO (L) 19, 1866; ZBO (L) 21, 1878; Smith 1998, 54.; Peter Schofield, OA North Survey 2015
Description A small narrow rectangular building to the south of Site **128**; it was perhaps a ruin by the time of the 1913 and 1919 maps. There was no building identified in this location during the survey.

Site Number **130**
Site Name Mine Shaft, Keld Heads, Preston-under-Scar
NGR 407776 491145
Type Mine: Shaft
Period Nineteenth century
Designations Outside scheduled area
Sources ZBO (L) 21, 1878; Peter Schofield, OA North Survey 2015
Description This was only referred to the 1878 map as an unnamed shaft. There is a slight mounded area here at the junction of the two footpaths adjacent to the Condenser House. It is possible that this is a misrepresentation of the sunken mine building (Site **117**).

Site Number **131**
Site Name Dam, Keld Heads, Preston-under-Scar
NGR 407759 491311
Type Dam
Period Nineteenth Century
Designations Outside scheduled area

Sources OS map, 1:10,560, 1856; OS map 1:10,560 1895; Smith 1998, 49; NYCRO ZBO (M) 1/1, 1723 and ZBO (M) 5/1, 1778; Peter Schofield, OA North Survey 2015

Description To the north and east of Area D on the west side of Keldheads Gill was marked a 'Dam' on the 1856 map (This area was not part of the 1866 map). By the time of the 1895 map the dam was no longer in use and only the western and northern edges of a cliff scar were delineated. Smith cites this as Dam 5. This was not the Dam marked on the eighteenth century maps associated with the Old Smelt Mill (Site **144**).

Site Number **132**
Site Name Track, Keld Heads, Preston-under-Scar
NGR 407999 490748
Type Track
Period Nineteenth Century
Designations Outside scheduled area
Sources OS map 1st edition, 1:10,560, 1856; OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map 1:10,560 1953-58; ZBO (L) 19, 1866
Description A track on the northern edge of Area A on the south side of Thowker Wood and maybe in Area B, but the map is not clear. It leads towards the area of the main adit.

Site Number **133**
Site Name Tramways, Keld Heads, Preston-under-Scar
NGR centre point 407990 497700
Type Tramways
Period Nineteenth Century
Designations Outside scheduled area
Sources OS map 1st edition, 1:10,560, 1856; OS map 1:10,560 1895; ZBO (L) 19, 1866
Description A network of tramways from the workshops (Site **43**) to and from the bouse teams (Site **26**), the dressing floors (Site **27**), Site **1** and the spoil tips at the eastern edge of the site. These were no longer in place by the time of the 1913 and 1919 maps.

Site Number **134**
Site Name Culvert, Keld Heads, Preston-under-Scar
NGR 407778 491035 to 407813 490956
Type Culvert
Period Nineteenth Century
Sources OS map 1st edition, 1:10,560, 1856; OS map 1:10,560 1895, Peter Schofield, OA North Survey 2015
Description An underground culvert carrying Keldheads Gill beneath the New Smelt Mill. It is orientated north-north-west/south-south-east and measures 86m long. There is an arched opening on the north end just north of the Smelt Mill (Site **89b**) and a similar opening at the south end (Site **71b**) where it outflows into a reservoir. The culvert has a vertical drop 9m from the north entrance where is drops beneath the ore bins on the north end of the Smelt Mill (Site **75a**). The culvert is depicted on the 1856 OS map as a dashed line and in 1895 as a 'C.C.S' a centre of covered stream.

Site Number **135**
Site Name Buddles, Keld Heads, Preston-under-Scar
NGR 408020 490640
Type Buddles
Period Nineteenth Century
Designations Outside scheduled area
Sources OS map, 1:2,500 1891-3; OS map 1:10,560 1895, ZBO (L) 19, 1866; Spensley, 2014, 62

Description To the south of the dressing floor were three circular features, which were buddles depicted on the 1866 map. By 1891-3 there were just two of these.

Site Number **136**
Site Name Field Boundary, Keld Heads, Preston-under-Scar
NGR 408020 490650
Type Field Boundary
Period Nineteenth Century
Designations Outside scheduled area
Sources OS map, 1:2,500 1891-3; OS map 1:10,560 1895; OS map, 1:2,500 1913; OS map, 1:10,560 1919, ZBO (L) 19, 1866
Description Eastern Field boundary for the lead mine buildings, dressing floors and spoil tips. This was not evident by the maps of 1953-8.

Site Number **137**
Site Name Leat, Keld Heads, Preston-under-Scar
NGR 407757 491056 to 407778 490964
Type Leat
Period Nineteenth Century
Designations Outside scheduled area
Sources OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map, 1:10,560 1919; OS map 1:10,560 1953-58; NYCRO ZBO (L) 19 1866
Description A leat flowing south from the dam / reservoir (Site **90**) to a point close to the Peat House (Site **73**). This was perhaps a re-arrangement of the water supply earlier provided by leat **26**. There is a short 31m long section extant between the reservoir and a later spoil heap. It is a 3.5m wide and 0.5m deep sunken area on the west side of a large retaining wall (part of Site **95**).

