Northern Archaeological Associates

THE WOODHEAD TUNNELS

SOUTH YORKSHIRE

AN HISTORICAL AND ARCHAEOLOGICAL SURVEY

on behalf of

The National Grid Company

NAA 05/48

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Marwood House, Harmire Enterprise Park, Barnard Castle, Co. Durham DL12 8BN

THE WOODHEAD TUNNELS

AN HISTORICAL AND ARCHAEOLOGICAL SURVEY

Summary

This report presents the results of some historical research and an archaeological survey of the Woodhead Tunnels undertaken by Northern Archaeological Associates for the National Grid Company in connection with a recent programme of remedial work. The survey work has been undertaken to provide background information on the tunnels, evidence of the extent of survival of railway period features, an assessment of significance and recommendations for future actions should NGC decide to decommission the cable installation and withdraw from the site.

The Woodhead Tunnels lie between Dunford Bridge and Woodhead to the west of Barnsley. They lie on a section of railway which formerly connected Manchester and Sheffield and comprise a modern double line tunnel built by British Rail in 1953 and two earlier mid 19th century single line tunnels which are located slightly to the north. The earlier tunnels have been used since 1968 to house and maintain 400kV electricity cables which form part of the National Grid.

Tunnels were an essential feature in the construction of railways from their inception up until the early years of the 20th century. They enabled reasonably direct routeing with acceptable gradients, as opposed to circuitous routes around high ground. The total number of tunnels on main line railways totalled approximately 1,050, until the advent of the recent channel rail tunnels there were only nine tunnels in excess of 2 miles in length in Britain. Woodhead was the fourth longest of these and the first to be constructed over 3 miles in length.

This survey has found that although large sections of the tunnels are generally well preserved, instability problems and water ingress require a significant programme of ongoing remedial work to be undertaken. Extensive civil engineering works have been carried out since 1988 to strengthen the tunnels at a number of points. Within the northern tunnel these works have been constrained by the need to maintain effective clearance, but in the southern tunnel some sections have been reduced to a narrow walkway. The installation of the cable in the north bore has removed most evidence of its railway usage and whilst the south bore has been less affected much of the railway infrastructure evidence has been removed. The principal surviving features include sections of the original ballast floor, the side drains, two pairs of 20th century signals, a set of points levers and some conduit. Internally, the tunnels contain little of real significance in terms of railway history.

Health and safety considerations are likely to be a major obstacle to any public access to the tunnels should NGC decide to decommission the underground cable in the north bore and withdraw from the site.

The Peak District National Park Archaeological Officer has suggested that the heritage interest could be addressed through the provision of some on-site

interpretation adjacent to the present portals, possibly linked to the nearby Trans Pennine Trail. In this respect, consideration should be given to the clearance of the structures adjacent to the portals at both Woodhead and Dunford Bridge to make these elements more visible.

If the cable route were to be decommissioned, the Peak District National Park should be given the opportunity to provide an input into the siting and content of any on-site interpretation in order that it should complement any existing or planned initiatives and literature for the area.

1.0 INTRODUCTION

1.1 This report presents the results of some historical research and an archaeological survey of the Woodhead Tunnels undertaken by Northern Archaeological Associates for the National Grid Company in connection with a recent programme of remedial work.

1.2 The disused Woodhead Tunnels lie beneath the Pennines, between Dunford Bridge (SE 15600225) and Woodhead (SK 11409990), approximately 32km to the west of Barnsley (Figure 1). They lie on a section of railway which formerly connected Manchester and Sheffield and comprise a modern double line tunnel built by British Rail in 1953 and two earlier mid 19th century single line tunnels which are located slightly to the north. All three tunnels are owned by the National Grid Company (NGC).

1.3 As a result of an initial appraisal undertaken in mid 2003, it was recommended that:

- a full walk-through of both tunnels be undertaken and a photographic record made of a representative sample of surviving features from the railway period
- further limited research be undertaken to establish what records and plans survive regarding the earlier arrangement of the tunnels
- informal discussions be held with the Peak District National Park Archaeological Officer to establish what inputs they would wish to have into discussions regarding the long term future of the tunnels

1.4 This report sets out the results of this additional work and integrates it with the earlier appraisal (NAA 03/119).

2.0 THE NATIONAL GRID INSTALLATION AT WOODHEAD

2.1 The earlier tunnels have been used since 1968 by CEGB, now NGC, to house and maintain 400kV electricity cables which form part of two circuits (Macclesfield - Stockbridge and Stalybridge – Thorpe Marsh). The cables are located above ground in two concrete troughs in the northern tunnel and are oil-cooled. A series of stop joints (hydraulic barriers) are located at several points above the cable, protected by wire mesh fences and fire extinguishing systems. A narrow gauge railway runs alongside the cable duct to facilitate access and maintenance. The adjacent southern tunnel contains oil tanks within concrete bunds which are linked to the cable stop joints in the northern tunnel via pipes. The tunnels are linked by 25 cross passages which are sealed at both ends by steel doors (Figure 2).

