Report No: 2010RO33

Stephens Shaft, Morwell, Devon

Archaeological Assessment

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CORNWALL COUNCIL

Historic Environment Projects

A Report to Mr and Mrs Hoskins

Stephens Shaft,
Morwell House, Devon

Archaeological Assessment

Client	**Mr and Mrs Hoskins**
Report Number	**2010R033**
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Acknowledgements

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The views and recommendations expressed in this report are those of the Cornwall Council Historic Environment Projects team and are presented in good faith on the basis of professional judgement and on information currently available.

Freedom of Information Act

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Cover illustration

A view of the internal west side of the former Winding engine house and external east side of the boiler house that formerly wound from Hamilton's Shaft, Russell United Mine. C. Buck 2010 © CHE (P)

Contents

List of Figures

Abbreviations

CC	Cornwall Council
CHES	Cornwall Historic Environment Service
DCC	Devon County Council
DHER	Devon Historic Environment Record
DHES	Devon Historic Environment Service
DRO	Devon Record Office
EH	English Heritage
HE	Historic Environment
NGR	National Grid Reference
OS	Ordnance Survey
NE	Natural England
PWDRO	Plymouth West Devon Records Office
WHS	World Heritage Site
WSL	Westcountry Studies Library

1 Summary

This assessment report is intended to inform and guide, conservation and site safety works to the remains of a former steam winding engine and boiler house as a capital projects element of an Environmental Stewardship Agreement for Morwell House, Morwell, West Devon. This small mine is a relatively undocumented late 19th century historic site, which includes three mine shafts. Building conservation works for occasional pre-arranged public visits and a viewing site from the adjacent public footpath forms the core of the scheme. This report outlines the history of the site, identifies archaeological remains, assesses their significance, and provides conservation management recommendations.

In 1870 **Wheal Russell Mine** was 60 fathoms deep and employed thirty people. From 1852 to 1860, the mine sold 2456 tons of copper ore for £11158 (Collins 1912, 573). The company was named **Wheal Russell Mine** up to 1880, after which it was named **(Wheal) Russell United Mining Co.** (1880-1889); and thereafter named **Russell Mines Co. Ltd** up to 1893 when it focussed on the limited production of tin ore. During its history **Wheal Russell Mine** had produced 11 tons of black tin, 11,400 tons of 5½% copper ore and 10 tons of mispickel between 1852 and 1891 (Geology of Tavistock and Launceston 1911, 117). The peak of the mine was during the mid 1870s, but it was still operating to a much reduced capacity up to 1893.

During its final phase as **Russell Mines Co. Ltd** to 1893, Stephen's and Hamilton's Shafts (at the eastern end of Main Lode), were re-equipped at surface, and the workings extended lower. It was during this final phase that the steam winding engine and boiler house was constructed near Stephen's Shaft. The mine finally ceased operating by the mid 1890s, later than many of its neighbouring mines.

Wheal Russell Mine is a component part of the World Heritage Site (WHS) within the Cornwall and West Devon Mining Landscape. This site, Stephen's Shaft near Morwell House (at the eastern end of the Wheal Russell Main Lode), is not within the WHS but its workings and development relate to Wheal Russell Mine to the west, sited within the WHS. This report describes, identifies and prioritises the historical and building resource, together with the feasibility of building conservation management (to be taken into account with a separately produced structural report), as part of short, medium and long term objectives that reflect the individual sites' importance and significance within the World Heritage Site. This report intends to ensure that the site's special qualities and importance are preserved and enhanced by any landscape and building conservation proposals (minimising any adverse impact upon the archaeological resource).

In addition this report contains Impact Assessment mitigation recommendations of the proposed conservation works on the historic structures within the project area, and guiding principles for future management and maintenance of these sites, the general policies and guidelines for which should reflect those produced within the World Heritage Site Mining Landscape Management Plan 2005 - 10.

This is a privately owned site. Access will be at the discretion of the landowner.

2 Introduction

2.1 Project background

Mr and Mrs Hoskins, landowners of Morwell House (SX 44553 70787), have entered their landholding into the DEFRA Environmental Stewardship scheme. The surface remains of a small mine site (SX 44662 70941, Devon HER No. 62831), are sited north east of Morwell House, on the southern side of the access road down to the house.

Historic Environment Projects was commissioned in February 2010 by Mr and Mrs Hoskins, on behalf of Natural England as part of the farm's Environmental Stewardship Agreement, to undertake an archaeological assessment survey of part of the former Russell United Mine within their landholding, to outline the mining history, identify archaeologically sensitive areas and if necessary, recommend the provision of an historic buildings consultancy and archaeological recording, during a proposed building conservation Scheme in mid 2010. In addition to the archaeological assessment HE Projects was asked to provide project management services to co-ordinate and supervise the various contractors to provide respective specialist reports to inform the Stage 2 site works.

It is anticipated that the land and building conservation scheme will address the following:

- The protection and conservation of important archaeological remains and their settings.
- Health and safety aspects of the site relating to public access.
- Identification and safeguarding of important ecological areas (by separately commissioned reports).
- Provision of low-key public amenity use where appropriate, incorporating limited access.

In terms of the management of archaeological features, engineering works are likely to be kept to a minimum, but in view of the fact that this site is related to the Tamar Valley component of the Cornwall and West Devon World Heritage Site mining landscape, particular attention has been paid to suggestions for the best mitigation of any such works. This archaeological report will guide the site owner and Environmental Stewardship Agreement, on the effective prioritised conservation of the archaeological resource present within this part of Russell United Mine, as well as providing guidance on mitigation of potential impacts.

2.2 Aims

The requirements of this project have been set out in a brief prepared by Joy Ede of NE (agreed by Stephanie Knight, DCC Agri-Environment Advice), and a Project Design by the Cornwall County Historic Environment Service (Buck 7/2/2010).

The main objectives of this report are to:

- Provide an understanding of the site's developmental and historic environment history through archive research and fieldwork survey.
- Carry out a descriptive archaeological survey of the Stephens Shaft site to identify archaeological remains, describe their condition and to investigate the potential for buried features.
- Assess the feasibility of consolidation and provide an outline of the building conservation work for each site with the appropriate level of analysis and building recording (specified to EH Level 2 standard).

- Identify and prioritise necessary consolidation works in terms of short, medium and long term objectives.
- Identify the need for further archaeological recording and investigation.
- Propose appropriate priorities for conservation management recommendations to ensure that the site's special qualities and importance are preserved and enhanced by any landscape conservation proposals (minimising any adverse impact upon the archaeological resource).
- Produce a provisional impact assessment of the effect of the proposed conservation works on each feature, and any perceived threats/issues and the potential for their future use.
- Guide future long term management and maintenance of the sites, buildings, access routes (within the mine) and their interpretation to users.
- Assess the importance and significance of individual and grouped features in terms of local, regional, national or international historic landscape criteria, in conjunction with stated research questions for events, periods and processes.
- Provide a resource for DEFRA grant funding for building conservation works and any necessary statutory consents.
- Disseminate and publish the results in a medium that can be utilised by information boards, leaflets, booklets, WHS web site and related sites.

This, in turn, will provide the site owner and NE with information to:

- Understand the development history of the project area within its local, regional and national context.
- Understand the nature, extent and quality of survival of historic and archaeological features within the project area.
- Take into account short and long-term management recommendations for the site and its components, including any requirement for further evaluative survey, excavation or information gathering, statutory or other forms of protection.
- Take into account guidance on the means by which the effects of undertaking the provision of increased public access and other necessary site safety works and building consolidation can most appropriately be mitigated.

2.3 Methods

2.3.1 Desk based assessment

During the desktop assessment historical databases and archives were consulted in order to obtain information about the history of the site and the structures and features that were known to have existed on it. The main sources located and consulted are summarised as follows (refer to Section 8.0):

- Historical documents, maps, plans and other published material held by Cornwall and Devon County Records Office (see Section 8.1)
- Devon's Historic Environment Record (DHER)
- Published histories of local industrial archaeology (see Section 8.2)
- Information on mining operations held by organisations such as the Tamar Journal of the Friends of Morwellham, Trevithick Trust etc

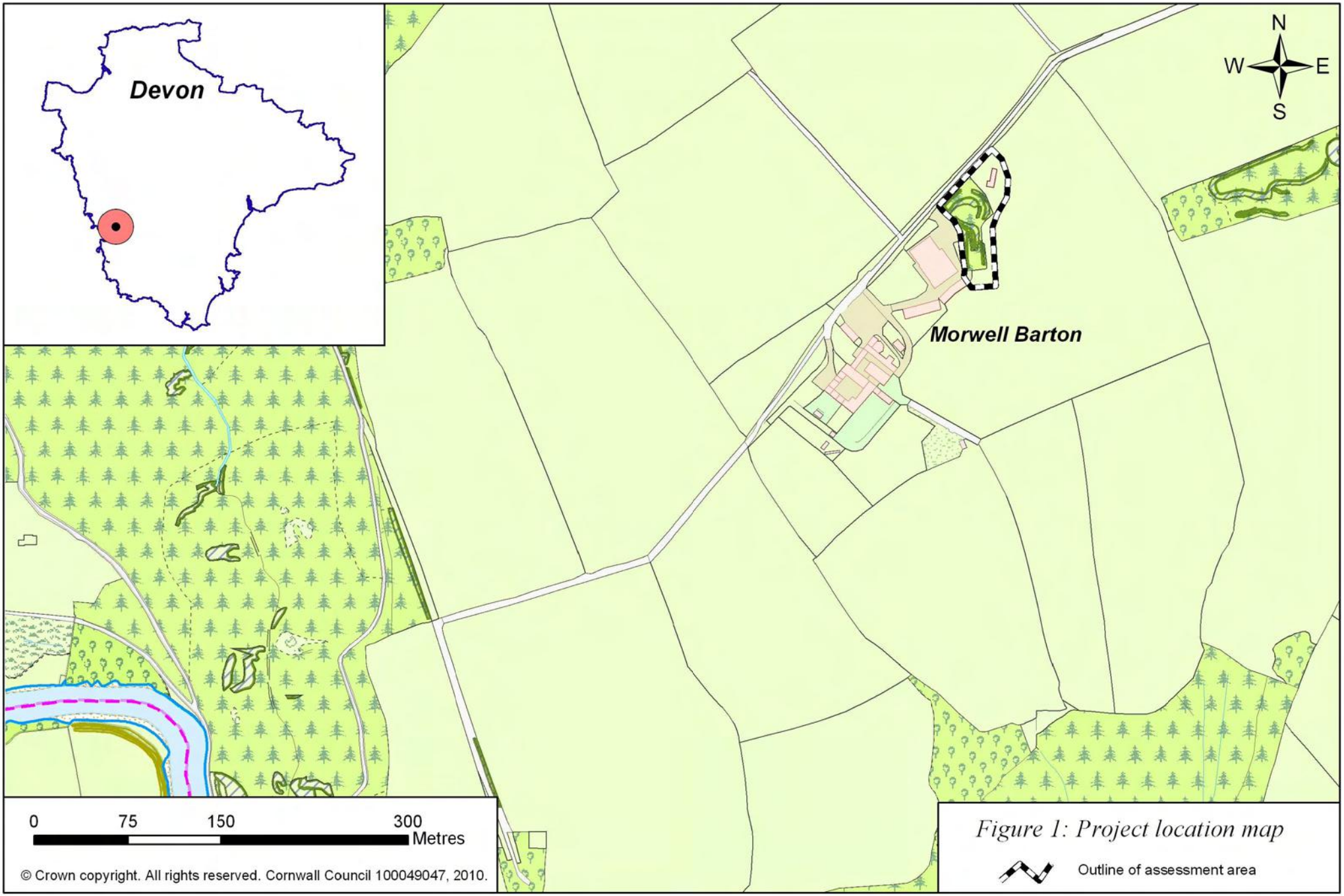
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Figure 1: Project location map
Outline of assessment area

- Statutory and other planning designations for the site
- Aerial photographs held by CC

Documentary research and fieldwork have been slanted towards the industrial development of the project area, with the majority of site management recommendations being applied to industrial sites. Nevertheless, sufficient background research has been undertaken to be able to summarise the pre-industrial history of the landscape within the project area (see Section 3.2).

2.3.2 Fieldwork

- Detailed maps for use in the field were produced from the Ordnance Survey Landline Digital Mapping and amalgamated with information derived from historic maps (including the 1st and 2nd edition 1:2500 Ordnance Survey maps), and other documentary sources. These images were also used as part of the fieldwork map base during the field survey component of the project.
- Field recording followed established formats and was based on a mixture of photography (digital), annotated sketch and measured recording (see HES (Projects) Stevens Shaft assessment Project Design – Buck 7/2/2010).
- A detailed building survey (plans and elevations) of the single extant mine building (Site 5), the winding engine and boiler house will be undertaken separately by a firm of structural engineers as part of their structural assessment to a minimum scale of (1:100).

3 Background

A Glossary of Mining Terms is produced in the Appendix (Section 10.3).

3.1 Geology and Lodes

The published geological map of the area (Geological Survey Sheet 337 (Tavistock), 1994) indicates that the site is underlain by the Kate Brook Slate of Upper Devonian geological age. The map shows two areas of intrusive igneous rocks within the site. In the south-east, a dyke of porphyry (Elvan) outcrops in the upper valley side, and the Gunnislake Granite intrusion extends across the River Tamar and into the lower slopes of Blanchdown Woods. The geology map also shows east-west trending copper lodes and significant areas of superficial soil deposits and alluvium mantling the bedrock in the valley of the River Tamar. At a small number of locations quartz intrusions have given rise to many near vertical outcrops up the steep sides of the Tamar Valley, within this mine sett known as Morwell Rocks and Pleasure Rocks.

'The most important mineral area is a belt of country 12 miles long from east to west, and 4 miles broad, extending from the edge of the Dartmoor granite, westwards across the Gunnislake and Kit Hill granites. The lodes of tin and copper which nearly all course about east and west, have yielded also large quantities of mispickel and pyrite…The district has been more prolific in sulphide ores than in tin, and large yields of copper with much pyrite and mispickel have been obtained from nearly all the mines on the east of the Gunnislake granite from Devon Great Consols southward to Gawton Mine..' (Dines 1956, 623). *'The country rock is killas, which, in the north-west, for nearly a mile east of the Tamar has suffered thermal metamorphism by the Gunnislake granite mass. There are several E-W. elvan dykes, notably south of Gulworthy and in the Morwelldown Plantation, closely associated with lodes'* (*op cit*, 663)… *The small dumps at the Russell United shafts show veinstone fragments of quartz and soft blue-green chlorite with chalcopyrite and mispickel and later siderite and fluorspar. Tourmaline and scorodite are also present (op cit, 675).*

Russell Mine Lodes:

*'The country rock consists of killas thermally metamorphosed by the Gunnislake granite mass… There are three east-west lodes: **Main Lode** (also known as Impham, Matthews or Russell) underlying steeply north, which has been traced for 350 fms. E. of the Tamar; **Great Lode**, 250 yds. to the South, underlying south and apparently a westward continuation of East Russell lode and **South lode**, about 15 yds. S. of Great Lode (op cit, 674).*

Figure 4 (Symons 1848 mining map), only shows a single Lode within the project area. It is named '*Huel Russell Lode*' but its location is north of the position of Great Lode (250 yards south of 'Main' or Russell Lode). Figure 5 (Bedford Estates 1867 shafts/lode map), also only shows a single Lode (in red) within the project area, to the south of 'Huel Russell Lode' shown on Fig 4.

The 1867 map appears to be a more accurate reflection of Great Lode: *'Great Lode has been opened up by an adit level driven into the valley side 290 yds. S. of Impham Shaft, and by two adjacent shafts, Steven's and Hamilton's, near Morwell manor, 900 yds. to the east. The adit follows the lode for 280 fms. E., passing through a crosscourse at 245 fms. which heaves the lode a few feet right. At 280 fms. the lode is heaved right (again) … as a crosscut, and then turns east on the lode for 95 fms. as the 57 fm. Level to the vertical Steven's Shaft, where it ends'* (*op cit*, 675).

In addition, field survey and documentary research have showed that there are at least two additional smaller (east-west) lodes just south of Impham Quay (SX 4392 7055), that have been worked since the 18th century. These are not shown on archive maps.

3.2 Historical Background

3.2.1 Summary background history of Tamar Valley

The Devon Historic Environment Record has no sites of prehistoric date within the Russell Mines part of the project area. However a general summary of prehistoric and medieval sites in the Tamar Valley has been given in Buck (1998, 5-6). This has been summarised below:

Neolithic axes have been found at Tavistock, Bere Ferrers, and Buckland Monachorum. At Heathfield (Beacon), between the parishes of Lamerton and Milton Abbot, a Bronze Age barrow cemetery has been located. Earthwork defensive enclosures of probable Iron Age date are found overlooking the Tamar at Furzeleigh (or Dunterton), opposite Cartha Martha Woods on the Cornwall side of the Tamar and there is a similar feature in nearby Dunterue Wood. Other Iron Age enclosures include Ramsdon Camp in Milton Abbot parish, Northcott Wood in Northcott parish, and an earthwork enclosure at Berra Tor in Buckland Monachorum parish (five miles to the south east).

The Tamar Valley itself is likely to have been occupied in the prehistoric era, due to its preferred, more fertile, lowland sites, and utilisation of the river as a means of transport, for trade and as a source for food (trout, salmon and lampreys). Later medieval and post-medieval settlements are likely to have hidden or destroyed much archaeological evidence for prehistoric occupation.

Domesday Book and medieval place-name evidence indicate a typical medieval farming landscape with settlements largely confined to the lower ground and the uplands left as open pasture. Medieval farming settlements are evidenced from documentary sources and from field evidence for strip-based field systems; they appear to have been small co-operative hamlets (of 3-6 farmsteads). Examples on the Devon side of the Tamar are in similar locations to those in Cornwall, as, for example a medieval strip field complex to the south of Dunterton. The farming landscapes on both sides of the Tamar now largely consist of single farms, some of which are the remnants of former medieval hamlets.