Site Number **138**
Site Name Aqueduct, Keld Heads, Preston-under-Scar
NGR *c* 408000 490680
Type Aqueduct
Period Nineteenth Century
Designations Outside scheduled area
Sources OS map 1:2,500 1891-3; OS map 1:10,560 1895; NYCRO ZBO (L) 19 1866
Description Aqueducts associated with the network of tramways (Site **133**) between the Keld Heads Mine entrance and workshops (Site 58) and the bouse teams (Site **48**) and the dressing floors (Site **134**).

Site Number **140**
Site Name Railway Building, Keld Heads, Preston-under-Scar
NGR 408187 490687
Type Building
Period Twentieth century
Designations Outside scheduled area
Sources OS map 1:10,560 1953-58
Description Small square building accessed on a siding of the N.E.R. railway near Wensley Station (Site 139). This was a loading station of the aerial ropeway (Site **141**) from Preston-under-Scar limestone quarry.

Site Number **141**
Site Name Aerial Ropeway, Keld Heads, Preston-under-Scar

NGR 407607 491497 to 408187 490687
Type Aerial Ropeway
Period Twentieth century
Photo Ref N/A
Sources OS map 1:10,560 1953-58; Peter Schofield, OA North Survey 2015
Description The alignment of the aerial ropeway used by Preston-under-Scar limestone quarry. It was first depicted upon the 1953-58 OS mapping and runs diagonally downslope from a series of storage bunkers immediately north of the property. The aerial ropeway was originally a 1000 yard long ropeway using a single rope system that carried 52 buckets (Johnson, 2002, 155It ran down through the area of Keld Heads lead mine to a loading station (Site **140**) (just east of the Preston under Scar WwTW) on a siding of the N.E.R. railway near Wensley Station
The extant sites include three concrete bases, each consisting of four square concrete supports, for the foundations of the aerial ropeway towers (Sites **1**, **4** and **103**). In addition, broken sections of twisted metal rope litter the floor along the alignment of the ropeway.

Site Number **142**
Site Name Mine Building, Keld Heads, Preston-under-Scar
NGR 407970 490740
Type Mine building
Period Nineteenth century
Designations Inside scheduled area 1014763
Sources OS map 1:2,500 1891-3; OS map 1:10,560 1895; OS map 1:2,500 1913; OS map, 1:10,560 1919; OS map 1:10,560 1953-58; NYCRO ZBO (L) 19, 1866; Peter Schofield, OA North Survey 2015
Description Just east of the workshops (Site **58**) was a tramway leading to a small building (Site **142**); this was on the west edge of the track dividing Areas A and B. There was no building identified in this location during the survey.

Site Number **143**
Site Name Mine Shaft, Keld Heads, Preston-under-Scar
NGR 407970 490973
Type Mine: Shaft
Period Nineteenth century
Designations Outside scheduled area
Sources ZBO (L) 21, 1878; OS map 1:10,560 1856; Peter Schofield, OA North Survey 2015
Description This was only referred to the 1878 map as Tullis Cote Shaft, and would appear to correspond with the position of the airshaft marked on the 1856 1:10560 map.

Site Number **144**
Site Name Old Smelt Mill, Keld Heads, Preston-under-Scar
NGR 407784 491163
Type Smelt Mill: possible location
Period Seventeenth century
Designations Within scheduled area 1014763
Sources Gill 1992, 115; Gill pers comm; Smith 1998, 59-61; www.nmrs.org.uk; NYCRO ZBO (M) 1/1, 1723; ZBO (M) 5/1, 1778; Spensley 2010, 178; Spensley 2014, 84; Atkins 2012; Peter Schofield, OA North Survey 2015
Description The detailed location of the Old Smelt Mill has been calculated from the examination of eighteenth and early nineteenth century estate maps alongside fieldwork and is thought to be on the site of the Condenser House. The old Mill was complex with three buildings and perhaps three hearths and probably associated with a reservoir to the north (Site **145**). It was built *c* 1650-1655 with two other hearths by 1664. These three hearths and flues were clearly shown on the eighteenth century map from the Bolton Estate alongside a structure to the west (probably Site **117**). The three hearths were fed by a leat from the dam (Site **145**) to the north.

Site Number	**145**
Site Name	Water supply and reservoir for Old Smelt Mill, Keld Heads
NGR	407785 491268
Type	Reservoir and Water Channel
Period	Eighteenth century
Designations	Within scheduled area 1014763
Sources	Gill 1992, 115; Gill pers comm; Smith 1998, 59-61; www.nmrs.org.uk; NYCRO ZBO (M) 1/1, 1723; ZBO (M) 5/1, 1778; Spensley 2010, 178; Spensley 2014, 84; Atkins 2012; Peter Schofield, OA North Survey 2015
Description	A reservoir was shown on the 1723 and 1778 maps and fed the Old Smelt Mill. Much of the reservoir has been cut by the later quarry (Site **5**), but the north-eastern edge of the reservoir survives as an earthwork, and the continuation of this leads into a linear earthwork, on the eastern side of the quarry, which may be a survival of a launder base and certainly corresponds in position and orientation with the outflow channel from the reservoir shown on the 1778 map. A water channel above the reservoir survives as a small ditch feature (Site **145**) and feeds into a former reservoir on the site of Quarry Site **5**.

ILLUSTRATIONS

FIGURES

PLATES