2.2 Since a major roof collapse in one cross passage in 1988, extensive civil engineering works have been carried out to strengthen the tunnels at a number of points. This work has comprised the installation of metal supports with concrete linings and the use of mass concrete to fill the voids between the new lining and the old sandstone lining or rock face. Within the northern tunnel these works have been constrained by the need to maintain effective clearance, but in the southern tunnel some sections have been reduced to a narrow walkway (Figure 3).

3.0 HISTORICAL BACKGROUND

3.1 The two 19th century Woodhead Tunnels represented the most impressive engineering feat of the Sheffield, Ashton-under-Lyne & Manchester Railway, which was the first railway to be constructed directly through the Pennines between Sheffield and Manchester. Between 1838 and 1852 two tunnels or bores were constructed between Dunford Bridge and Woodhead at the summit of the line, although initially only the southern tunnel (the down line) was constructed. The first tunnel measured 3 miles and 22 yards in length and was the longest in the country when it opened in 1845.

3.2 The original scheme was for a tunnel to accommodate two tracks but it was decided to economise by constructing a single line tunnel, known as the Woodhead Down Line. The initial phase of construction started in the spring of 1838 and comprised the construction of cart roads to move coal and materials over the moors, and the erection of accommodation for the men and horses working on the project. Magazines for the storage of gunpowder, to be used for blasting the rock, were also constructed. The first sod was not cut until September 1839 in the vicinity of the western portal at Woodhead after which excavations commenced. The tunnel was constructed by working from each end towards the centre and by means of five vertical shafts excavated between Pikenaze Moor and Dearden Moss. These last ranged between 57m to 173m in depth and were 2.44m (8ft) in diameter. Water was pumped from each shaft using 9 inch pumps powered by a steam engine. Some eight million tons of water were pumped out of the workings over the six years of construction. Initially 'driftways' or pilot headings were cut between the shafts and the portals and once these were linked the tunnel was driven by two contractors in two sections. It is estimated that the total volume of excavated material taken out of the tunnel amounted to 273,000 cubic yards and that about half of this was brought up the shafts.

3.3 The 1st edition Ordnance Survey map of the area in the vicinity of Dunford Bridge was published in 1855, but appears to show this first stage in the construction of the Woodhead Tunnel (Figure 4). The map depicts a single rail line entering the south bore, the line of the tunnel being indicated by a pair of dotted lines. Although the North Bore was completed in 1852, the survey work for the map was undertaken prior to this date (1844-49) and consequently did not record it. A series of ventilators are marked on the moor above the tunnel, which would appear to accord with the position of three of the five shafts used in the construction of the original tunnel. Each of the ventilators is close to a cart track and to major spoil tips. The towers which are marked on the plan are also likely to have been constructed as part of the initial laying out of the line of the tunnel above ground. Traces of ruins recorded adjacent to the cart track at Wike Gutter are likely to be the remains of temporary buildings used as part of the construction. Similarly the various sandstone quarries which are marked at the ends of the cart track at Grip Hill Well, Rusby Quarry, Windleden, Dearden Moss are also likely to have been the source of cut stone utilised for the sections of tunnel lining. Unfortunately, the mapping of the corresponding former Derbyshire area to the west, in the vicinity of Woodhead, is later and does not record a comparable situation.

3.4 When finished, the tunnel had a maximum height of 5.49m (18ft) between the trackbed and the soffit and a span of 4.57m (15ft) at the level of the trackbed. The arch was semi-elliptical in shape with its springing some 3m above rail level. Two open side channels

0.46m wide by 0.61m deep were cut at the base of the side walls for drainage and throughout the length of the tunnel 25 side arches were cut into the northern side at approximately 60m intervals to facilitate the construction of a second tunnel were this to be required. Castellated stone portals were constructed at the two ends and sections of the tunnel were lined in stone. The tunnel had a constant gradient from west to east of 1:203 and was perfectly straight.

3.5 Initially, special precautions were taken to ensure against accidents and a pilot engine, stationed at the tunnel, was attached to every train that passed through. The single line through the tunnel soon proved an acute bottleneck and work commenced on a second bore in the Spring of 1847. Initially, the side arches in the southern bore were extended to form cross headings for the new tunnel. From these, the second single line bore was driven to accommodate the 'up line' and this was completed in 1852. The dimensions of the second tunnel were virtually identical to the first, although it appears to have been lined throughout with brick and sandstone.

3.6 In 1889 electric bell signalling was installed to improve communications through the tunnel. At each of the 25 cross passages two devices were installed (one for each line) to enable a train crew to indicate their position and any difficulties by means of a bell code to the signal boxes at both ends of the tunnel. This was later replaced by a telephone system.