Figure 2. Gardner Map (1784-1786): section showing River Tamar and Morwell Downs

(MAPS K.TOP XI 80-80a. By Permission of The British Library)

Near the project area, the only medieval settlements are those of Morwell Barton (east of the project area) and probably Morwellham. Other settlements (Hatchwood and Impham) are mainly of post-medieval date. There are no medieval church towns within the project area, although Tavistock - the medieval stannary town - would have provided administration through the Abbey and the stannary court. It is likely that the land within the project area would have been owned by Tavistock Abbey (who also owned Morwell Barton). This would have continued from the medieval period, up until the Dissolution in 1539, when the lands were transferred to the Russell (later Duke of Bedford) family. It is likely that Gunnislake and Tavistock were the area's centres for social and market needs from the 19th century onwards.

Mining activity in the Tamar Valley is by no means confined to the post-medieval period. Although tin appears to have been worked in Cornwall since the Bronze Age, during the 12th century the alluvial gravels of Dartmoor and possibly the Tamar Valley were of major national economic importance. Documentary evidence from the late 13th century and early 14th century attests to lead/silver mining in the Bere Alston and Lopwell districts that appears to have continued sporadically for some years.

On both sides of the Tamar Valley alluvial and shallow ore extraction proceeded sporadically until the early 18th century, when there was renewed interest in the copper ore resources of this area. Furthermore there is documentary evidence for copper mining in the 18th century (most in the first and last quarters) at many sites in the Tamar Valley (Patrick, 1983). Copper ore was mined using the traditional method of costean pits/trenches to locate the lode and through excavation of the valley sides just above river level. The outcropping back of the lode (oriented east or east south east), was followed up the steep sides of the hill by sinking 'shallow' pits, openworks and shafts for as long as the lode was found. Adits were also cut along the lode for access, drainage and to remove the ore and waste rock at varying heights from river level to nearly the top of the valley slope.

Copper ore was exported (mainly from Impham Quay, New Quay and Morwellham – all on the Devon side of the Tamar) to the Bristol and Swansea smelters (after being dressed locally). Through archaeological fieldwork a few sites in the Wheal Russell Mine project area (Buck 2005) have been found that mirror this early technique of ore extraction (Buck 2005, Sites 7 and 57 for costean pits, and Site 37 as an early example of a likely 18th century adit working), together with their related methods for generating power (usually via water wheels), to pump and wind shafts and dress the ore. Unfortunately post - medieval leats have not been definitely located (as they have to the north within the Bedford Mines project area (Buck 2003, Site 109), supplying water to power stamps/crushing (or crazing mills). The northern edge of the project area runs along the south side of the Impham valley, which has been shown to be the site of 18th century stamping mills and contemporary copper mines (Buck 2003). It is likely also that Impham Quay and the adjacent copper smelter were also built in the early years of the 18th century, possibly by the same industrial entrepreneurs.

The Gardner Map of 1784/6 (Fig 2) is the first relatively detailed map that shows the form of the landscape towards the end of the copper boom of the 18th century. Of note, is the 'upland' track that leads from the 'Waggon Lane' (later to become the route for ore wagons from Devon Great Consols to ore quays at Morwellham, Gawton, New Quay and Impham Quay prior to the construction of the Devon Great Consols railway in 1858), down to Impham and Morwellham Quays. The map also shows a long track from 'Waggon Lane' down to the River Tamar through dense woodland, perhaps to a timber bridge over the River Tamar, to Impham Quay or to small mine working operations. Mine works appear to have taken place mainly within the steeply sloping sides of the valley, and so are not shown in detail. However the post - medieval field systems up to the edge of the wooded slopes can be plainly seen, with enclosure of Morwell Down starting after 1828, when a local enclosure Act was passed (9 George IV).

The 1843 Tithe (Index) Map (Fig 3), and Symons 1848 lodes and setts map (Fig 4), replicates the detail of the earlier 1784/6 map. The Tithe Map in particular shows the distribution of woodland, parallel to the River Tamar, along the steep sides of the valley and the location of post - medieval settlements and their associated field system making inroads into the surrounding woodland. Level ground from the top of the valley sides eastwards appears to have been farmed from the early years of the medieval period. The distinctive west/east thin line of wooded areas (for example the later site of East Wheal Russell north east of the project area), stretching from the steep valley slopes up to the north/south spine road to Bere Ferrers, had already formed, forever changing the landscape of the area. These workings, many likely to be a century old by this date, appear to have reached their full eastern extent by the late 18th century. However, the presence of charcoal burning platforms along the steep sides of Morwell Wood perhaps gives a general indication of an industry that preceded the small 18th century mines, and later 19th century amalgamations.

3.2.2 Wheal Russell Mine (18th century)

In the 18th century small mine setts were being leased from the Duke of Bedfords Estate. They were being worked by relatively small numbers of miners who were locating the surface outcrops of the lodes by digging regular shaped costean pits, and then working out the lode outcrops both at surface and underground, following them up through the steep sides of the valley. The names of these small setts are often difficult to reconcile with the place-names of later 19th century maps, nor do they appear on the Gardners Survey map of 1784 (Fig 2). However attempts have been made to locate these 18th century documented sites where they are within the boundary of the project area (which is much larger than the Wheal Russell Sett of 1867 – Fig 5).

Wheal Impham was a mine whose lode was located in the northern part of the later 19th century Wheal Russell Sett, working Impham (or Main) Lode. However, it was already being worked in the second decade of the 18th century. It was an old work referred to by Kalmeter in 1724 (a Swedish engineer, who visited the mine on 13th November 1724 (his text published in 2001 by Justin Brooke) as; *'a copper mine called Impham out of which Mr Coster, if one can believe people, in the four years he worked it, with five or six men, took over a 100 tons of ore'* (Brooke 2001, 13). The same Mr (John) Costar is documented earlier in 1717 as being a joint lessee of **Impham Wood Copper Works**. *'In fact John Costar is recorded as being much involved in copper mining in Cornwall* (and had a smelting house on the River Wye - Patrick 1983, 38). *'A cost-book formerly in the Bedford Estate Office at Tavistock shows that the mine was still in operation during the years 1799 to 1820 ...'* (Jenkin 1974, 33).

In the Bedford archive at Devon Record Office (Exeter), the earliest documentary records detail the **Impham Wood Work** sett (in 1717) as being 200 fathoms long and 70 fathoms wide *'from where they have already begun to work'*, and later **Impham Copper Mine** (in 1733) leasing 200 fathoms of land in length and 70 fathoms of land in breadth, near the brook that separates Impham Wood from Gutterhall (worthy ?) Wood *'to begin from Hawkins' Old Work'*. To the south east of Impham Quay (Buck 2005 Site 33), the sides of the valley are very steep. However, in between the near vertical outcrops of rock there are possible sites where mining may have occurred, although evidence of this is very difficult to see given the steep topography and the degree of loose rock and trees etc. Documentary records also detail Duke of Bedford leases for a further two copper mines; The **Good Luck Mine** (in 1718 &1723) *'to begin where an earlier essay or tryall was made in Belcamore Wood 80 fathoms in length and 40 fathoms in breadth'*, and The **Christian Ann Mine** (1720) *'200 fathom of land and 60 fathoms of land in Belcamore Wood eastwards from the River Tamar on the course of a copper load lately found and now wrought'. Dues were paid by the* **Christian Ann Mine** in 1720 and **Two Brothers Mine** in 1728 (*pers comm* John Goodridge).

Further supporting documentary and cartographic evidence for mining activity in the area (*pers*

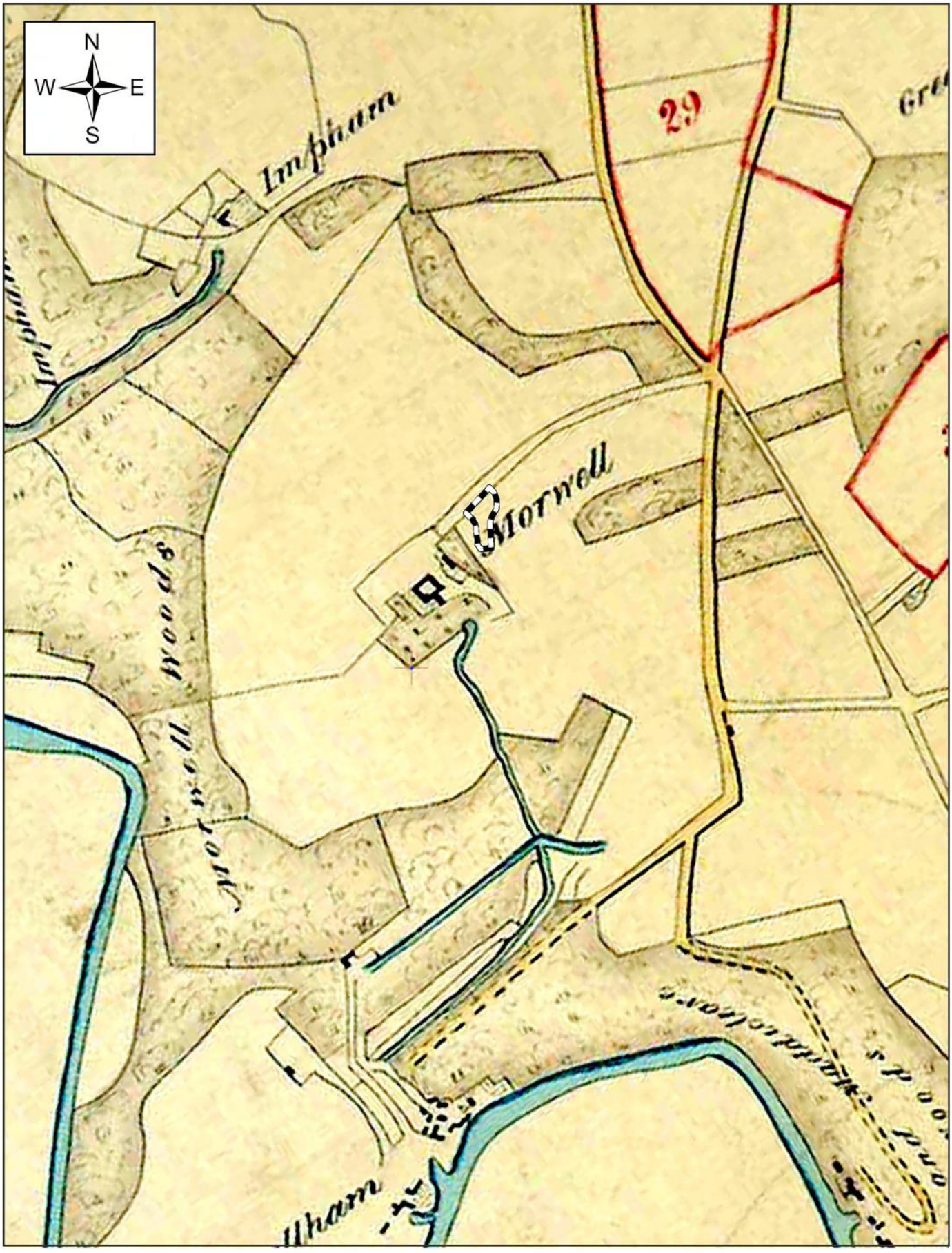

Figure 3. Tavistock Parish (Index Map) Tithe Map (1843)

(DRO/Tavistock Tithe Map)

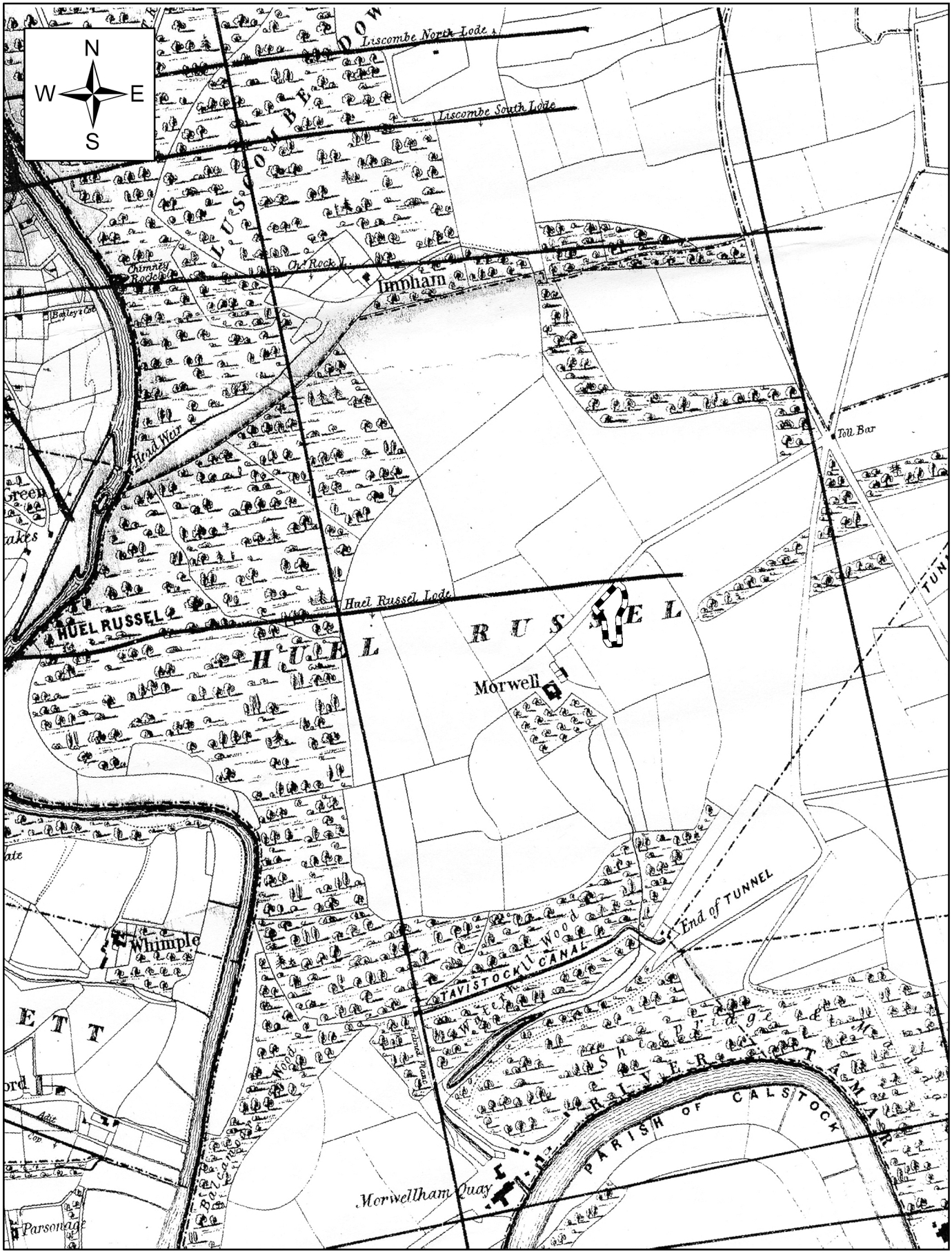

Figure 4.Symons' mine sett/ lodes map of the Tavistock District (1848)

(CRO ME 2462 - scale 6 inch - 1 mile)

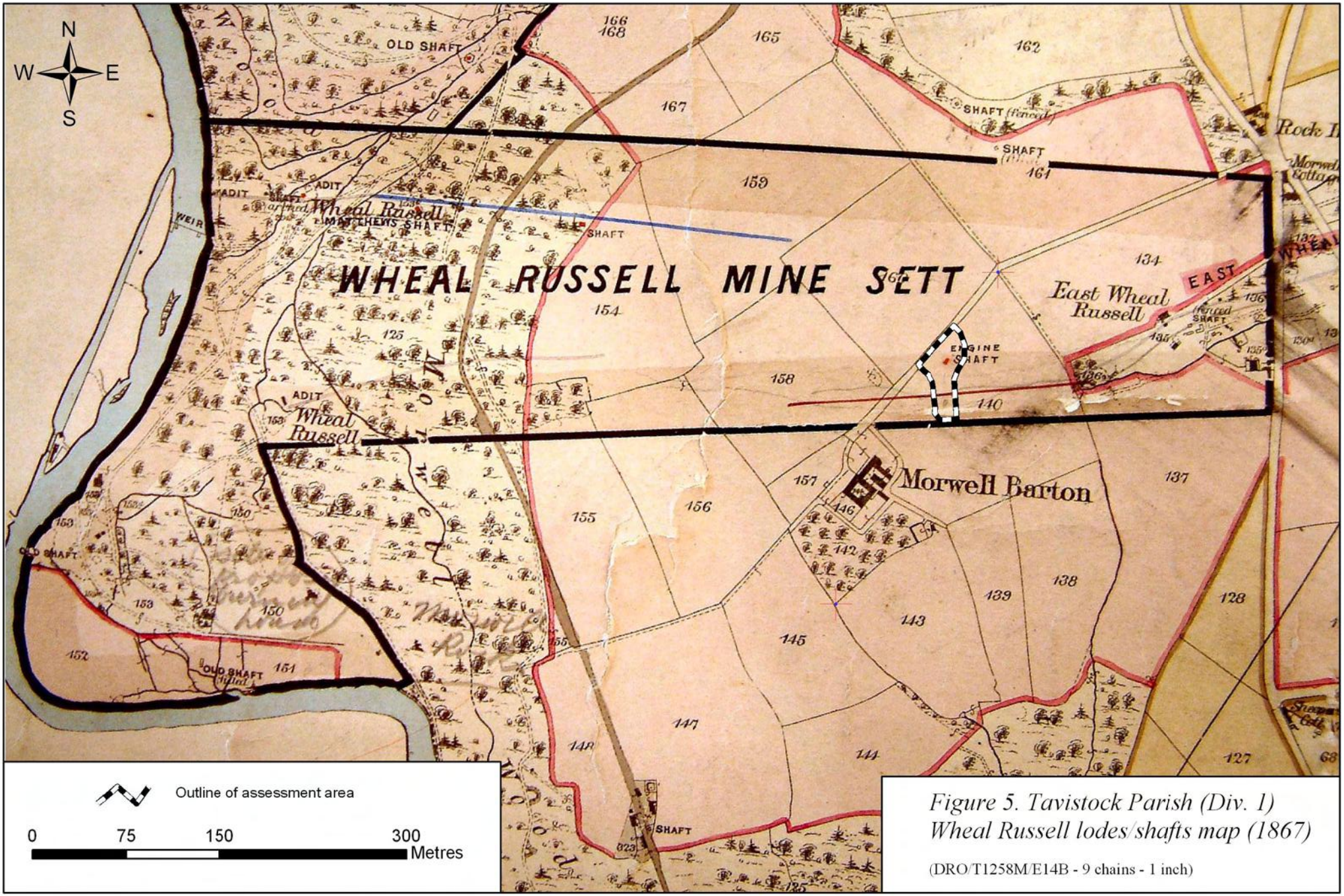

Figure 5. Tavistock Parish (Div. 1) Wheal Russell lodes/shafts map (1867)

(DRO/T1258M/E14B - 9 chains - 1 inch)

comm John Goodridge), comes from early to mid 18th century references of a smelting house (approximately SX 4395 7058) at Impham Quay (Buck 2005 Site 34, Devon SMR No. 20815). The area of Impham Quay was marked as a smelting house before 1758 and was smelting tin in 1724 -5 with possible tin slag being recovered nearby (*pers comm*. Tom Greeves - information held in the Devon SMR No. 20815). Observations made by Hendrik Kalmeter are: *'No ore is smelted here, and it is only broken small and separated from the waste rock. The poorer kind is crushed and washed, and is sent by land* (presumably via Newbridge) *to a place two miles away called Net Stakes, where the River Tamar is navigable for barges or boats … from there the ore is shipped to Bristol or to Neath in Wales'* (Brooke 2001, 12). However, Kalmeter goes on to state; *'The black tin is sent to Impham melting house near Tavistock to be smelted, and there give 1,125 lbs. of tin metal for 2,000 lbs of black tin'* (*op cit*, 47). Evidence for copper ore production after the third decade of the 18th century in the Bedford archives and the Port books appears to be lacking although it seems to have picked up again by the last decade of the century.

3.2.3 Wheal Russell Mine (1842 – 1881)

To date, there appears to be no further documentary evidence of the small mining setts described above (often following a single lode), until 1842 when, within the project area, the old 18th century workings (probably those in the Impham Valley), were reopened and amalgamated into the sett of **Wheal Russell Mine**. This is shown in detail on Figure 5 (1867 Bedford Estate Shaft/lode Map). The main centres of operation follow the two main lodes. The first being the Main (or Impham) Lode worked from Impham Shaft eastwards, using adits and waterwheels to provide power via flat rods to pump and wind from shafts, often higher up the sides of the river valley. The second being of a similar nature (Great Lode) from the centre of the mine with a main adit and waterwheel working and sending flat rods westwards (to work the grinder and dressing floor apparatus) down to the dressing floor near the River Tamar and probably eastwards up to (initially) Stephen's Shaft by 1867 (see Fig 5). At the same time the mine's adit (at the 57 fm. level), had been developed to Stephen's Shaft (north-east of Morwell Barton). Figure 5 is also the first map that shows Stephen's Shaft, Hamilton's Shaft is not shown. However, Figure 6 (1867 estate survey map), shows both shafts although it appears to have been added to the plan by hand at a much later date (c1880s). Unfortunately the abandoned mine plans for this mine are all undated (although the date of copying the original mine plans by the Mines Inspectorate was 1895, when Russell United Mine closed).

The Bedford Estates 1868 Report on the Mines (T1258M E 44a-b) by Gilson Martin (dated 31st Dec), showed that the mine's lease (dated 7/5/1858) from the Duke of Bedford ran for 21 years, 9970 shares having been issued (there was an earlier lease dated from Ladyday 1846). The current lessees were John Bayly and Josh Matthews. The area of the sett was described as 434 acres, 162 of which was woodland but '*the remainder in arable and pasture, the quay, cottages and other premises at Morwellham are also in it'*. Production returns start in 1852 when 181 tons of copper ore were sold for £763.40. The peak production years were from 1871 to 1876 when nearly over 1000 tons of copper ore per annum was sold for £2000 - £4000. By 1868 the mine employed 18 men/boys and 2 women/girls. Two shafts were being used, four shafts abandoned (but protected), and two cottages rented from the Bedford Estate. 1/15th dues were paid to the Duke and 3,267 tons of ore had been sold. The value of the copper ore was nearly £12,798. £25,729 capital had been expended, which also formed the mine's net loss. *'This company was formed in 1842 and Mr Baylys' interest has preponderated over everyone else to the detriment of the shareholders generally as well as the Duke. The company has spent upwards of £25,000 in addition to their receipts from ores amounting to £12,798 but has never made any dividend. The mine is drained and worked by three waterwheels. The ores at present are conveyed by boat to Morwellham Quays, but should the company work the hill, they could then be conveyed by the Devon Great Consols railway. There is not much harm doing at present by the discharge of mineral water but should the Impham or any other lode upon which the company may work turn out*

profitably, pits for the purifying of the water would have to be made. Mr Paul says that 'The present workings are confined to a drivage on the Impham Lode. I have recently urged them to do more upon this lode and Mr Bayly is the sole impediment to their doing so…The chief mining setts are in the midst of very fine scenery adjoining the River Tamar which of course is much defaced by them although everything is done to make the surface works as sightly as possible and also that they should not be extended further than can be avoided, still to look at these mining operations as a lover of the beautiful only it would I think, seem a great pity that such a strikingly picturesque district as that of Morwell Rocks and its vicinity should have been in any way disturbed when nature had done so much for it – in a commercial point of view there can be no doubt but that the Duke's mines have proved to be a most complete success and fortunately the richest deposits of ores have been found where the surface land is very poor and commanding but a small rent for agricultural purposes' (Report on Mines from the Bedford Estate Collection (excerpts) DRO Ref: T1258M E44a-b), Gilson Martin, Bedford Estates Office, Tavistock, 31 December 1868.

'In 1870 the mine was 60 fathoms deep and employed thirty people'. From 1852 to 1860, the mine sold 2456 tons of copper ore for £11158 (Collins 1912, 573).

The peak copper ore production of this mine company was during the mid 1870s. One must assume that the easily 'winnable' shallow surface copper ore had been removed over a century before, and the miners by the late 1870s were concentrating on seeking new lodes rather than continuing old drives, that had already become exhausted. By 1880 **Wheal Russell Mine**, having worked for nearly half a century, was taken over by another company; this was often a method of gaining a fresh supply of finance to continue operations, especially when the original lodes had been worked out.

3.2.4 Russell United Mining Co. Ltd (1881 – 1890)

This new company was registered in July 1881 to take over and work the leases/setts formerly held by the old Wheal Russell cost book company, and included the already closed **East Wheal Russell Mine** and sett (see Figs 5 and 7), for a cost of £900. The mine continued operations in 1881 at the 97 fathom (bottom) level. A year later a 'fine' lode was discovered east of Matthews Shaft (Buck 2005, Site 8, SX 44002 71156). It appears the main working levels from East Wheal Russell were being extended westwards to meet those of Wheal Russell from the east, especially the deep adit level (see Fig 9).

Stephens Engine Shaft was being sunk (deeper) in 1883 in blue killas with branches of mundic. It is quite possible that Hamilton's Shaft was sunk during this mine company's tenure; however it is not certain how the winding shaft was powered - perhaps by flat rod similar to Stephen's Shaft. Alternatively in its later years (post 1884), it is possible that the steam winding engine was constructed (Site 5), although, from documentary evidence it appears that this was during the next mine company's operation. Either way, the spoil heap from Stephen's Shaft was oriented towards Hamilton's Shaft (compare Figs 7 and 10), indicating that the waste ore from working the deep lodes was being brought to surface from Hamilton's Shaft, and deposited next to the shaft, using a surface tramline to form a linear shaped waste rock heap (Site 2).

Figure 7, the 1884 OS map shows Stephens Shaft (surrounded by an enclosed small waste heap – presumably soon after the shaft had been sunk), two small buildings (Site 7), and a leat emanating from the shaft westwards to a small rectangular reservoir pond (Site 8). This pond appears to have fed in turn, Morwell House 'pond' (or water feature – SX 44632 70737) which appears to have been built between 1848 and 1867, to perhaps supply water to a garden feature and to reservoir ponds to the south above Morwellham.

Confusingly, Figure 6 (an 1867 estate survey map) shows both shafts, but the later 1884 OS map (Fig 7) only shows Stephens Shaft (perhaps an early First Edition map). MRO Plan 3260 (Sheet 4/4) also uses an 1884 OS map base (surveyed 1882) to record the Wheal Russell Main

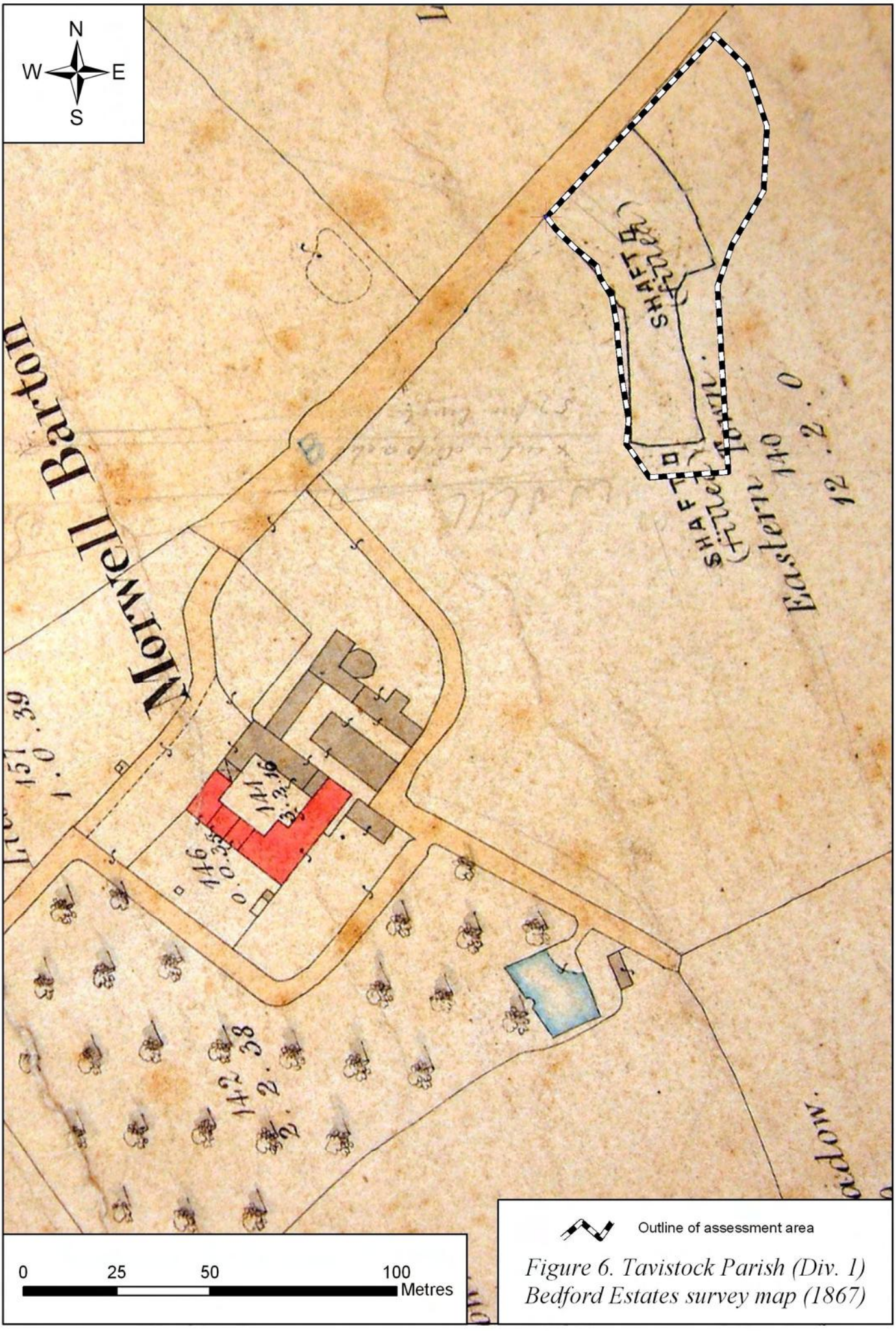

Figure 6. Tavistock Parish (Div. 1) Bedford Estates survey map (1867)

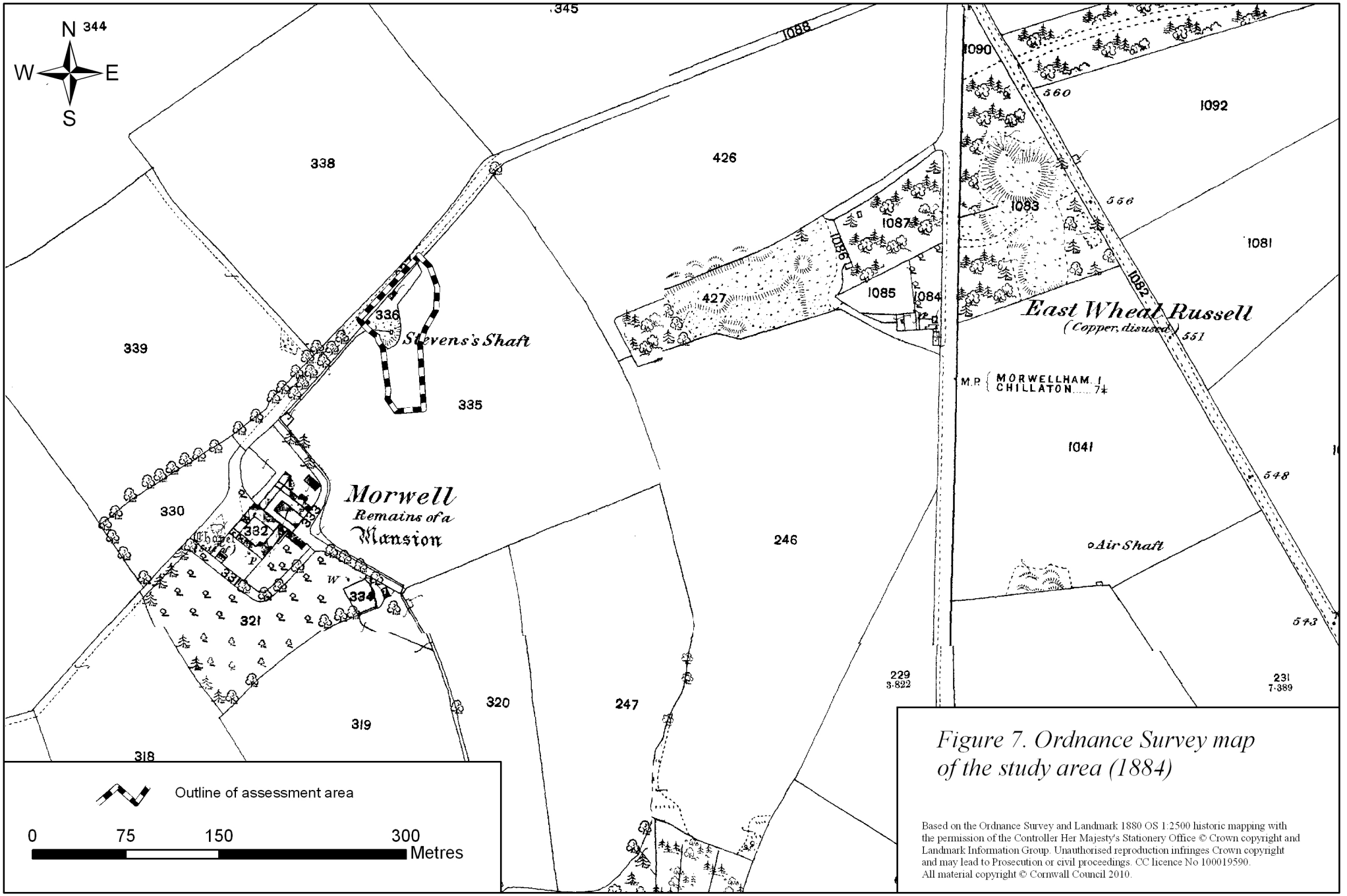

Figure 7. Ordnance Survey map of the study area (1884)

Adit Level, but shows the two shaft sites as being the same as Figs 6, 8 and 10. It also appears that both the Steven's and Hamilton's shaft sites (as shown on Fig 6), have been drawn onto the survey plan, so it post-dates the original 1867 estates survey map.

More funds were raised in 1885 to continue the mining operations and to also produce tin ore (in small quantities), which had been found at depth. In 1889 meetings agreed to reconstruct the company again, as **Russell Mines Co. Ltd**, the final company meeting being held in January 1890 (Brookes 1986, Russell Utd. Mining Co. Ltd).

'(East Wheal Russell) *was worked between the years 1853 and 1869 for copper of which a fair tonnage was raised. On the whole the workings were not a great success, however about 1890, the Western part of the sett was worked for tin ore, but the only information is rather vague. It appears, however, that a new Western Shaft, Stephens Shaft, was sunk and connected with a Deep Adit driven into the hillside under Morwell Rocks…..The plan of the East Russell workings does not show Stephen's Shaft, but it shows the 88 fathom level driven west from Hitchens Shaft a distance of about 500 feet, which would bring it within about100 feet of Stephens Shaft. It is quite possible, therefore, that the workings from Stephens Shaft connected with the old workings and drained them to the level of Deep Adit. The tin ore developed and mined, in this western section, was trammed out along the deep adit and dressed in a small plant south of Impham… During the years 1890-1896 the price of tin fell steadily from £100 to £60, the lowest price for a great number of years. From 1896 to 1900 it rose to £180 per ton. This steady decline in price during the years that this western section was being worked probably had a great deal to do with the abandonment of the enterprise'* (Barclay Toll reports in Stewart 2003, 51).