3.7 Ventilation proved a problem within the tunnels. A signal box was installed c.1899 in cross passage No. 12 in order to be able to operate intermediate signals on the up line, so as to increase capacity. It was closed about seven years later as there were problems finding signalmen prepared to work the long shifts in the tunnel, difficulties identifying signals and tail lights due to smoke, and trains stopped in the tunnel found difficulty in re-starting on the rising gradient. Ventilation was improved when the diameter of shaft No. 2 was doubled. This work was not commenced until 1912, after the signal box closed, and took three years to complete.

3.8 The provision of a new double track tunnel was considered as early as 1882, however, the scheme was dropped. The need for a new tunnel was ultimately brought about by the very poor state of repair of the single bores after the Second World War. The war had caused an enormous backlog of maintenance and this combined with damage to the stone lining caused by prolonged heavy use made repair uneconomic both in terms of cost and delay. A contract was placed in 1948 with Balfour Beatty & Co for the construction of a new tunnel to be used by electric locomotives. Both of the original tunnels were closed to rail traffic in 1954 with the opening of the new double line tunnel, which coincided with the electrification of the line.

The Installation of the Electric Cable

3.9 Following a Public Inquiry in 1963, CEGB were refused permission for a section of 400kV overhead line across Pikenaze Moor. Various underground cable options were examined and it was decided to install it in one of the disused Woodhead tunnels. The northern bore was chosen as being the most suitable for the cables because it was lined throughout in stone and brick, whilst the southern bore was only partially lined.

3.10 Prior to the installation of the cables the tunnel was cleaned of soot encrustations up to 0.23m thick. This was carried out using high pressure air jets rather than water in order to

prevent pollution of the adjacent rivers. Once the soot was removed to floor level it was neutralised with lime and mixed with cement and the former track bed to form a new hard floor. Repairs to the stone lining and arching were carried out in a number of locations where an absence of weep holes had caused distortion of the arches and walls by water pressure. The joints of the sandstone lining were re-pointed over half the tunnel by using compressed air to remove the old mortar and high pressure to force in the new mortar. Three of the six air shafts were infilled with stone, while a fourth was sealed at both the top and the bottom. A fifth shaft was only partially infilled as it provided ventilation to the later BR tunnel. The largest shaft, which had been enlarged in 1912, was re-pointed and left intact. Steel partitions with doors were installed into the cross partitions so that, in the case of a fire or collapse, the southern bore could be used as an emergency route.

4.0 RESULTS OF WALK-THROUGH SURVEY

4.1 A detailed walk-through inspection of the tunnels was undertaken in November 2003.

4.2 Due to remedial work carried out in the north bore to make the tunnel suitable for the installation and maintenance of the cables, the stone lining which extends the full length of the bore is in generally good condition. However, this work has removed most of the soot encrustations, together with all evidence of railway signalling and earlier communications. It has also modified the nature and height of the trackbed. At a relatively limited number of locations, repairs and reinforcement have masked sections of the original tunnel lining and reduced the width and height of the tunnel (Plates1 & 2).

4.3 The south bore does not appear to have been so heavily cleaned or altered from its original condition as a railway tunnel and railway period features have been principally identified in the lined sections of the tunnel. The south bore is only partially lined in stone, predominantly in the sections adjacent to the portals, but much of the central section contains no lining and in these sections the original rock cut walls are clearly exposed (Plate 3). Here there is some evidence of drill marks on both the side walls and the tunnel roof (Plate 4). More recent remedial work (prior to the current phase of work) has severely constricted the size of the tunnel in several areas where large volumes of mass concrete have been used to support weak sections (Plate 5).

4.4 The original drainage channels at the base of either side wall are visible in several areas. There was some evidence that the drains were lined in timber and there were remains of both wooden and metal cross pieces over the drains which must have supported timber coverings (Plate 6). A combination of wooden and metal brackets were observed on the north side of the south bore which held wrought iron u-profile trunking. There were traces of a wooden lid surviving in places but the trunking contained no cabling. Several short wooden posts on the south side of the tunnel with a pulley attached may have been related to signalling (Plate 7).

4.5 Several examples of railway period reinforcements to the arch of the tunnel are visible, where sections of curved rail have been bolted together to form an arched frame (Plate 8). This reinforcement comprised sections of bent rail which followed the profile of the tunnel lining and which were tied together with straight metal sections. Behind these hoops were sections of timber planking that were retained by either metal or wooden

wedges (Plate 9). The timber shuttering was partial rather than total, but it was unclear as to whether this had always been the case.