3.2.5 Russell Mines Co. Ltd (1889 – 1892)

This company was formed as a reconstruction of the former company and registered in September 1889. A new shaft was started in the end of the following month (site unknown), the new promoters having put £7000 into the concern. *'At a meeting held in July 1891, it was stated that work completed by this date included laying a tramway in the adit and equipping Hamilton's Shaft'* (Brookes 1986). In 1890 30 men were employed underground and 17 at surface (Burt, Waite, Burnley 1984, 97). A special meeting held in August 1891 resolved to wind up the company and reconstruct it as **Russell Mines Ltd**, the final meeting being held in May 1892 (Brookes 1986, Russell Mines Co. Ltd). In 1891, the final year of copper production realised only 8 tons, a value of £30, whereas twenty years previously it had produced over 1000 tons, a value of over £4300 (Burt, Waite, Burnley 1984, 96).

It is during this company's operation therefore that one could assume that the winding engine and boiler house was built. The Morwell Farm lease map is dated to 1891 (Fig 8), and is the earliest (and only) map which shows the correct plan of the engine and boiler house, which is oriented to wind from Hamilton's Shaft. It is assumed during this period that deepening development work had been undertaken at Hamilton's Shaft, as well as creating a new connection to the earlier constructed deep adit drain, and laying of a tramway to take the ore for dressing westwards to the old Wheal Russell dressing floor. The steam engine would have wound the waste ore up Hamilton's Shaft to deposit it on the adjacent waste mound (Site 2).

3.2.6 Russell Mines Ltd (1891 – 1896)

This company was formed as a reconstruction of the former company and registered in August 1891. A meeting held in March 1892 was told that more capital was needed to improve the mine. *'There was no tin to value in the 92 fm. level, and nothing of value below the 80, nor in cross-cuts to the south lodes at the 92 and 117 fm. levels. The junction of two lodes had been expected at 25 fms. below the 80 at Hamilton's Shaft, but it had not been found and the lodes were still 3 fms. apart. Cash in hand was only £6.18s.6d'*. A subsequent meeting put the company in voluntary liquidation in July 1893. The final company meeting was registered in April 1896 (Brookes

1986, Russell Mines Ltd).

The Tamar Journal (1982, Vol 4, 40), reproduces a letter from GA Rowe of Victoria B.C, Canada, commenting on a gravestone in Calstock churchyard *'The stone records the death of William George who drowned at Weir head in 1893. George was the captain of Russell United Mine at the time of his death and he had been captain for some four years. The stone shows some of the topography associated with the Russell Sett and prominently shown is the large waterwheel'*.

A sale notice in the West Briton dated 26/4/1894 states, *'24 inch winding engine, steam capstan, air compressing equipment etc 'all broken up ready for immediate removal', close to a quay on the Tamar. Tavistock station within 10 miles …' (pers comm*. Ken Brown). It is assumed that this was the steam winding engine (Site 5) that wound from Hamilton's Shaft.

Figure 9, a reproduction of an abandoned mine plan (MRO 3260 Plan 1 of 4 copy tracing) is dated to April 1895, when the mine had closed and sent its mine plans to the Mines Inspectorate for copying (a statutory requirement). This shows the mine in section and plan at its final stage of development. The upper section of the plan shows the location of the water wheel on the sides of the River Tamar (Buck 2005, Site 16, SX 43770 70846) which powered a long series of flat rods up the sides of the River Tamar valley, and along the enclosed fields to Stephens Shaft. This would have provided the power to pump water up to adit (or surface) level. The adit is also shown in plan and section at 57 fm. level, which was used to tram out (for a long distance), the ores for dressing at the older Wheal Russell Mine site. Only 3 people were employed in its final year of 1893 (Burt, Waite, Burnley 1984, 97).

By the time the mine had ceased to operate, it had produced 11 tons of black tin, 11,400 tons of 5½% copper ore and 10 tons of mispickel (1891) between 1852 and 1891 (Geology of Tavistock and Launceston 1911, 117). The 1901 Report on Mines and Quarries by the Estate Manager (J. Paull - dated 31st Dec.) states *'Wheal Russell is abandoned – a shaft shrinkage has been filled up*'. (1901 Report on Mines and Quarries).

Figure 10, the 1904 OS map only shows the site of Steven's Shaft (apparently fenced) and its surrounding embanked spoil mound. Hamilton's Shaft is not shown, and most of the winding engine house is also not shown, although the attached boiler house can be seen as roofed. Figure 11, the 1946 AP shows the site as being similar to the later 2005 aerial photo, but a little less covered with trees. The 2005 aerial photo (Fig 12), shows the heavily wooded site, and the form and extent of the new farm buildings to the south west.

4 Site description

4.1 Location and setting

The study area is tightly defined in Fig 1, but includes the former Russell United Mine surface workings (1880s to 1890s). The site is set in the western side of a field located to the north east of Morwell House. The intervening space between the house and the mine site (shown on Fig 7), has been occupied in the 20th century by modern farm buildings (large barns), which are rented by the landowner (Mr and Mrs Hoskins of Morwell House), to a farmer. The former core of Wheal Russell Mine is to the west of the site near the River Tamar.

The general topography of this small site is trending to slope gently from north to south and to the south east. The landscape was predominantly open downland (Morwell Down), reclaimed soon after 1828 (following an enclosure Act of Parliament). It now is characterised by large fields enclosed by stone hedges. The fields are bound to the west by woodland, in the past mixed deciduous, but now predominantly conifer, part of the Tavistock Woodlands Estate. However, the area is also characterised by central spines of woodland, oriented east-west,

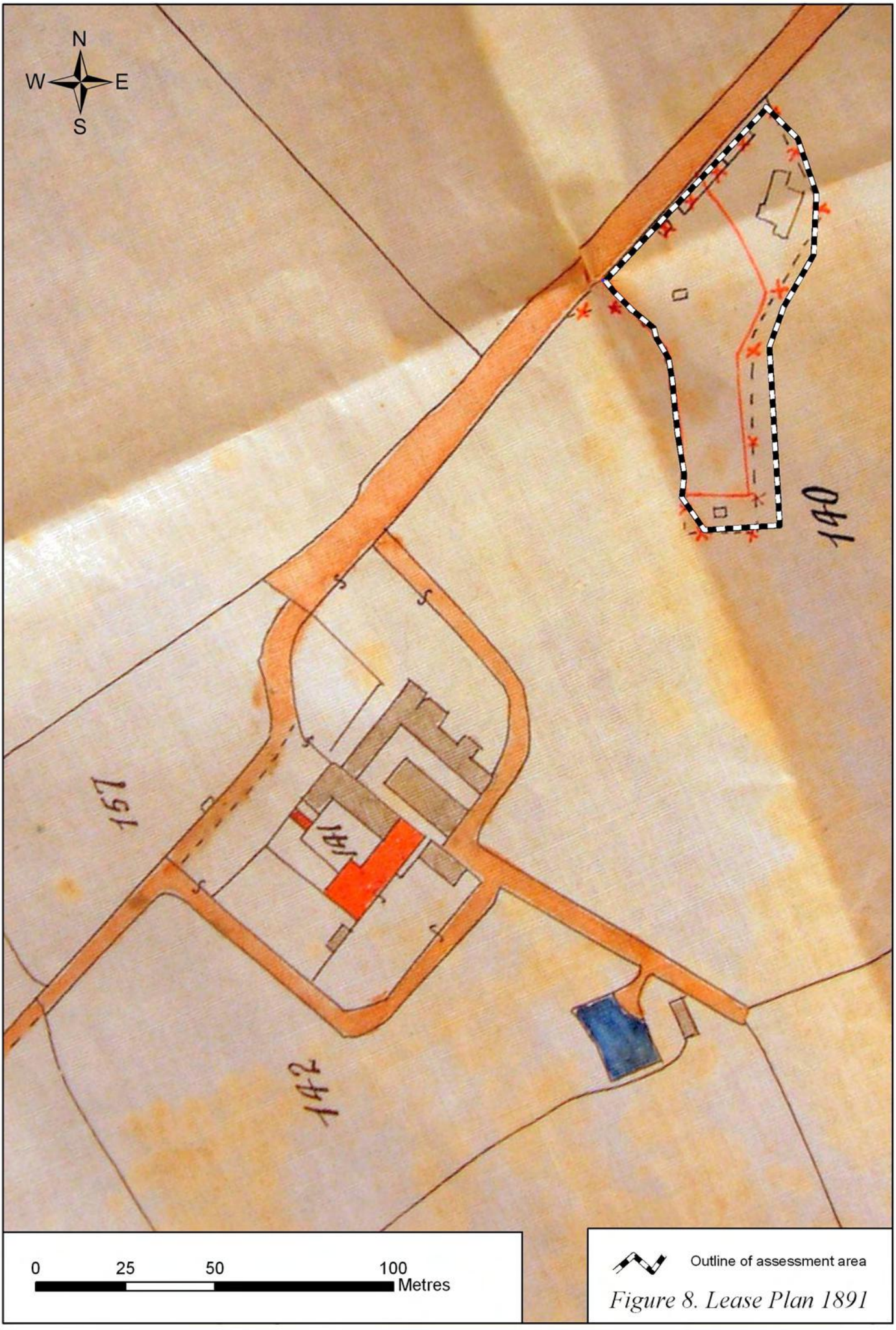

Figure 8. Lease Plan 1891

Sheet No. 1 of 4 Sheets

RUSSELL UNITED MINES

ADIT

ADIT

STEPHENS SHAFT

HAMILTONS SHAFT

LONGITUDINAL SECTION

BARRATTS SHAFT

STEPHENS SHAFT

ADIT

SCALE

F1 OF 2

Figure 9 Abandonment Mine Plan of Russell United Mine (copy dated 1895) DRO 3260 Plan 1 of 4

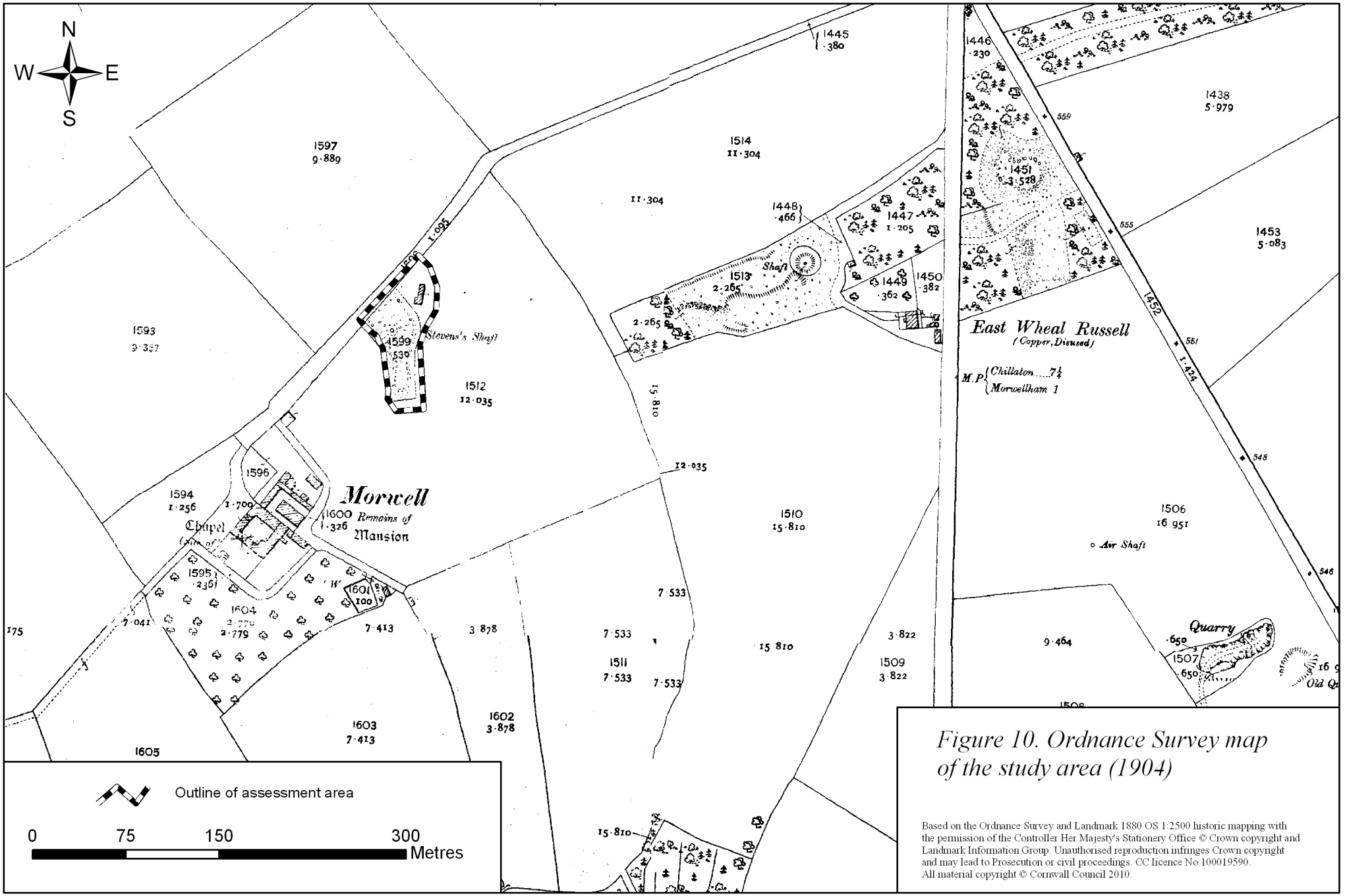

Figure 10. Ordnance Survey map of the study area (1904)

which, in the 19th (and possibly late 18th century), contained openworks, exploiting the surface copper lodes that traversed the West Devon landscape eastwards from the steep sides of the Tamar Valley.

Since final abandonment in the late 19th century, the Stephens Shaft site (eastern end of Main Lode) mine building remnants have become generally overgrown with smaller buildings and structures either decayed, robbed or over dumped by the later re-working. Surviving building components within the Stephens Shaft project area include remnants of a steam winding engine and attached boiler house (Site 5) - possibly a water wheel (not visible-Site 6), two mine shafts (both infilled – but visible-Sites 2 and 4), and an enclosed mine spoil heap (Stephen's Shaft – Site 2).

This report essentially focuses on (and brings to a higher prominence), the important historical heritage that can still be found over a century after these related industries and mines folded, a result of which has been the nearby inclusion (to the west) of Wheal Russell Mine in the World Heritage Site for the Cornwall and West Devon mining landscape (Area 10).

4.2 Statutory Designations

4.2.1 Statutory

The entire project area and to the north and south of the site is within the Tamar Valley Area of Outstanding Natural Beauty (AONB). The access road to the site (and Morwell House) is a Public Right of Way.

4.2.2 Non – statutory

The project area site is not within the World Heritage Site but it is still an important (related underground) component (see Section 4.3.6 of the WHS Management Plan). The core mine's remains were based to the west in the Tamar Valley, within the World Heritage Site. The mine building (Site 5) is not Listed.

The Cornish Mining World Heritage Site (WHS) seeks to demonstrate the international importance of the developments within mining and allied technologies which took place within Cornwall and West Devon during the last half of the 18th century and into the 19th century, establishing beyond doubt the contribution of this region to the development of the modern, industrialised world.

The World Heritage Site Management Plan 2005-2010 (2005, 12), statement of Outstanding Universal Value states that: '*The Cornwall and West Devon Mining Landscape was transformed during the period 1700-1914 by early industrial development that made a key contribution to the evolution of an industrialised economy and society in the United Kingdom, and throughout the world. Its outstanding survival, in a coherent series of highly distinctive cultural landscapes, is testimony to this achievement'*.

The WHS areas, representative of the period of Cornish dominance of the mining world (c.1700-1860), excludes the project site within the Tamar Valley Area and Tavistock (Area 10). World Heritage Site status will increase the likelihood of a further round of statutory designations of mining related sites (i.e. mine sites with significant buildings, harbours, foundries, mine settlements etc).

4.3 Landscape characterisation

In 2005, Devon was systematically assessed by Historic Landscape Characterisation (HLC) in which each parcel was assigned to one of a number of HLC Zones according to its predominant historic landscape character. The landscape characterisation within the project

area has been assessed from two historic landscape periods criteria; firstly the post medieval landscape, secondly the modern landscape, with a single landscape zone type for each. The post medieval landscape zone for the project area consists of 'post medieval enclosures with medieval elements'. To the south west, part of Morwell House and an adjacent field has been zoned as 'orchard', whilst to the east the site of East Wheal Russell has been zoned as 'Mining'. The woodland to the west has been zoned as either 'Ancient Woodland' or 'Conifer'. The modern landscape zone for the project area consists of 'post medieval farmland'. To the south west, part of Morwell House and an adjacent field has been zoned as 'Woodland', whilst to the east the site of East Wheal Russell has been zoned as 'Plantation and scrub'. The woodland to the west has been zoned as either 'Ancient Woodland' or 'Woodland'.

Although predominantly now an agricultural and wooded sloping landscape, the industrial archaeological remains of earlier 18th century openworks, and 19th century deeper lode mining at Stephens Shaft, East Wheal Russell and (further to the west) Wheal Russell, all demonstrate the landscape effect these 19th century mines had on the landscape and nearby communities.

4.4 Archaeological summary

4.4.1 Thematic outline of archaeological resource

The principal surviving site in the project area is the late 19th century mine engine house and attached boiler house (Site 5). The walling of the boiler house is substantially intact, probably because it was re-used as an agricultural building in the 20th century. Of the engine house itself, little more than just the substantial western wall survives, but there is enough to see its general structure and arrangement.

The engine house housed a winding engine to raise ore from Hamilton's Shaft (Site 4); the position of the shaft is known but there are no visible remains. The mine dump (Site 3) is extant, and retained by a revetment wall. It is planted with trees, presumably as part of the ornamental approach to Morwell House; this helps to emphasise the mound as a landscape feature.

Located within the mound of mine waste is Stephen's Shaft (Site 2) which was used to pump this part of the mine. The pump was worked by flat rods (Site 1), driven by a water wheel beside the Tamar. Neither Stephen's Shaft nor the site of the flat rods is now visible.

Other small buildings (Site 7) shown on late 19th century mapping are also no longer extant.

4.4.2 Devon Historic Environment Record sites

These sites are within (bolded) the study area, others are relatively close to have been identified from the Devon Historic Environment Record:

- **Engine House (62831)**
- Morwell Barton (Listed Grade 1) (3884)
- Morwell Manor House (3885)
- Possible medieval Chapel site (3860)
- Possible site of Dovecote (30109)
- East Wheal Russell Mine/Russell Mine (22887)
- Russell Mine (4040)

Fig 11 1946 Aerial photograph of the Stephens Shaft site (4142 46-44)

Fig 12 2005 Aerial photograph of South Hooe Mine (CC 2005 24400700)

4.5 Site significance

This section essentially summarises the local, regional and national significance of Russell United Mine. It also examines the wider context of the study area as part of a medieval settlement (Morwell Barton) with attached woodlands owned by Tavistock Abbey (which from the late 18th century onwards changed to more of an industrial use).

Russell United Mine is one of a number of mine sites on the West Devon side of the Tamar Valley that contains evidence for 18th century mining, both documentary and physical extant remains, as evidenced by open adits and lode back openworks. It is quite rare to find so many examples of the early years of copper mining, the steep slopes of the valley and dense woodland having preserved these features. As a result, these are of national importance.

The primary site of Wheal Russell demonstrates to a very good degree the overall survival of a coherent 19th century water powered mining complex and its range of related site components. All of its main waterwheel pits are infilled as are many of its shafts, no doubt due to the efficiency of the 19th century Duke of Bedford's Estates department. Many of the main mine buildings are still extant (but roofless), and other ground level features (the dressing floor for example) are simply covered with years of vegetation and some earth build up. Again, from this respect the site is important in a national context.

As with all of the mines in the Tamar Valley, this mine has excellent examples of the use of 19th century engineering skills to provide water (via long leats), for use at a number of locations and for a number of reasons (i.e. to power water wheels which in turn powered flat rods up and down the valley to wind up ore and to pump water from the deep workings and to supply large amounts of water to the main dressing floor).

Russell United Mine focussed on connecting the underground workings of East Wheal Russell with Wheal Russell (to the west), utilising a deep adit to remove the tin/copper ore, and dress it in the old dressing floors of Wheal Russell. The Stephens Shaft engine house (Site 5), is possibly the latest engine house to be erected (1891) in the Tamar Valley, at a time when many of the other adjacent mines had closed. The boiler house is possibly the most extant example in the Tamar Valley.

In terms of the wider context of the study area and its historic land use, Morwell Woods, a major part of the project area, is historically associated with Morwell Barton Manor, a medieval ecclesiastical settlement owned by Tavistock Abbey. Morwellham Quay was this medieval settlement's link to the river (always a major trading/industrial thoroughfare) and was a Tavistock borough and Abbey port from the 12th century, busy not only importing products, but exporting metallic ores, at different times throughout its existence. The dissolution of 1539 saw the former abbey lands transferred to the ownership of the Russell (Duke of Bedford) family and in the early 1960's to the Earl of Bradford, the existing owners. There is some evidence for woodland management in terms of hedge boundaries and of course numerous charcoal platforms along the steep valley sides. The field pattern around Morwell Barton and the enclosure of Morwell Down to the east and south east after 1828 (see Fig 2), can be seen to be part of a broader picture of agricultural (and industrial) expansion from the early 19th centuries.

Statements of Significance

Within the setting of the site, its origins directly related to the World Heritage Site to the west, the Stephens Shaft building and shafts retains coherent remains and the character of an unusually late 19th century tin/copper mining enterprise.

5 Management Recommendations

5.1 General Recommendations

The following management recommendations form a broad range of summary impact assessments, building conservation guidelines, site management and maintenance guidelines, WHS management policies, archaeological potential and recommendations for further archaeological interventions, all of which should be taken into account during the project implementation stage.

5.1.1 Site impact assessment:

This report identifies and informs the client of the significant site assets and site constraints. A separate provisional impact assessment is produced for each site within the Site Inventory (Section 7.0), to inform the project developer and any other statutory (DEFRA), and non-statutory agencies, of the impact of the site proposals on the identified site assets. Revised impact assessment variations will be produced if the final site proposals differ from those described in this report.

Future uses/threats/issues

- The mine buildings near Stephen's Shaft are not thought to be proposed by EH to be Scheduled nor Listed in the near future.
- The landowner has intimated that there are no plans to re-use or adapt any of the former buildings described in this report.
- Minimal vegetation clearance (ivy/brambles) and building conservation works to Site 5 (Engine/boiler house) would minimise further structural deterioration and preserve the sites for future generations.
- Minimal selective tree clearance from the dry stone retaining wall surrounding Stephen's Shaft (Site 2 - where tree roots are actively causing localised wall instability), would minimise further structural deterioration and preserve the site for future generations.
- Site monitoring by the landowner would minimise long term damage to the sites by the site management of cutting vegetation growth, repairing weathered lime mortar and wear to the site by occasional animal/human access.
- Pre-arranged public access through guided walks and educational school site visits should not result in an additional threat to any of the sites, given their low perceived frequency and guided (informed) nature of their visits. It is expected that vehicular access to any of the sites would be prohibited (except by the landowner and during the site works).
- Prior to the start of conservation works, a site should be located for the contractor's vehicular access, site accommodation and a mortar mixing location (as agreed by Mr and Mrs Hoskins), preferably near Site 5, the boiler/engine house.
- Consultation between the project developer and the relevant agencies should form a cohesive overall site project and conservation plan that not only conserves and protects the main significant site assets, but promotes these in a positive way to ensure safe, informative and pre-arranged educational public access.
- The current condition of the single extant building is described in the Site Inventory (Section 6.3). However, if building conservation works are not soon carried out the structural deterioration of the buildings (Site 5), may well mean that parts of the building will collapse in the near future.

5.1.2 Guiding principles of building conservation works

Appendix 10.1 reproduces a 'Mine landscape and buildings conservation philosophy' which includes general building conservation specifications and an appropriate mitigation strategy to reduce the effect of any impacts. It is recommended that the following guiding principles for the Stephen's Shaft building conservation project should be adhered to:

- The building conservation philosophy is based on respecting the character of each significant feature and its contextual relationship. The long term conservation and preservation of the built and standing archaeology should reflect its individuality, character and construction. The methodology of using traditional lime based mortar and timber structural components is intended to replicate its original construction technique; however the end product is intended not to monumentalise the site but to conserve, protect and give the appearance of an old but safe structure. The building conservation text reproduced in the Appendix (10.1) is intended to describe in more detail the appropriate philosophy underlying building conservation works to enable safe public access and appropriate site interpretation.
- Contractors for the building conservation works should be experienced in the use of traditional materials and lime mortar techniques and specifications for use.
- An essential component of the mitigation strategy is the employment of an historic environment consultant who should ensure that English Heritage principles of conservation practice are adhered to both in terms of the design of appropriate schemes, to ensure that consolidation works are carried out to acceptable (EH) standards, to ensure close liaison between statutory agencies, and to record any changes to the historic fabric. In addition it is important that the nature, extent and development of the site conservation works should be guided by the relevant short and long term management plan policies (statutory, archaeological, conservation and WHS etc), which are an important part of any mitigation strategy of the site. A more detailed explanatory text relating to this mitigation strategy is produced in the Appendix (Section 10.2).

5.1.3 Building consolidation

Specifications for all works should be agreed by the Devon County Historic Environment Service (Agri-Advice team). These should be in line with the principles of good conservation practise set out in *'A Guide to Conserving Historic Mine Buildings in Cornwall'* (Sharpe, Johnson and Lewis 1996), English Heritage general principles and guidelines (Ashurst 1989, Bereton 1991), and the WHS Management Plan policies.

- Consolidation of the engine/boiler house structure is considered an urgent priority, if further collapse of lintels is to be avoided on the basis of its historical importance, significance and condition.
- A measured sketch building survey (EH Level 2) will be undertaken by the tendered Structural Engineer. This will provide a detailed record of condition prior to any structural consolidation works and will provide information (i.e. dimensions and building type/materials) for building conservation recommendations, and details for the building contractors whilst undertaking structural repairs etc.

5.1.4 Future site management and maintenance requirements

This varies according to each site, and has been described for each feature in the Site Inventory (Section 6.0). However, these broadly fall into specific categories depending on the size, nature and extent of each site:

- Masonry wall remnants that have been consolidated by repointing and wall capping (ie rebedding the top two masonry courses and lime mortar pointing to achieve run-off), will need little maintenance, although annual/bi-annual vegetation/weed growth checks and removal will be necessary. If abundant weeds or ash for example are affecting the feature, stump killer may need to be used.
- Masonry conservation sites which are prone to extremes of weather may need surface re-pointing at a greater incidence than slight patching (for wall capping) once every decade, for example, the exposed pumping engine house upper walls. This site will need to be checked every five years for increased weathering of mortar joints, particularly at the more exposed west side.
- The existing Environmental Stewardship scheme is recommended to offset any management costs of the long-term impact of preserving archaeological features.

5.1.5 Possible further work

- Vegetation and minimal tree clearance from the revetment walls surrounding Stephen's Shaft could be used to safeguard the walls from further deterioration and to enhance the character of the surviving remains.
- Archaeological monitoring and recording may be needed during any geotechnical works (fencing safety works etc), in addition to archaeological recording and historic buildings consultancy.
- Thought should be given to the improvement of visual access through the provision of a visibility splay in/on the existing hedge line close to Site 5, and perhaps foot access by the provision of pre-arranged guided trips (at the discretion of the landowner): possibly including a limited number of guided walks and educational visits from schools. This is an important focus of the NE scheme (see Section 2.1).
- The inclusion of all sites in published material (TVAONB guidebooks/leaflets-histories/web sites etc) is recommended. These should include detailed maps derived from research and surveys.
- A research agenda could include the aim of answering key questions on aspects of the site history and its relationship underground with the former workings of East Wheal Russell.
- The DEFRA NE Project has not commissioned a Conservation Management Plan to combine the main summary reports of the ecological, geotechnical/structural and archaeological assets, following their respective site surveys and propose ongoing conservation of these significant assets. Therefore a long-term conservation management plan for the surviving archaeological remains is recommended.

5.1.6 Site interpretation themes

The provision of site interpretation via an appropriate medium is an important aspect of enabling the history and character of the area to be communicated. The following points represent key historical themes of the landscape:

Industrial archaeological background

- Use of the woods in the wider rural context as part of a medieval ecclesiastical settlement.
- Changes in land use (extending from the steep sides of the River Tamar eastwards across the former Morwell Downs), as mineral lodes were discovered and then exploited during the early years of the 18th century through adits and lode back working.

- First signs of industrialisation as copper mining operations (Impham Valley) were financed by industrial entrepreneurs in the 18th century, using water power for mineral dressing, pumping and smelting.
- The export of mineral ores through riverside quay sites (Morwellham, Impham Quay etc) to other parts of the country as part of a well organised industrial operation.
- Early 19th century industrial technology and innovation was utilised to create the Tavistock Canal and tunnel with a water powered Incline tramway down to Morwellham.
- The resurgence in the mid 19th century of copper mining following increases of the world copper price and the success of other mines in Cornwall and West Devon.
- Advances in pumping technology ensured the century old workings were re-visited, extended and deepened. However, for Wheal Russell the same water power techniques were still used.
- The decline of mines in the area prior to the turn of the 20th century as the copper lodes were worked out and world market prices fell.
- The finding (unusually late in the 1880s), of small amounts of tin and copper between the former setts of East Wheal Russell and Wheal Russel Mines gained additional finance, resulting in the construction of a steam winding engine to wind ore waste via Hamilton's Shaft, whilst Stephen's Shaft pumped the workings via flat rods from a large water wheel near the River Tamar.
- Consequential decline in employment in the entire Tamar Valley, as all related primary and secondary mining industries failed.
- General population movement out of the district to seek employment.

The key element for interpretation at the Stephen's Shaft site is its character as presenting the surface remains of a relatively small and unsuccessful late 19th century tin/copper mine. The key site which could be integrated into a scheme of public access is the engine/boiler house building (Site 5), which is proposed for building conservation, and will be viewed from the adjacent public footpath by the public, with occasional pre-arranged guided tours.

The approach to site management and conservation works to present and interpret the site needs to take into account two potentially contradictory elements:

- Retaining the sense of an abandoned site, returning to 'nature' (reflecting the demise of the particular socio-economic context which led to its development), but within the setting of a working farm.
- Ensuring that appropriate sites, areas and views are sufficiently open (and conserved) to enable the complex overall and key components within it to be safely accessible and understandable. The removal and management of obscuring trees and dense vegetation will be an important part of this philosophy.
- Site information could be produced and possibly the creation of historical informative web sites and related leaflets with detailed booklets could be part of an Interpretation Strategy as part of a Conservation Management Plan.

5.2 Individual structures or site components

An historical background analysis, condition survey, significance rating, conservation recommendations and impact assessment for individual buildings, earthworks, and structures is described in the site inventory (Section 6.0) and summarised in Section 7.0. Appropriate conservation strategies for shafts and other mining features are detailed below.

5.3 Planning Policies

World Heritage Site Strategic Policies

The WHS policies given below are relevant excerpts relating to the proposed site development from the WHS Management Plan 2005-2010.

Issue 7 Sustainable development

Policy 7a: Sustainable heritage-led regeneration should be promoted.

Policy 7c: There should be a presumption in favour of retaining and re-using historic buildings which are important components of the World Heritage Site

Policy 7e: Landscape, nature conservation and agri-environment management regimes should have regard for the authenticity and values of the site.

Issue 8 Conservation of key components

Policy 8a: The conservation and continuing maintenance of the historic fabric of the site should be undertaken to the highest standards to ensure authenticity and integrity.

Policy 8b: The historic character and distinctiveness of the Cornwall and West Devon mining landscape should be maintained.

Policy 8c: Traditional materials and skills should be encouraged in the maintenance of the authentic historic fabric within the site.

Issue 10 Sustainable physical access

Policy 10: The partnership should promote access to the site that is sustainable to the environment and consistent to the values of the site.

Issue 11 Increasing intellectual access

Policy 11a: The site should be interpreted and presented as a distinctive, evolving, living landscape.

Policy 11c: The values and significance of the site should be communicated to a wide range of educational audiences.

5.4 Safety works to shafts and other mine openings

5.4.1 Policy in relation to safety works to mine openings (WHS)

- Generic World Heritage Site Management Plan Policies and site specific Conservation Management Plans have been produced as a guide for all works effecting the historic components of mine sites.
- Mine shafts, outcrop workings, prospecting features, adits, and openworks are important archaeological sites and monuments.
- Shafts often have key mine components located adjacent, near or within their mouths. These components may be buried and invisible at surface today.
- Shaft capping or plugging should only be carried out where there is a direct threat to the safety of the public that cannot be addressed by other means, or where the stability of historic structures is at risk.
- Engineers should always take the known archaeological significance of sites into account when designing shaft safety treatment programmes.

- Non-intrusive methods of excluding the public from mine shafts should be used wherever historically significant sites are involved.
- Planning Policy Guidance Note 16 (PPG 16) should form a model for the involvement of archaeological constraint in the process of land reclamation or shaft safety works.

All measures taken to ensure public safety (fencing, hedging, grilling, or capping) will result in some measure of disturbance to the shaft head and its surroundings, but plugging, capping and backfilling are obviously the most destructive. In circumstances where plugging or capping are considered to be the only options on the grounds of public safety, particular care must be taken to minimise damage to nearby archaeological features and to ensure an adequate record of features destroyed or damaged during such works is made through the commissioning of an archaeological watching brief during works.

Summary

- Treatment of mine shafts must be sympathetic to the archaeology and appearance of the landscape.
- There should be avoidance, where possible, of capping/plugging – this is archaeologically destructive and difficult to reverse.
- The use of protective fencing is more in character with the landscape and is a traditional technique for this site.
- Consultation with the Cornwall Underground Access Advisory Group should take place before previously open shafts are proposed to be sealed or permanently fenced.

5.5 Archaeological Potential below Ground

Contingency funding should be made available as part of any proposed works to allow for an appropriate level of archaeological recording if shallow mining features are revealed during the course of the works programme. However detailed consultations with the Devon County Archaeologist (HE Agri-Advice) should take place at every stage of the project where below ground archaeological features are likely to be affected.

5.6 Further Archaeological Work: Historic Buildings Consultancy and Recording

Provision should be made for a suitably qualified archaeologist to be present to record (and if necessary survey), the archaeological features of the site affected by the building conservation works in line with the general and specific recommendations contained within this report. A copy of the archaeological record produced during such a Historic Buildings consultancy and archaeological recording should be deposited in Devon's Historic Environment Record.

An archaeological recording and historic buildings consultancy during all of the site works may be able to minimise any further below ground site impacts, but also record any visible/disturbed archaeological features and to record the nature and extent of the building conservation works. A WSI (PD) for this necessary role (as advised by DCC HES (Agri-environment Advice), has already been produced (C Buck 9/2/10).