4.6 The partial remains of two railway signals were identified on either side of the tunnel close to cross-passage 23 (Plates 10 & 11 south; Plates 12 & 13 north). Both structures were set slightly into the tunnel wall on a steel plate and were surmounted by lamps. There were the remains of a signal arm which incorporated two lenses adjacent to each lamp and a metal ladder provided access to the lamp. At the base of the signals were two counterweights which were attached to metal link rods and it is thought that they were operated electro-mechanically. The signals were marked LNER 30 and LNER 40 and the lamps were marked *Lamp Manufacturing Railway Supplies Ltd London*. It is thought that these structures must post-date the Railway Act of 1921 (which created company groupings such as LNER). These signals appeared to be secondary as there was evidence that a recess in the tunnel lining had been infilled behind them. A second pair of identical signals were identified some 150m to the east. At least one tall shallow round-headed recess was also identified at another point in the stone lining which may have been related to earlier signalling (Plate 14).

4.7 There was evidence for a small iron lever and cam arrangement set on two timber baulks which spanned a side drain on the south side of the tunnel (Plate 15). The apparatus was clearly not *in-situ* and it was unclear whether it had operated a signal or a set of points. There was no indication as to its date.

4.8 The cross passages between the tunnels appear to have been significantly altered with the installation of steel partitions fitted with doors at either end of each passage (Plate 16). At least one passageway has been modified due to a collapse.

4.9 Both the eastern and western portals were constructed in rusticated stone but views of them are severely obstructed by gate structures, buildings and vegetation (Plates 17 & 18). In both cases the arches to the portals were formed by stepped voussoirs. The western portals lay beneath a natural stone crag whilst the eastern portals lay within a man-made cutting. According to Dow (1959) the portals originally had mock crenelations with three turrets and gargoyles. The crenelations and gargoyles appear to have been removed.

5.0 RAILWAY ARCHIVES

5.1 A search was undertaken at Sheffield Archives but with the exception of a general map of the Sheffield, Ashton-Under-Line and Manchester Railway dating to 1846 (SYAS 205/B1/1), no specific records were found relating to the Woodhead Tunnels.

5.2 Enquiries were made regarding records held at the National Railway Museum. No records were thought to be held on the tunnels by NRM.

5.3 Enquiries were also made of Network Rail but to date no response has been received from them.

6.0 SIGNIFICANCE OF THE TUNNELS

6.1 Tunnels were an essential feature in the construction of railways from their inception up until the early years of the 20th century. They enabled reasonably direct routeing with acceptable gradients, as opposed to circuitous routes around high ground. The total number of tunnels on main line railways totalled approximately 1,050, although this included structures built by cut-and-cover techniques as well as tunnels driven through ground as a bore or heading. Until the advent of the recent channel rail tunnels between Folkstone and Coquelles in France there were only nine tunnels in excess of 2 miles in length in Britain. Woodhead was the fourth longest of these and the first to be constructed over 3 miles in length.

6.2 The development of tunnelling on a really large scale, in terms of both length and section dimensions was wholly related to the demands of railway construction. These works far surpassed anything previously undertaken in canal construction. They were monumental feats of engineering which were accomplished largely with hand tools and gun powder with men and horses providing most of the motive power.

6.3 Although the tunnel is not recorded in the South Yorkshire or the Peak District National Park Sites and Monuments Records, there is a brief entry for the former railway line (SMR SY6664 – 0405/01). There have been no reviews by English Heritage of the railway industry to date and at present there are no specific criteria by which to assess the importance of tunnels. The two 19th century Woodhead tunnels are significant in terms of their length and the fact that they were associated with a Commons Select Committee inquiry into working conditions of railway labourers in 1846. Work on the project became notorious for the poor conditions in which the navvies were forced to live and work.

6.4 Although the tunnels are generally well preserved in terms of the lined sections and the cross passages, their potential significance is reduced because much of the railway infrastructure evidence has been removed from them. This has been the result both of improvements and remedial work before and after the closure of the tunnels to rail traffic. As a result, there is no surviving evidence for 19th century signalling or communication within either tunnel and the evidence for the former signal box in cross passage 12 has been completely removed.

7.0 CONCLUSION AND RECOMMENDATIONS

7.1 This survey has found that although large sections of the tunnels are generally well preserved, instability problems and water ingress require a significant programme of ongoing remedial work to be undertaken. Extensive civil engineering works have been carried out since 1988 to strengthen the tunnels at a number of points. This work has comprised the installation of metal supports with concrete linings and the use of mass concrete to fill the voids between the new lining and the old sandstone lining or rock face. Within the northern tunnel these works have been constrained by the need to maintain effective clearance, but in the southern tunnel some sections have been reduced to a narrow walkway. The installation of the cable in the north bore has removed most evidence of its railway usage and whilst the south bore has been less affected much of the railway infrastructure evidence has been removed. The principal surviving features

include sections of the original ballast floor, the side drains, two pairs of 20th century signals, a set of points levers and some conduit. Internally, the tunnels contain little of real significance in terms of railway history.

7.2 Health and safety considerations are likely to be a major obstacle to any public access to the tunnels should NGC decide to decommission the underground cable in the north bore and withdraw from the site. It is considered that:

- there would be no over-riding need for access to the interior of the tunnels to be maintained if such a decision was made, in terms of the heritage interest
- the re-opening of one or both of the 19th century tunnels to railway enthusiasts would be problematic as the future costs of maintaining the tunnels is likely to be prohibitive and sections of the existing remedial work would need to be replaced to provide effective clearance, particularly in the South Bore
- consideration could be given to providing a secure gate and limited lighting to a short section of tunnel at one of the portals to facilitate some visual appreciation of the form of the tunnel
- occasional guided tours of the tunnels could be given to special interest groups, however, the costs of dealing with health and safety issues and infrastructure maintenance would need to be compared to the heritage benefit

7.3 The Peak District National Park Archaeological Officer has suggested that the heritage interest could be addressed through the provision of some on-site interpretation adjacent to the present portals, possibly linked to the nearby Trans Pennine Trail. In this respect, consideration should be given to the clearance of the structures adjacent to the portals at both Woodhead and Dunford Bridge to make these elements more visible.

7.4 If the cable route were to be decommissioned, the Peak District National Park should be given the opportunity to provide an input into the siting and content of any on-site interpretation in order that it should complement any existing or planned initiatives and literature for the area.

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Text: Richard Fraser
Illustrations: Cath Chisman
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Maps

1846 *Map Shewing the Sheffield, Ashton-Under-Line and Manchester Railway and the Lines Proposed to be Amalgamated with it.* South Yorkshire Archive Service ref 205/B/1