5.7 Statement of likely COSHH Hazards

The mines within this southern part of the Tamar Valley area are highly mineralised, and particularly in this area were amongst the 19th century's principal producers of tin, silver lead and fluorspar. Residues from the mining activity (especially upriver from Devon Great Consols but specifically from Ding Dong Adit and perhaps other smaller adits), have resulted in un-vegetated spoil tips and local soils which are highly contaminated with Arsenic (ranging from 120 to 52,600 μg/g), Arsenic and Tin. However, simultaneous exposure to the environment can also be from a number of other elements present in the mining waste at highly elevated levels, including copper, lead, zinc, antimony, molybdenum, tin, selenium and mercury. It appears that all of the mine waste (from both Stephen's and Hamilton's Shafts has been placed within the Stephen's Shaft waste mound retaining wall).

Note:

Although this report identifies some health and safety issues it is not intended as a health and safety assessment of the site or of individual features. The CC Historic Environment Service disclaims liability for Health and Safety issues arising from the use and management of the site.

6 Site Inventory

6.1 General comments:

- Refer to Figure 17 (Site Inventory map) to locate these sites within the project area.
- All identified structures and sites are located by a 10-figure grid reference. In most instances these relate to a point at the centre of the feature/structure. If the feature covers a large area, the NGR is an eight or six number grid reference. Linear features (flues etc), are given NGR at either end where possible.
- Management recommendations for each site have taken into account a combination of the proximity of public access (and consequently the need for a higher safety factor), and the short/long term preservation of archaeological features.
- A descriptive site significance rating, Low (**L**), Medium (**M**) and High (**H**), has been applied to every site inventory entry and in Section 7.1, the summary management table. The purpose of this is to help with the prioritisation of conservation works. The descriptive significance rating within the site includes the elements: feature condition, survival, complexity, context and rarity value. However, the final significance grading may also be skewed by a further comparative rating with other sites in the locality.
- As a general comment relevant to all sites, specifications for all building conservation work should be agreed with the Devon County HES (Agri-environment Advice) team. An Historic Buildings Consultant should be included in the project team, to advise on the works and undertake archaeological and building recording.

6.2 Site impact assessment

The impacts during work (and residual), of the building conservation works on Site 5 is described in the Site Inventory, followed by a final section which details the impact remediation measures. If the final site proposals differ from those described in this report, following the detailed structural report and specifications from the structural engineer, impact assessment variations will be separately produced.

It is usual practice that the schedule of works, site specifications, and structural assessment,

reproduces detailed internal and external elevations of the site's main significant assets, the single engine house, with annotated notes summarising the conservation works, using the survey plans of the building. A method statement will be produced by the site contractors to detail the procedures (and extent) of repointing the walls, capping the tops of walls with a lime based mortar, adding new timber lintels and ensuring the buildings remain in a sound structural condition. The style and extent of re-pointing (often slightly recessed from the masonry face), will mimic that of the original and will be decided when the test mortar panel is agreed by the site engineer and site historic buildings consultant.

6.3 Site Inventory

Site 1 Site of Flat rods SX 44581 70928 to 44656 70937

Background

The flat rods are shown in detail on Figure 9 (Undated Abandoned Mine Plan 3260 Plan 1 of 4). The plan is titled Russell United Mines so this dates the plan within the period 1881 – 1890; however this is a later plan than MRO 3260 Plan 2 of 4, which also shows the flat rods, but Hamilton's Shaft is not as deep as the shaft shown in Figure 9. The upper section of the plan shows the location of the water wheel on the sides of the River Tamar (Buck 2005, Site 16, SX 43770 70846) which powered a long series of flat rods up the sides of the River Tamar valley, and along the enclosed fields to Stephens Shaft. This would have provided the power to pump water up to adit level (57 fathoms), or surface level for the reservoir pond (Site 8) and beyond to the Morwellham reservoir ponds. The flat rods would have connected to an angle bob on the western side of Stephens Shaft (see Fig 9).

Survey

There is no evidence for the site of the flat rods as shown on Fig 9. The flat rods would have been mounted on a timber frame structure.

Significance

Low

This site has a Low significance rating, given the lack of upstanding remains.

Recommendation

Not applicable.

Site impact

There are unlikely to be any surviving archaeological features.

Site 2 Stephen's Shaft SX 44656 70938

Background

The 1867 lode map (Fig 5 named *'Engine Shaft'*), the 1867 survey map (Fig 6 *'Shaft filled'*) and the 1884 OS map (Fig 7 *'Steven's Shaft'*) all show and label a shaft. Dines (1956, 675) states, '*Great Lode has been opened up by an adit level driven into the valley side 290 yds. S. of Impham Shaft, and by two adjacent shafts, Steven's and Hamilton's, near Morwell Manor, 900 yds. to the east… 57 fm. Level to the vertical Steven's Shaft, where* (the adit) *ends.. Development is not extensive; there is a short drive at the 45 fm., and below the adit (57 fm. Level) the 67 fm. and 80 fm. levels extend 30 to 40 fms. W. The only stoping shown on the plan is a few small patches above adit*

just west of the shaft …'.

The latest abandoned mine plan of Russell United Mine (Undated MRO 3260 Plan 1 of 4 - a later plan than 2 of 4), shows the shaft to end below the 80 fm level by 1895 – the date of the Mines Inspectorate copy section drawing). The date of sinking the shaft is not certain, but it was under the operation of Wheal Russell Mine (1842 – 1881), and probably marks the eastern extension of working Great Lode, whilst forming the Deep Adit at the 57 fathom level, by the 1860s.

Survey

In 1922 the site was visited by Barclay and Toll *'Between the East or Mathews shaft and East Russell Mine, is a fair sized dump & shaft (sollared) which was at first thought to be part of East Russell, but is now believed to be Stephens Shaft of Russell Mine. A depression in the centre of the dump marks the position of the shaft, while just north of it is an old engine house now used as an old cart shed or cow house'* (Stewart 2003, 47).

The shaft is sited within a large overgrown and wooded dry stone revetted mine waste dump (Site 3). It is not visible, nor could be located at surface level. Its probable location is described above, and there is no sign of movement to indicate any instability. The shaft site is not visible from the adjacent public footpath road access to Morwell House.

Significance

High

This shaft is significant as the primary shaft site to pump the eastern (sett) end of Great Lode, before being further utilised for pumping as part of Russell United Mine's further underground development work. It therefore has a significance rating of High.

Recommendation

The mine and shaft site is likely to be viewed by members of the public who visit the site, as part of pre-arranged guided tours. It is unlikely that there will be funds for intrusive shaft capping works, however the shaft site can be easily accessed once entry is gained into the adjacent field to the east. It is recommended that the shaft site be fenced and a shaft warning sign erected.

Site impact

Given that the site impact will be new fencing, the overall impact of the proposed new fence posts can be defined as '*Negligible positive*'. The works will provide a safer site, in case the shaft fill collapses.

Residual impact

The main residual impact will be the short term visual impact of the new fence posts and fencing wire. It is not expected that an increase in site visitor numbers will affect the character of the feature.

Reduction of impact

The fence specification will be designed to have a low visual impact, but a high safety factor. A Historic Buildings Consultant, experienced in minimising these issues can advise on site fencing specifications and fencing routes to minimise the impact it will have on the feature.

Fig 13 Stephen's Shaft (Site 2 from the south) C Buck 2010© CHE(P)

Fig 14 Hamilton's Shaft (Site 4 from the south) C Buck 2010© CHE(P)

Site 3 Steven's Shaft mine waste dump and revetment wall

(Centered) From SX 44658 70970 (north) to SX 44665 70885 (south)

Background

The 1867 survey map (Fig 6), the 1884 OS map (Fig 7), the 1891 Lease Plan (Fig 8), the 1904 OS map and the aerial photos all show the extent of the elongated waste dump and surrounding revetment wall.

Survey

A dry stone revetment wall surrounds all sides of the waste dump, which varies in height from 1.0m to 1.5m above ground level. At the south end, next to the site of Hamilton's Shaft (see Fig 14), the waste mound extends above the wall on the east side to a height of approximately 2.0m. At the northern end of the feature, it extends above road level. The visual impact of the site's waste ground is somewhat minimised by the number of mature conifer trees which covers its interior and sides (see Figs 12 to 14). It is unclear if these have been planted as part of an ornamental landscape, seeded naturally, or simply for timber production. Unfortunately, at a few locations, trees growing within the mound, close to the revetment wall, are dislodging stones.

Significance

Medium

This site has a Medium significance rating. This is a prominent visual site, demonstrating a significant typical spoil mound feature of local character.

Recommendation

The site should be retained, any small scale collapse of revetment walling repaired, and any trees that are dislodging the revetment walling should be removed.

Site impact

The overall impact of any revetment wall localised repairs, and tree removal can be defined as '*Negligible positive*'. The works will provide long term stable site management.

Residual impact

The main residual impact will be short term visual impact of localised revetment wall repairs, and limited tree removal.

Reduction of impact

Any stone revetment repairs will be undertaken by experienced walling contractors and any tree felling by experienced personnel. This will minimise impacts to the feature.

Site 4 Hamilton's Shaft SX 44664 70882

Background

The (1867) survey map has (at a later date) had this site drawn in (Fig 6 *'Shaft filled'*) and the 1889 Lease map (Fig 8), all show a shaft. Dines (1956, 675) states, '*Hamilton's Shaft, 60 yds. S by E. of Steven's is vertical to the 80 fm. and follows the underlie to 118 fms. The 92 fm. and 118 fm. levels are short west drives. Crosscuts of about 5 fms. S. from the 80 fm., 92 fm. and 118 fm. of Great Lode pick up South Lode on which short drives at these levels are the only work known to have been done'*.

The latest abandoned mine plan of Russell United Mine (Undated MRO 3260 Plan 1 of 4 - a later plan than 2 of 4), shows the shaft to end below the 118 fm level by 1895 – the date of the Mines Inspectorate copy section drawing. The date of sinking the shaft is not certain, but it appears to have been during the tenure of the later Russell United Mines (c1891 – see Section 3.2.5). Its function was to haul waste rock from the deep workings, up the shaft and deposit it on the top of the linear spoil heap, south of the site of Stephen's Shaft. The tin ore was then trammed for a long distance below ground (see Fig 9) along the deep adit (57 fathom level) to be dressed on site at the old Wheal Russell dressing floor.

Survey

The site of the shaft is not visible. Survey evidence indicates that it is next to a field gateway currently used to access the farm yard and building complex. The shaft site appears to be regularly driven over by tractors etc.

Significance

High

This site has a High significance rating, given its former function as a working shaft, and for Health & Safety reasons its need for preventative safety works.

Recommendation

It is unlikely that there will be funds for intrusive shaft capping works. It is recommended that the shaft site be fenced or preferably walled (hedge design to match the character of the adjacent mine spoil waste revetment wall), and a shaft warning sign erected. It is further recommended that a new gated access is formed away from the shaft site, between the field, the shaft fence/hedge and the farm yard/buildings as soon as possible.

Site impact

It is hoped that the main impact of the works to this site is perhaps only a visual one, namely a shaft fence or hedge. Any ground works to this site are subject to NE grant funding criteria. However, it may well be the case that the site will not be affected by any works at all, therefore there may not be any site impacts.

Residual impact

The main significant residual impact may be the erection of a new fence or related protective feature. It is not expected that an increase in site visitor numbers will affect the character of the feature.

Reduction of impact

An Historic Buildings Consultant, experienced in minimising these issues can advise on site specifications and fencing routes to minimise the impact it will have on the feature, other likely related below ground features and the overall site character.

Site 5 Engine/Boiler House SX 44677 70963

Background

It appears likely that this steam winding engine was erected in 1891 by the Russell Mines Company (1889-1892). Presumably tin ore had been found, and investment was made in order to facilitate deeper and more extensive workings on Great Lode, but utilising Stephens Shaft for pumping, and the already created Deep Adit for drainage and tramming the tin ore for dressing at a site near the River Tamar (Buck 2005, Site 25 – which may have been converted to

dressing tin ore). The 24" steam engine with a single boiler, was of sufficient power to haul the waste rock up Hamilton's Shaft, and deposit it onto the adjacent linear spoil heap. By the late 19th century, compressed air rock drills were common, and even for this small undertaking, was no exception. The air compressor tank would have been near the engine house, with compressed air pipes going down one of the two mine shafts. The steam capstan was likely to have been mobile and would also have been near Hamilton's Shaft (see Section 3.2.6).

By 1904 (Fig 10), the building is shown with most of the engine house missing. By 1922 Barclay and Toll (in Stewart 2003, 47), describes the building (boiler house) having been used as a cow shed/agricultural building. It appears from the survey evidence, that most of the boiler house had a mono-pitch roof, with the 'office' building having a traditional pitched roof.

Survey

The engine house is sited in the corner of a field and is partially extant, but is missing its east wall, and virtually all of both the north (gable) and south (bob) walls. However, the west (wing) wall is fully extant. This is shown on the front cover image, where the remains form in effect, a sectional elevation of a steam engine house. Thus, the window and cylinder plug arches are visible on the short stub sections of the north (gable) and south (bob) walls. The west wall clearly shows the outline of the cylinder bedstone masonry (1.9m high and 2.1m long), the cataract pit (1.7m deep to grass level and 1.0m wide i.e. valves for steam piston operation), the blocked up boiler house steam pipe entry opening (0.6m x 0.8m), a blocked masonry doorway from the boiler house into the engine house, and the profile of the loadings in front of the engine house.

Both the north and south walls (the upper sections are remains of window openings with brick sides), only extend for 1.45m and 0.4m respectively, although the lower section of bob wall extends a little further to 0.6m from the boiler house wall. The overall dimensions of the masonry plinth of the engine house is 4.8m long and 2.3m high, whist the engine house is approximately 5.8m high. Both the north and south wall stubs are extant to the top of the engine house west wall, the bob wall being 1.0m thick and the north gable wall 0.55m thick. Timber lintels in the west wall (see front cover photo) are either rotted or completely missing. These are over the former doorway to the engine house from the boiler house, and over the steam pipe entry hole. The wall appears to be relatively stable, although there is loose stone over the top of the wall, which may have been capped with cement (similar to the boiler house walls).

The single boiler engine house, was constructed soon after the engine house, its east internal wall is aligned with and abuts the engine house external west wall. A rectangular building has been built onto the southern end of the boiler house, which may have functioned as an office or store (no chimneys are visible), heating no doubt provided by the adjacent boiler. A brick edged doorway is set in the western elevation (overall 3.8m long and 2.8m high), and a splayed window (1.0m high and 0.9m wide), in the southern wall (overall 5.0m long and 4.9m high). Lintels to both are either missing or will need to be replaced. The south gable wall is intact; however its top surface has been capped with cement. The interior of the building is partly occupied by large sections of cut trees on a floor that appears to consist of stone and possibly cement.

The boiler house is a relatively stable and well preserved roofless structure. The building is constructed of stone with a lime mortar. The building is 7.1m long, 3.0m wide and 3.6m high (south end). The east side of the northern section of wall (abutting the engine house), contains an area of brick infill adjacent to the remnants of a masonry protrusion (1.4m long and 1.0m high), of unknown function. This section of wall is approximately 3.1m high. It appears the front of the boiler house had two timber doors, the vertical timber frame missing from each side wall (see Fig 15) where they abutted the brick edged jambs. The west side of the boiler

house contains two brick edged window openings (see Fig 16), each 1.3m high and 1.1m wide). The northern window has two columns of brick infills, forming three slots for ventilation, rather than light. It is likely that these are secondary to the window's primary construction. The adjacent window has a traditional timber framed window. Again, the top of the wall has been capped with cement, although the side walls are of the traditional lime mortar, with some repointing necessary in places.

Significance

High

This small mine could not operate underground without the operational winding power of the steam engine, which once was housed within its walls. The structural condition of the building is relatively good. This site therefore has a High significance rating.

Recommendation

The engine/boiler house will need to be fully scaffolded to permit a degree of lime mortar repointing of the sides and removing existing cement capping and re-bedding of the tops of the walls with an appropriate lime mortar. Many timber lintels will need to be replaced where they have rotted, or have already gone, and where appropriate, localised collapses of masonry above the missing lintels, replaced.

Soft and crumbling mortar will be removed (to a maximum depth of 40mm), from the masonry walls following a detailed site assessment of the feature by the site contractors. Following approval of an appropriate mix of lime mortar and an aggregate to match the existing, the site contractors will repair any defective stone or mortar. The style and extent of re-pointing (slightly recessed from the masonry face), will mimic that of the original (this will be decided when the test mortar panel is agreed), by the site engineer and Historic Buildings Consultant. Any loose crumbly mortar (old and new) that has accumulated on the ground as a result of the works will be carefully cleared from the site.

Future management recommendations relate to reducing any vegetation growing out of the side walls (particularly brambles, cotoneaster and possibly ivy – if it cannot be managed). Removal of earth/grass etc on top of the bob wall and wing walls should be undertaken once every five years – again to reduce cumulative build up. Patch repointing of the weather side (west) of the building and possibly the wall tops may need to be undertaken after a decade. If these recommendations are not acted upon brambles/weeds etc will grow out of the walls, making the building unsightly and ultimately causing structural damage due to excessive root growth. Water ingress through deterioration of the wall capping (due to neglect) would also cause structural deterioration at a lower level.

Site impact

The overall impact of the conservation scheme on the fabric of the building remnants will be to remove old and crumbling mortar and replace with new lime mortar. This may well entail repointing some surfaces of the building to retain structural strength. It is the intention of the project to make the building structurally safe by replacing rotted timber lintels. The impact on the site for this is highly beneficial.

Residual impact

It is certain that there will be regular (pre-arranged with the site owner) visiting members of the public throughout the year. By using the mechanism of trial test panels for matching new lime mortar aggregate mixes with the existing colour and pointing style etc, it is hoped that the new lime mortar pointing will be very similar to the existing, resulting in little visual impact. It is a known problem that vegetation growth appears to accelerate once buildings have been

Fig 15 Hamilton's Shaft Engine/Boiler House (from the north) C Buck 2010© CHE(P)

Fig 16 Hamilton's Shaft Engine/Boiler House (from the west) C Buck 2010© CHE(P)

conserved (both on the buildings and at ground level).