1855 First Edition Ordnance Survey 6 inch map Yorkshire Sheet 280

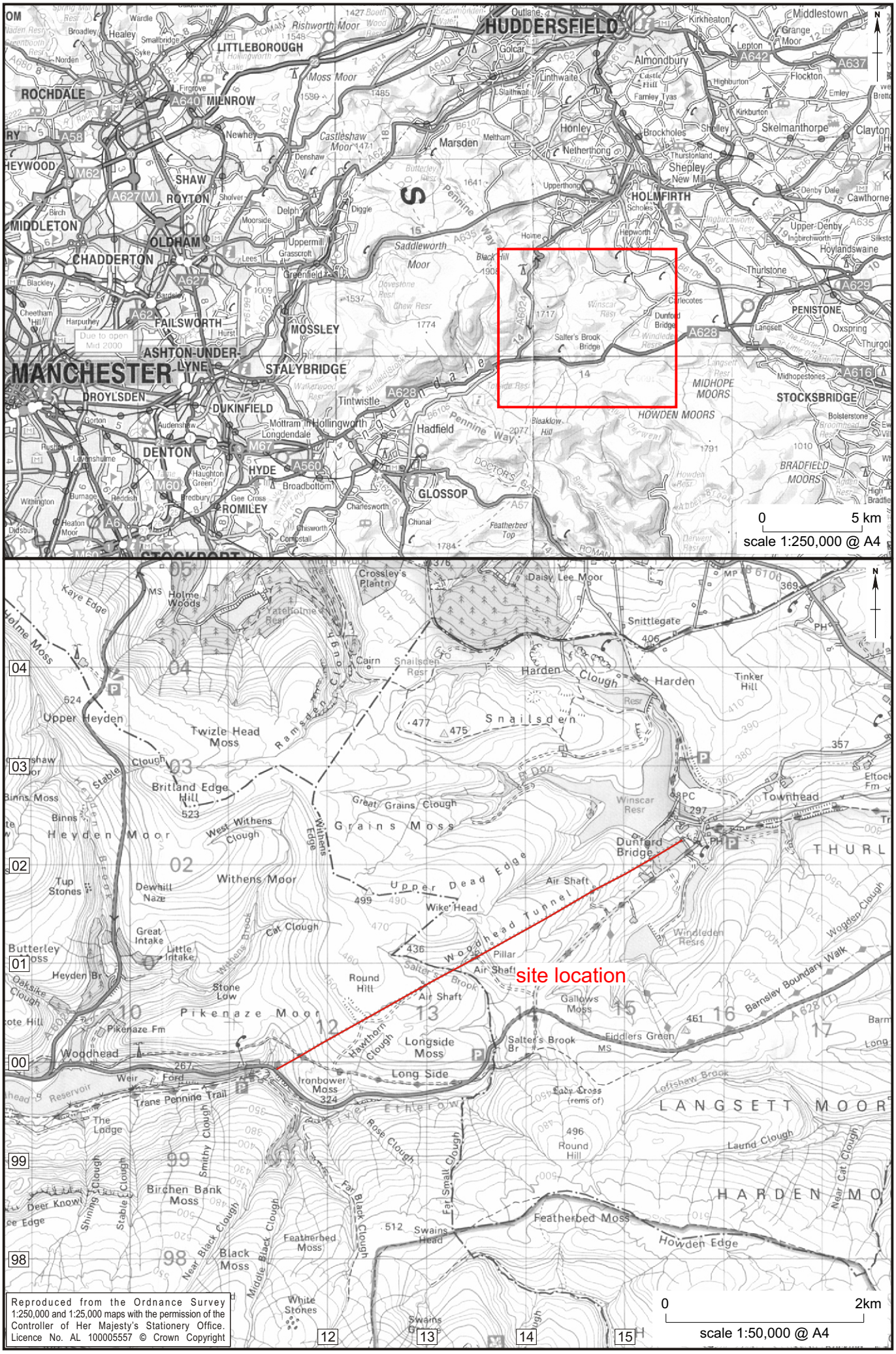
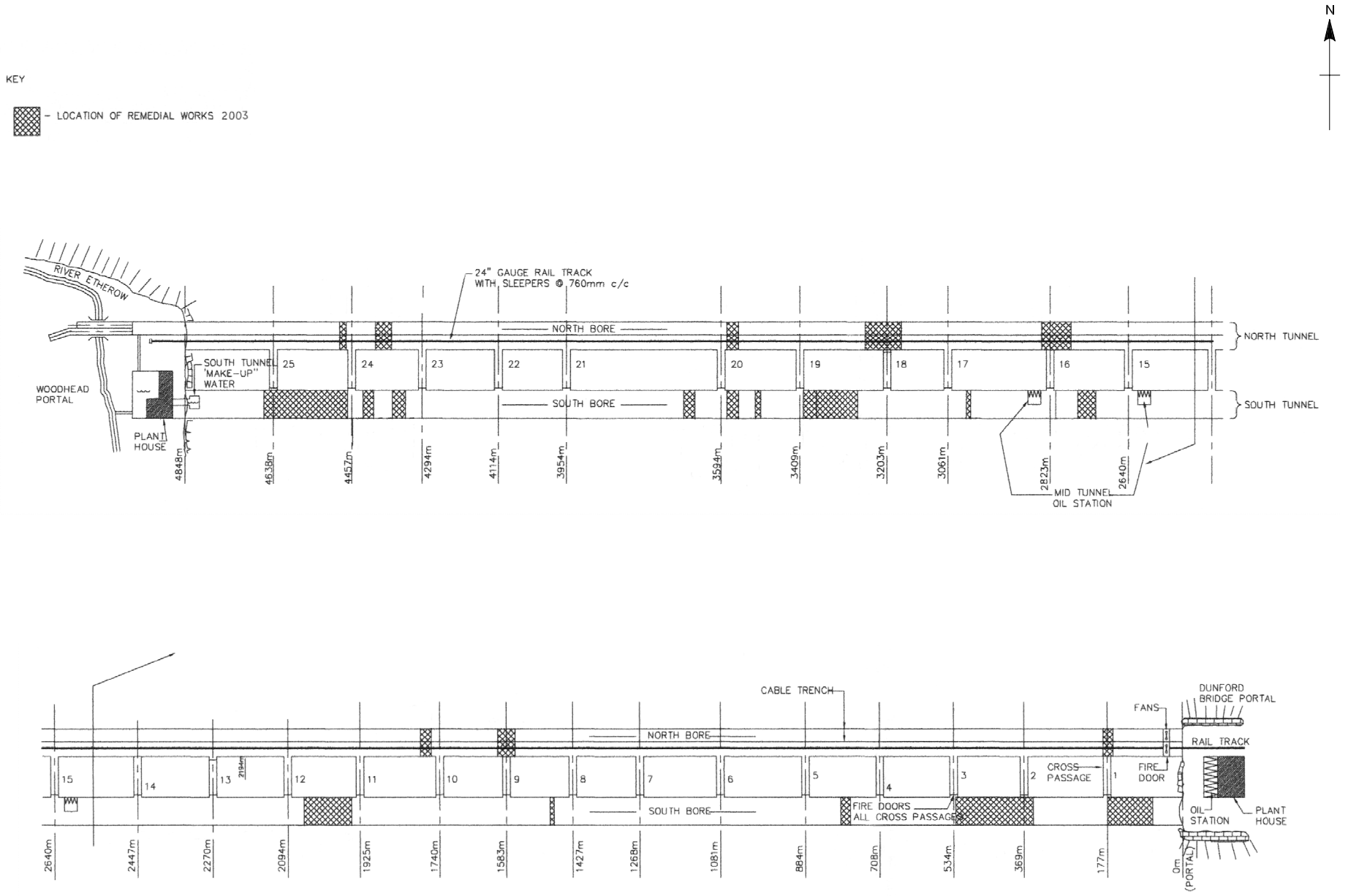