Reduction of impact

A method statement will be produced by the site contractors in order to promote a reduction of the effect of the new lime conservation works on the fabric and character of the site. An historic buildings consultancy and archaeological recording during the site works may be able to minimise any further below ground site impacts, but also record any visible/disturbed archaeological features and to record the nature and extent of the building conservation works.

Site 6 Possible wheelpit/buildings SX 44664 70974 to SX 42545 65604

Background

The long thin rectangular feature (approximately 2.5 to 3.0m wide), shown on Figure 8 (1891 Lease Map), close to the road hedge, is likely to have been either a wheelpit, or perhaps more likely a couple of small narrow buildings/sheds etc. The roofed building at Site 7 (SX 44657 70965) is on the same alignment on the earlier 1883 OS map, when compared to the features shown on the later 1891 lease map (Fig 8). In addition, there is a line showing the additional feature is divided into two. This new site appears to be contemporary with the re-use of the site by the construction of the new steam winding engine in 1891, all of which is shown as a complete site (perhaps fenced or marked to remove it from the Morwell Farm lease). All of these features had gone by 1904 (Fig 10).

Figure 9 (Abandoned Mine Plan) shows that flat rods (Site 1) powered the pumps in Stephens Shaft (Site 2), and the steam engine (Site 5), powered the waste skips up Hamilton's Shaft (Site 4). The tin ore was trammed along the deep adit to be dressed at the former Wheal Russell site. Therefore, the necessity of having another power source (ie a wheelpit) seems questionable. In addition a leat water supply to this site is not shown on any map. It does seem likely therefore that this feature is a line of narrow buildings. It was preferable to erect temporary buildings as a coal store for the steam boiler, and that storage buildings were always necessary. However, these do not appear to be large enough to have been a Smithy or Carpenter's Shop. In addition, it appears to have been likely that the main access to the workings was along the adit (entrance not far from the River Tamar), rather than up/down these two shafts (so a Miner's Dry was not necessary either). However, for the workmen maintaining and operating the steam engine and boiler a site toilet and crib hut would have been a necessity.

Survey

There is no evidence at ground level for the existence of this feature.

Significance

Low

This site has a Low significance rating, given the lack of upstanding remains.

Recommendation

The site should be retained, with a minimal amount of disturbance to the ground as there is reasonable potential for the presence of foundations/masonry stones of the former buildings/possible wheelpit.

Site impact

There is a project proposal to undertake some limited site investigation trenching to investigate the possibility of the feature being a wheelpit. The specifications for this project are described in detail in the project design (Buck 2010). If this part of the project is given consent by NE to

proceed, the trenching works will be supervised by an archaeologist, and any revealed features (if appropriate), conserved as part of the project for improving site interpretation. However, if the site trenching does not proceed there will be no other site impacts.

Residual impact

If the site investigation trenching does occur, and there are masonry features (at or just below ground level) to preserve in situ, the residual impacts will be visual. It is not expected that an increase in site visitor numbers will affect the character or structural integrity of these archaeological remnants.

Reduction of impact

The style and colour of any new mortar will reflect the style and colour of any existing so reducing the visual impact of the conservation works. An Historic Buildings Consultant may be able to minimise any further site impacts, but also record any visible/disturbed archaeological features.

Site 7 Site of small mine buildings SX 44637 70944 and SX 44657 70965

Background

These two small rectangular (roofed) buildings are shown on the 1883 OS map (Fig 7), and partly on the later 1891 Lease Plan (Fig 8). They appear to have originally been built to serve the operation and maintenance of Stephen's Shaft (Site 2). Their specific functions are unknown. They may well have survived into the site's re-use of the 1890s. Refer to Site 6, Background section comments.

Survey

There is no evidence at ground level for the existence of these features.

Significance

Low

These sites have a Low significance rating, given the lack of upstanding remains.

Recommendation

The site should be retained, with a minimal amount of disturbance to the ground as there is reasonable potential for the presence of foundations/masonry stones of these former buildings.

Site impact

There will be no site impacts

Site 8 Site of Reservoir Pond SX 44576 70872

Background

This rectangular shaped reservoir pond feature is shown for the first time on Fig 7 (1884 OS map), and then finally on Fig 10 (1904 OS map). It was presumably built when Stephen's Shaft was pumping water to adit and surface level. Whether the need for water was primarily for Morwell House's water features (pond etc), or the need to top up Morwellham Quay's reservoir ponds, is not known. But this small reservoir pond (approximately 9.5m x 9.5m), fed from Stephens Shaft via a leat, would have allowed the murky mine water to settle and clear before it would have been sluiced to provide water for the Morwell House pond and thereafter the

Morwellham ponds two miles away.

Survey

There is no evidence at ground level for the existence of the reservoir pond. However, the site does exhibit a circular dip in the ground (3.0m x 2.5m x 0.25m deep), where the centre of the pond was sited. The leat supply to the pond from Stephens Shaft was parallel to and inside the road hedge. There are no surface remains of this feature either.

Significance

Low

These sites have a Low significance rating, given the lack of upstanding remains.

Recommendation

The site should be retained, with a minimal amount of disturbance to the ground as there will be below ground deposits of mine waste silts overlying the original clay lining.

Site impact

There will be no site impacts

Site 9 Barratt's Shaft SX 44576 70928

Background

The 1867 lode map (Fig 5), the 1867 survey map (Fig 6), the 1884 OS map (Fig 7) all show an unlabelled circular/angled patch of ground at this site. Fig 9, the latest abandoned mine plan of Russell United Mine (Undated MRO 3260 Plan 1 of 4), shows that this was the site of Barratt's Shaft, although it had gone out of use by the 1880s. According to the mine section, it may extend vertically to the 67 fathom level, accessing the lode rather than the deep adit, but this is not certain. The date of sinking the shaft is not certain, but it was under the operation of Wheal Russell Mine (1842 – 1881), and probably marks the lode working to the eastern extension of working Great Lode (up to Stephen's Shaft), by the 1860s.

Survey

The site of the shaft is not visible. Survey evidence indicates that it is not far from a field gateway currently used to access the field within which it is sited. The shaft site may well be regularly driven over by tractors etc.

Significance

Low

This site has a Low significance rating, given its lack of upstanding remains.

Recommendation

It is unlikely that there will be funds for intrusive shaft capping works. It is recommended that the shaft site be fenced and a shaft warning sign erected.

Site impact

It is hoped that the main impact of the works to this site is perhaps only a visual one, namely a shaft fence. Fencing will provide a safer site, in case the shaft fill collapses. However, any ground works to this site are subject to NE grant funding criteria. It may well be the case that the site will not be affected by any works at all, therefore there may not be any site impacts.

Residual impact

The main significant residual impact may be the erection of a new fence. It is not expected that any increase in site visitor numbers will affect the character of the feature.

Reduction of impact

The fence specification will be designed to have a low visual impact, but a high safety factor. A Historic Buildings Consultant, experienced in minimising these issues can advise on site fencing specifications and fencing routes to minimise the impact it will have on the feature.

7 Site Inventory summary

This section of the report summarises the information and management recommendations presented in the Site Inventory (Section 6.0). The inventory table (Section 7.1) summarises all of the site recommendations for safety works and cross references these with other known site surveys. The second table (Section 7.2) prioritises consolidation works to masonry structures.

7.1 Summary Management Table of archaeological sites

Cornwall Historic Environment Projects favours low-key approaches to health and safety treatment of mine shafts and choked adits. This report has been provided to guide works where they are deemed necessary and to advise the landowners of management of archaeological features and health and safety mitigation measures.

The significance ratings relate to a combination of factors including the quality and extent of the remains (both within the site and compared to adjacent sites), as well as the importance and understanding of the feature as part of a complex and how it contributes to the overall site character.

Table Notes:

S (Rating)**:** Significance rating denotes the relative significance of **L**ow, **M**edium or **H**igh, as described in the Site Inventory (Section 6.0).

Site No.	Feature	NGR (SX)	Archaeological recommendations	S (Rating)
	Russell United Mine		**DHER No. 62831**	
1	Site of Flat Rods	44581 70928 44656 70937	None – site to be retained	L
2	Stephen's Shaft	44656 70938	Fence shaft, warning marker - site to be retained	H
3	Stephen's Shaft mine waste revetment wall	44658 70970 44665 70885	Tree management survey to maintain revetment wall stability	L
4	Hamilton's Shaft	44664 70882	Fence/hedge shaft, warning marker - site to be retained. Move existing gated access to field from shaft	H
5	Engine/boiler house	44677 70963	Consolidate walls and replace lintels.	H
6	Possible wheelpit/buildings	44664 70974 42545 65604	Trench site investigations under archaeological supervision	L

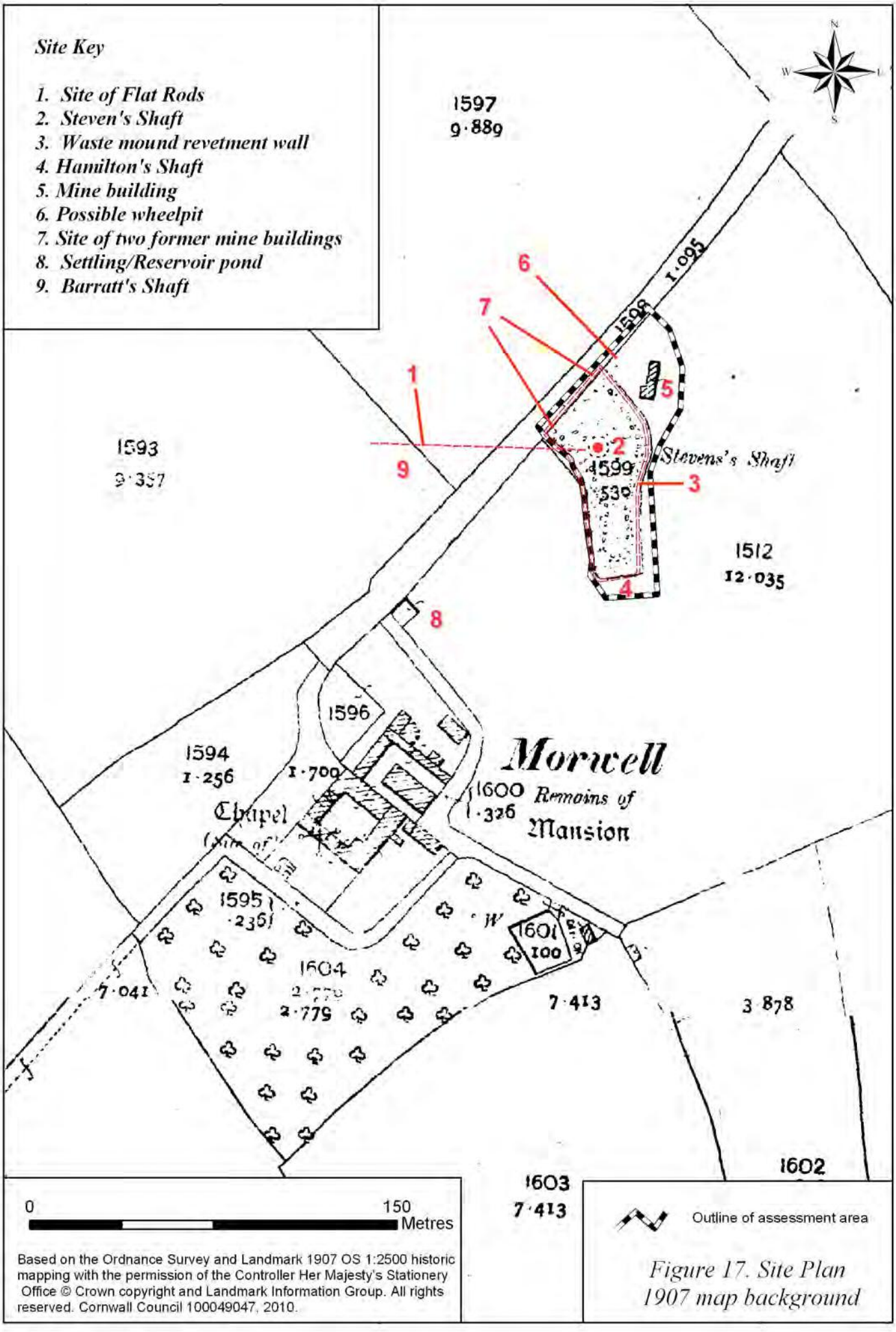

Figure 17. Site Plan
1907 map background

Site No.	Feature	NGR (SX)	Archaeological recommendations	S (Rating)
7	Mine buildings	44637 70944 44657 70965	None – site to be retained	L
8	Reservoir pond	44576 70872	None – site to be retained	L
9	Barratt's Shaft	44576 70928	Fence shaft, warning marker - site to be retained	L

7.2 Masonry structures requiring treatment

A number of structures (not including shafts and adits), identified during the survey will require urgent attention (both large and small). There will be the necessity for archaeological recording, if full consolidation and repointing works are to be carried out.

- **Limited works** (shaded) means non-structural works, wall 'capping' and small areas of repointing where necessary for structural reasons to preserve the building. These sites do not necessitate a detailed building survey.
- **Structural priority** relates to an assessment of the long term structural competence of the feature and so prioritises works in the short/long term. **1** = urgent need for works (i.e. structural components failing), whilst **3** = less urgent needs for works.
- **Visibility (public access)** relates to proximity of features to existing permitted/adjacent public access. Public access is not related to designated routes – rather general public access throughout the project area.

Site No.	Site name	Limited works (shaded)	Struct. Priority (1 – 3)	Visibility (public access)	Overall priority
5	**Engine/boiler House**		1	H	H

8 References

8.1 Primary sources

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8.2 Publications

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9 Project archive

The HE project number is **2010012** (Stephens Shaft)

The project's documentary and photographic archive is housed at the offices of Historic Environment, Cornwall Council, Kennall Building, Old County Hall, Station Road, Truro, TR1 3AY. A copy of the report will be deposited in Devon's Sites and Monuments Archive as well as a copy of all digital images. A copy of the Project administration and black and white images will be archived with Plymouth Museum (following the agreed guidelines produced in the WSI).

The contents of this archive are as listed below:

1. A project file containing site records and notes, project correspondence and administration (File No. 2010012).
2. Digital photographs are archived in Cornwall's Sites and Monuments Archive (R:/Images/HES Images/Devon/Stephens Shaft 2010012).
3. This report is held in digital form at HE CC as: G:\Historic Environment (Documents)\HE Projects\Sites\Devon\Stephens Shaft (Assessment) 2010012
4. EH OASIS No. Cornwall2-76647

10 Appendix

10.1 Mine landscape and buildings conservation philosophy

Conservation philosophy

A site's importance may relate to its historic heritage, its ecological or mineralogical heritage, or more usually, to a combination of two or more of these factors. Statutory designations (Scheduled Monuments, Listed Buildings, SSSI, RIGS, SAC etc) and non-statutory designations (World Heritage Site), may well affect or constrain the scope of a proposed scheme and detailed consultation with relevant statutory agencies will need to take place both prior to and during the scheme with a marked emphasis on a continual dialogue with consultants, focussing on the preservation of the historic character of the mining landscape and buildings.

Conservation work usually involves more than just the consolidation of a building or structure. The work carried out must respect its character and should take into account future access and interpretation, as well as the integrity of its surroundings. It is particularly important that all of these aspects are considered from the outset to avoid situations where consolidation or safety works compromise future plans for the site. Thus the process of professional dialogue and assessments needs to be co-ordinated often by County Council Historic Environment (Planning Advice Agencies), broadly following the pattern of Assessment, Evaluation (excavation or Impact Assessment), and Mitigation (the results of an agreed Mitigation Strategy). The assistance and close liaison of a Historic Buildings Consultant is very important before, during and after works have finished to ensure communication protocol with the respective statutory agencies and to ensure that the works are undertaken to the required standard.

The proposals should be specified in the schedule of works and specifications (through consultation with the appropriate statutory and non-statutory bodies), that result in the conservation, protection and enhancement of the historical authenticity, biodiversity and mineralogical heritage potential of the site. Therefore disturbance to a site should be kept to the minimum required to achieve the aims of the schedule of works and impact assessment mitigation strategy (all of which should have been designed in close consultation with appropriate statutory agencies i.e. EH, EN, CC (HE Advice), etc). Thus the site should be (as far as possible), left in an enhanced or similar condition to that when work started.

Building Conservation

The conservation of a structure is likely to include a combination of one or more of the following approaches: Stabilisation, Partial or full Reconstruction, Selective or full Demolition and adaptive Re-use. Schedules of work should incorporate some flexibility of approach and be tailored to specific site conditions and problems. The particular options selected are likely to be influenced as much by immediate objectives (e.g. stopgap measures to prevent further deterioration) as long term aims intended to serve for many decades, but should always take into consideration the intended long-term use of both the structures and the sites within which they stand.

The preferred conservation approach is based on retaining the essential appearance of a structure, whilst tackling the effects of time, weather and previous destructive interventions, with the aim of undertaking the minimum of work necessary to produce a stabilised ruin in the medium term. This may involve limited demolition and reconstruction, and, in rare cases, the addition of aids to long-term stability - underpinnings to foundations, hidden reinforcing and stitching, though it is preferable to avoid such solutions unless no other options exist. Preventing the ingress of water to wall heads not designed to be exposed to the elements is almost always likely to be required; lintels and other structural timbers should be carefully

examined, and where necessary, replaced. Such interventions should be kept to a minimum in order to maintain the integrity of the structure, however and all wall capping and masonry reconstruction should be to profiles existing at the commencement of the works.