Figure 1 Woodhead Tunnel: site location



Based on survey data supplied by:
Mott MacDonald
ref: 202970/HCG/004 date: 04/03

not to scale

Figure 2 Woodhead Tunnel: layout of tunnel showing remedial works locations

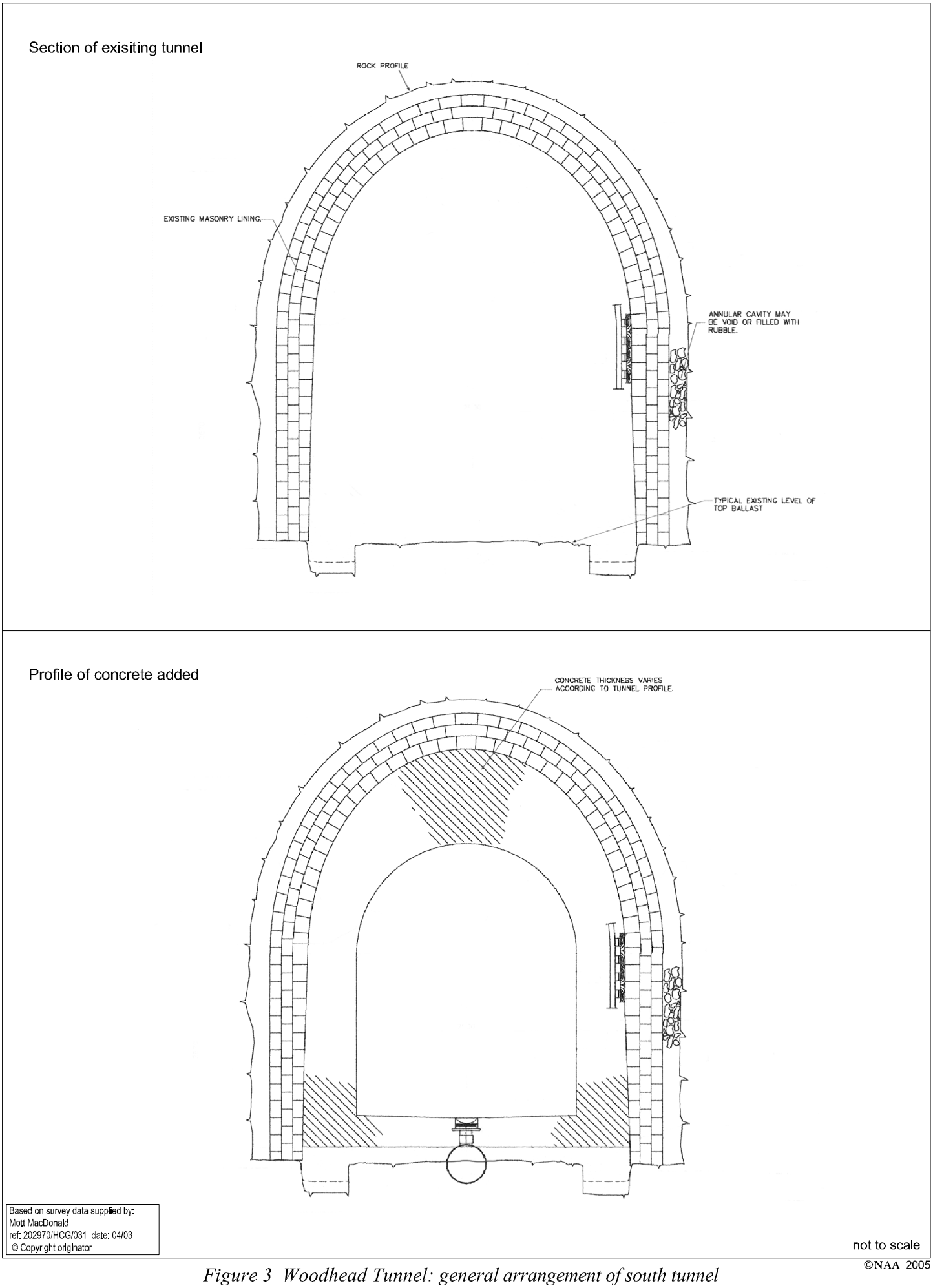


Figure 3 Woodhead Tunnel: general arrangement of south tunnel

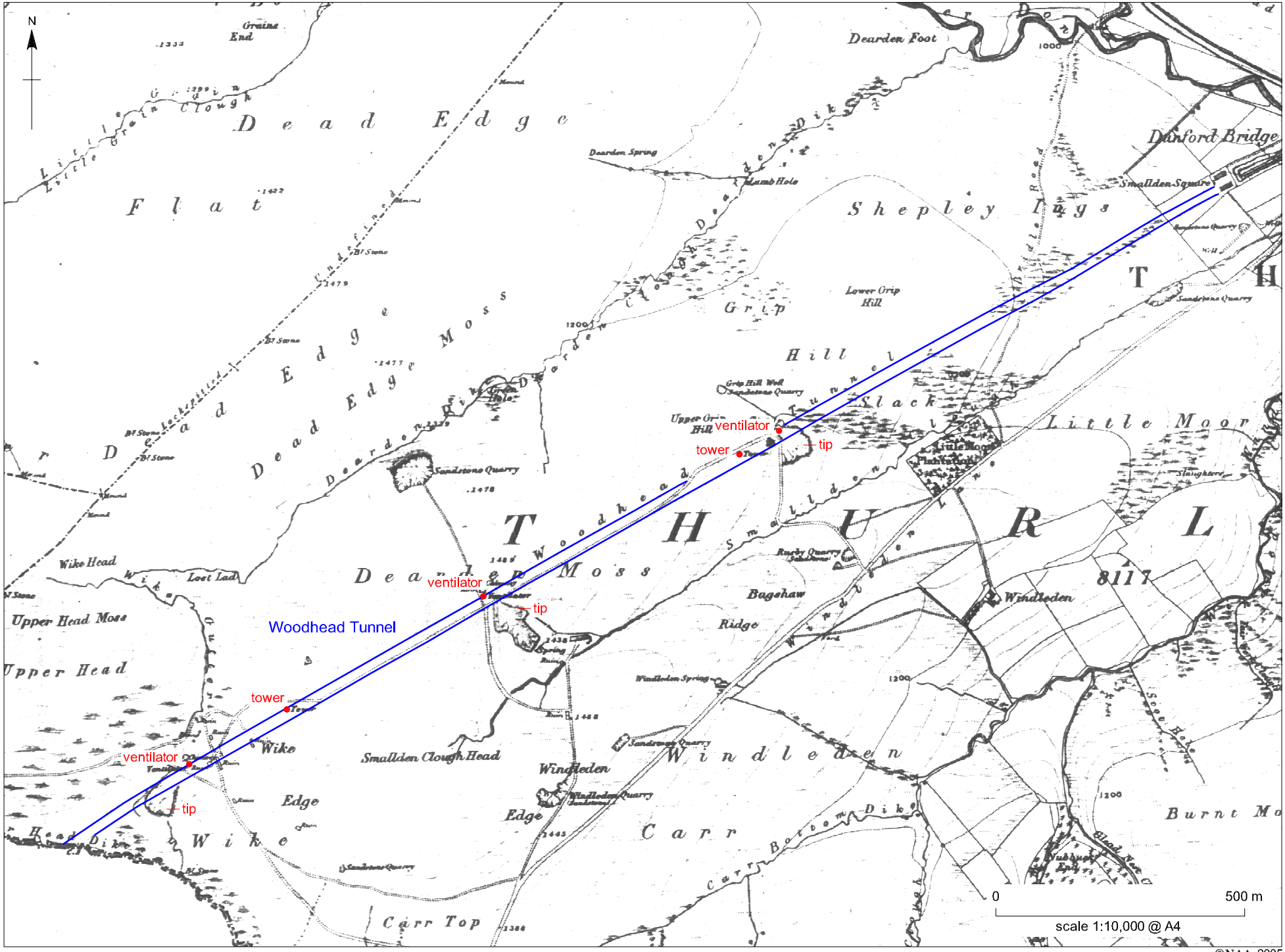


Figure 4 Woodhead Tunnel: 1st edition Ordnance Survey map (1855), Sheet 280

Plate 1 Woodhead Tunnel: Concrete and steel reinforcement to North Bore with access railway in foreground and cable conduit to right

Plate 2 Woodhead Tunnel: Concrete and steel reinforcement to North Bore with cable conduit in foreground

Plate 3 Woodhead Tunnel: Example of junction between lined and unlined section of South Bore

Plate 4 Woodhead Tunnel: Linear drill marks on the rock cut roof and side wall

Plate 5 Woodhead Tunnel: Example where successive phases of reinforcement has narrowed the South Bore

Plate 6 Woodhead Tunnel: Section of the wooden cable trunking and detail of timber lined drain below

Plate 7 Woodhead Tunnel: Example of a short wooden post with wire pulley attached

Plate 8 Woodhead Tunnel: General view of railway period steel and timber reinforcement of lined section of South Bore

Plate 9 Woodhead Tunnel: Detail of steel and timber reinforcement comprising arched sections of rail and partial timber shuttering

Plate 10 Woodhead Tunnel: Signal Lamp (20th century) and access ladder on south side of South Bore. Lamp faces east

Plate 11 Woodhead Tunnel: Detail of signal lamp showing infilled cavity behind suggesting that apparatus was secondary in this position

Plate 12 Woodhead Tunnel: Signal Lamp (20th century) and access ladder on north side of South Bore. Lamp faces east

Plate 13 Woodhead Tunnel: Detail of signal lamp showing similar infilled cavity behind suggesting that apparatus was also secondary in this position

Plate 14 Woodhead Tunnel: Tall shallow recess in stone lining possibly for an earlier signal

Plate 15 Woodhead Tunnel: Remains of possible points levers

Plate 16 Woodhead Tunnel: Cross passage No.2 incorporating later fire-proof blocking

Plate 17 Woodhead Tunnel: View of western portal at Woodhead

Plate 18 Woodhead Tunnel: Eastern portal to South Bore at Dunford Bridge