Wherever possible, conservation approaches should be based on carrying out repairs rather than rebuilding, other options being resorted to only where absolutely necessary. Reducing the ingress of water is the main pre-requisite of building conservation, and this will usually result in re-pointing and wall capping. Other structural remediation works are likely to necessitate operations such as masonry removal and re-setting, masonry replacement, re-installation of lintels and other structural timber or stonework, pointing and weatherproofing of areas of exposed wall cores and wall heads, installation of strengthening features such as hidden steel rods or 'beams', treatment of chemical hazards, removal or control of vegetation, clearance of rubble or rubbish, installation of lightning conductors and perhaps reinstatement or replacement of roof structures and coverings. Archaeological excavation may also be necessary, in particular of floor deposits within buildings.

Specifications

- Traditional building materials (e.g.: second hand brick or stone, Oak/Douglas Fir timber lintels) should be used when consolidating historic buildings. Where material is to be site won, advice must be taken from the archaeologist and ecologist on the project team to ensure that the sites where this is to take place are appropriate.

- Traditional lime mortar mixes (NHL 3.5 for walls and NHL 5 for wall capping and exposed sites) should generally be used (specifications can be supplied by HES/EH), using locally sourced aggregates to match the original mortar composition. Mortar test panels should be made to permit the selection of appropriate aggregate mixes/colour and finish before the pointing work is undertaken.

- Cement and modern materials should be used very rarely and only when the need for their use can be demonstrated.

For public access and interpretation, additional works are likely to be required, including hazard treatment, safety barriers or hazard warnings, site access arrangements – paths, parking, perhaps steps or ramps to enable public access, including arrangements for those with restricted mobility. There may also be a need to restrict access to the structure, or to parts of it, using railings or other barriers. Signs or interpretative features may also be installed.

Whatever approach is taken, the need for flexibility, sensitivity and above all, authenticity must be recognised from the outset, and, where possible incorporated into the design brief. It should also be remembered that many of the surviving former industrial buildings in Cornwall are Listed Buildings or Scheduled Monuments, or are likely to become so in the near future, and that a vast majority lie within Cornwall and West Devon's World Heritage Site. Work to such buildings will almost certainly need specific and detailed written consent from local or national agencies. Any existing consents, permissions and approvals should always be checked, and attached conditions strictly adhered to.

Mitigation strategy

The project briefs for the site assessments and any follow on evaluation or impact assessments should be specified by the appropriate statutory or non-statutory authorities.

As part of the mitigation strategy (described in the Impact Assessment and archaeological recording report), Historic Building Consultants should be utilised to ensure that English Heritage principles of conservation practice are adhered to both in terms of the design of appropriate schemes, to ensure that consolidation works are carried out to acceptable (EH) standards and to ensure close liaison between statutory agencies and the project works.

In addition it is important that the nature, extent and development of the site conservation works should be guided by the relevant short and long term management plan policies (statutory, archaeological, conservation, ecological, mineralogical and WHS etc), which are an important part of any mitigation strategy of the site.

CC (HES Projects) 11/2/2008

10.2 Historic Buildings Consultancy and archaeological recording

There is a close relationship between the Historic Buildings Consultancy (HBC) and the standard CC archaeological recording elements – essentially both are intricately tied together. It was deemed to be more cost effective to combine both of the roles into a single work specification which could be undertaken simultaneously. For example in the recent HLF Mineral Tramways, the Tamar Valley Mines Heritage Project (TVMHP) and the East Cornwall Regeneration Project (ECRP), the archaeological brief for this work was produced by the CC HES and approved by CC (WHS) Advice team (on behalf of the County Archaeologist), who combined both of these elements as a mechanism to essentially ensure that the building conservation work is undertaken in a consistent style across the Devon and Cornwall WHS area and to ensure that site contractors strictly follow English Heritage guidance for building conservation works (in fact I have been undertaking this combined 'role' for building conservation works since 1997 for CC).

The project brief should describe in detail; the nature and extent of the buildings consultancy, the standards of archaeological recording (to meet EH and IFA National Standards) and specify the archaeological recording report. EH Inspectors of Monuments has approved a number of similar project briefs (for building conservation work to Scheduled sites in Cornwall (e.g. Mineral Tramways, ECRP, TVMHP). The following Aims and objectives section has been reproduced from a project brief which combines the Historic Buildings Consultancy and archaeological recording elements:

Aims and objectives

The purpose of the historic buildings consultancy, historic buildings recording and archaeological recording is:

- To ensure that the agreed Mitigation strategy produced in the Assessment/Impact Assessment report is followed during the site works (CC HES (Advice) Policy).
- To ensure that site works are undertaken in such a way as to maintain the integrity and authenticity of the historic resource, minimising adverse impact upon the resource (following WHS Management plan policies).
- To ensure that the highest possible standards of workmanship are maintained during the conservation works, which must be carried out to recognised current best standards in this discipline (following WHS Management plan policies).
- To ensure that works are undertaken in such a way as to allow adequate recording of remains affected by the works (CC HES (Advice) Policy).
- To ensure (through site and monitoring meetings), that the methodologies and techniques of all aspects of the site works accord with the Method statements and agreed methodologies outlined in the Schedule of Works and Specifications (CC HES (Advice) Policy).
- To ensure that there is an agreed appropriate communication link strategy for progress and any issues etc with CC (Advice) throughout the duration of the project.

- To record sites, features, deposits and artefacts affected by or uncovered by the works for Cornwall's Sites and Monuments Record.
- To record the character and extent of works to the sites for Cornwall's Sites and Monuments Record.
- To disseminate the results of the project appropriately and arrange for the deposition of the project archive for Cornwall's Sites and Monuments Record.

C.Buck Senior Archaeologist 12/2/2008

10.3 Glossary of mining terms

ADIT A level tunnel (usually driven into a hillside) in order to give access to a mine, and used for drainage or the hauling of broken ore. Deeper adits did not necessarily connect to surface, and were used to carry water back from distant workings to a pumping shaft.
ANGLE BOB A simple lever-based device using which the direction of a reciprocal motion (of pump rods, flat rods) could be changed (for example from horizontal to vertical).
ASSAY HOUSE The mine laboratory, where samples or ore were analysed for their mineral content.
BAL or BALL From Cornish "*Pal*" a shovel, and hence "a digging" = a mine. Generally applied to earlier mines. See also WHEAL.
BALANCE BOB A large counterweighted lever attached to the shaft pump rods and used to offset their weight and thus reduce the work of a pumping engine to lifting water alone. A surface balance bob would be mounted adjacent to the shaft on a pair of plinths or on a masonry support at ground level (balance bob mounting), the attached counterweight - a large box filled with scrap iron or rocks - working in an adjacent stone-lined pit. Other balance bobs would be installed in chambers cut into the rock adjacent to the shaft wall as needed to counterbalance the weight of the pump rods, especially on a deep shaft..
BAL-MAID A woman or girl employed at surface on a mine, generally in the dressing of ore.
BEAM-ENGINE A type of steam-engine much favoured in Cornwall for use in pumping, winding, and providing the power to crush ores preparatory to dressing on Cornish mines. The power from a large cylinder set vertically in an engine-house was transferred via a massive rocking beam or bob to the pumps in the shaft outside. For winding and crushing, the bob was instead attached to a flywheel and crank on a LOADING next to the BOB-WALL (or in the case of all indoor engines, the side wall). In most cases, the engine house formed an integral part of the framing of the engine.
BEDSTONE The granite slab which formed the foundation for the cylinder of a Cornish Engine.
BLOWING-HOUSE An early form of tin smelting furnace, small in scale and using charcoal as a fuel.
BOILER HOUSE A generally lightly-built structure attached to an engine house, and designed to contain the horizontal boilers for a steam engine; the associated chimney stack may be attached to this structure, or built into one corner of the engine house.
BRATTICING Timber partition work in a mine, for instance the LAGGING BOARDS which lined the upper section of a shaft where it ran through soft ground.
BUCKING The breaking down of copper ore on an anvil to about 10mm in diameter by bal-maids using small hammers, after which the ore was separated from the waste by hand. This process followed cobbing, in which it had been broken down to about 25mm in diameter, the waste again being hand removed. These processes, through which the majority of the highest quality copper ore was recovered, took place within roofed structures called bucking houses.
BUDDLE A device for concentrating tin ore. In the mid-19th century these most usually took the form of a circular pit with rotating brushes; the tin from the stamps was fed into the centre or side of the pit and was graded by gravity, concentrating the heavy ore near the inlet point. These were often mechanically worked. Earlier buddles were trapezoidal in shape, and manually operated. A variation used in tailings works to treat sands and slimes was the ROUND FRAME: a free-standing, all wooden, mechanically-actuated buddle, whilst a further variation was the dumb buddle or dumb pit, which was not mechanically operated.
CALCINER A furnace and heating chamber in which ores were roasted to drive off impurities such as sulphur and arsenic. These were also known as Burning Houses, later patterns being of REVERBERATORY design. The Brunton pattern calciner, introduced in the mid-19th century, was mechanically powered, and operated on a continuous basis, unlike earlier designs. Other patterns of calciner were also devised, the majority named after their designers (e.g. Oxland, Hocking and Loam).
CAPSTAN A manually or steam-operated winding drum, usually installed on a mine to raise pitwork from the shaft for maintenance or repair.
CATARACT PIT (or cock pit) A sub-floor area within the foundation levels of an Engine house between the Cylinder Plat and the Bob Wall, containing the regulating apparatus, and giving access to cylinder hold-down bolts.

CILL The base of a window or other wall opening.
COFFIN or GOFFEN The narrow excavation resulting from stoping on a lode being carried to or from surface on part or all of a lode. See also GUNNIS, STOPE, OPENWORK.
CONDENSER The cast-iron cylinder set in a tank of cold water immediately in front of the bob wall of an engine house in which the exhaust steam was condensed, creating a vacuum which greatly increased the efficiency of a steam engine. For a pumping engine this equipment was often contained within a pair of masonry walls projecting from the bob wall towards the shaft.
COST BOOK COMPANY A company of unlimited liability into which shareholders either paid 'calls' for further finance or shared any profits. Mines kept a 'cost book' to record expenses/costs/dues/earnings. This system was replaced by the end of the 19th century by limited liability companies.
COUNT HOUSE Properly ACCOUNT HOUSE, but generally shortened. The mine office, sometimes incorporating accommodation.
CULVERT A small tunnel constructed to carry a channel of water.
CYLINDER OPENING The often large, arched opening in the rear wall of an engine through which the steam cylinder was brought into an engine house during the erection of the engine. This opening was generally subsequently closed off with a timber partition and usually incorporated the principal doorway into the engine house.
CYLINDER PLAT The massive masonry base on which the cylinder of a Cornish Engine was bolted down (see also BEDSTONE).
DRESSING The concentration of the tin (copper or other ores) contained in the rock excavated from the stopes of a mine. Carried out on DRESSING FLOORS.
DRESSING FLOORS An (often extensive) area at surface on a mine where the various processes of concentration of ore took place - these consisted of crushing or stamping to attain a uniform size range, sizing (particularly on later mines), separation of waste rock, concentration (generally mechanically and hydraulically on tin mines, manually on copper mines), the removal of contaminant minerals (by calcination, flotation, magnetic separation), and finally drying and bagging for transportation to the smelter. Tin floors in particular were generally laid out down a slope to reduce mechanical or manual handling between stages in the process.
DRIVE (alternatively lode drive or heading). A tunnel excavated on the line of a lode as the first stage of the development of a STOPE.
DRY or CHANGE HOUSE (earlier MOOR HOUSE) The building within which miners changed their clothes before and after going underground. Some were heated by steam pipes connected to the engine boilers. Where there were large numbers of women or children employed on a mine, there might be two drys - one for men, the other for women and children. The pithead baths or showers found in collieries were rarely found in Cornwall.
DUMP or BURROW (alternatively spoil dump, spoil tip). A pile of waste material, usually from a mine or quarry. May contain primary waste (where this could not be disposed of underground) or waste from various stages in the dressing process. TAILINGS LAGOONS stored the extensive slimes from the final stages in the process; in earlier mines these were flushed over cliffs or allowed to wash away in streams or rivers.
EDUCTION PIPE The large diameter pipe through which exhaust steam was drawn into the condenser set outside the bob wall.
ENGINE HOUSE A building designed to contain steam, gas, oil or electric engines on a mine or other works. When forming part of the framework of a beam engine, these were particularly strongly constructed.
FATHOMS Measurement of horizontal or vertical distance at surface or underground (1 fathom is the equivalent of 6 feet)
FINGER DUMP A linear dump of waste material from a mine or quarry, flat-topped to allow material to be barrowed or trammed along it, and often equipped with a temporary tramway track.
FLAT RODS Reciprocating (or very occasionally rotative) iron rods used to transfer power from a steam-engine or water-wheel to a remote location.
FLUE A masonry-constructed tunnel or conduit connecting a furnace to a chimney stack
FRUE VANNER A mechanically-driven, laterally vibrated, inclined rotating belt on which fine tin-containing material in suspension in water was treated by relative density.
GIRDER The massive timber beam set across an engine house just below top floor level to which the parallel motion was attached and on which the spring beams sat.
GOSSAN The upper part of a mineral vein as it breaks surface. The natural weathering of the rock will decompose the metallic sulphides, characteristically leaving a porous rusty Quartz.
GUNNIS A narrow linear excavation left where a lode has been worked, most commonly used when open to surface. See COFFEN
HANG A TACKLE A temporary headframe construction with a winding mechanism to aid in the sinking of a shaft on a lode or to access a lode
HEAD or CROP The richest part of material in a buddle - nearest its feed point.
HEADFRAME The tall construction set over a winding shaft which carried the sheave wheels over which the winding ropes ran. Headframes usually contained ore bins or ore chutes to allow the broken rock in the skips or kibbles to be tipped into trams at surface.
HORIZONTAL ENGINE A steam engine where the cylinder(s) are set on a horizontal bed and the piston rods are

attached via a cross-head to a crank and flywheel.
HORSE WHIM Similar to a capstan, but in this case power supplied by a horse walking around a circular platform (PLAT) was applied to an overhead winding drum; frequently used for winding from small shafts on Cornish mines, especially during exploratory work and shaft sinking. The smaller under-gear whims found in some 19th century farms were little used on mines.
JIG A large mechanically or hand-operated sieve set in a tank of water using which ore could be separated by waste. Sometimes constructed in groups within jigging houses.
KIBBLE A large, strongly-constructed, egg-shaped, iron container used for ore and rock haulage in earlier shafts. Superseded by SKIPS.
LAGGING BOARDS The timber planks lining the upper part of a shaft, or where it ran through soft ground.
LAUNDER A wooden or steel trough used to carry water or other liquids; often used to feed water or finely-divided material in suspension around a dressing floor.
LABYRINTH (colloquially "lambreth") A series of interconnected masonry-constructed chambers set adjacent to one another on whose walls the arsenic vapourised in a calciner or arsenic furnace was condensed out. The gas followed a zig-zag path through such groups of chambers, and one end of each chamber would be closed off with a door using which the condensed arsenic could be collected.
LEAT An artificial water-course, built to carry a supply of water to a mine.
LINTEL The horizontal timber or stone support above an opening in a wall or structure.
LOADING The masonry platform in front of an engine-house (or elsewhere on a mine) on which machinery such as cranks, flywheels or winding drums were mounted and on which the reciprocal motion of the sweep rod attached to the beam was turned into a rotative motion.
LOBBY The excavated cutting running up to an adit portal.
LODE A linear area of mineralization underground. In other parts of Britain a VEIN, or SEAM. Generally vertical or near-vertical, and often extending for considerable distances along its strike.
LODE-BACK PIT A shallow shaft dug from surface into shoad or the upper part (backs) of a lode, from which ore could be extracted from shallow stopes to the depth of the water table or just below. Waste material was generally dumped adjacent to the shaft mouth.
MAGAZINE Small strongly built store containing explosives (gunpowder or dynamite); often circular, sometimes with additional enclosing walls to contain the blast of an accidental explosion.
MELLIOR STONE The granite bearing stone in which the upright shaft of a HORSE WHIM ran.
MIDDLES The material in a buddle found between the crop and the tailings, this generally containing enough ore to warrant its re-treatment.
OPENWORK or BEAM. A mineral extraction site open to the surface, and similar to a quarry but usually distinguished by its elongated shape, and steep sides. Generally applied to features broader in extent than a GUNNIS OR COFFIN. A variety is a STOCKWORKS, where an area of ground containing a large number of small parallel lodes was removed wholesale.
OVERBURDEN The topsoil and subsoil removed in the process of opening or extending a quarry, streamworks or mine.
PELTON WHEEL A small enclosed water turbine, working at high pressure and rotational speeds. In use from the later 19th century.
PITWORK The term used to describe the pump rods, rising main, shaft guides (buntons) etc. within a shaft.
PORTAL The entrance to an adit beyond its LOBBY. Often timbered or stone vaulted.
PROSPECTING PIT/FOSSICKING PIT OR COSTEANING PIT A small pit dug in search of minerals, and almost always found in linear groups, often arranged cross-contour, or at right angles to the projected strike of known lodes or deposits of shoad. A COSTEANING TRENCH is a linear excavation cut for prospecting purposes.
RAG FRAME or RACK FRAME An inclined table-like surface on which very fine slimes in slurry form were treated to recover their tin. Large mines would have hundreds of such frames arranged in groups.
REVERBERATORY KILN A design of furnace in which there was indirect contact between the heat from a hearth and ore to be roasted, usually by incorporating a baffle flue.
ROTATIVE ENGINE A beam engine in which the reciprocating motion of the beam was converted to rotary motion via a sweep rod, crank, and flywheel.
SETT The legal boundary within which a mine could extract minerals.
SETT One of a series of stone supports for a tramway, performing the same function as sleepers.
SETT One of the components of timber framing of an adit where it ran through loose ground; also the timber framing of a shaft to which the shaft guides and LAGGING BOARDS were attached.
SHAFT A vertical or near-vertical tunnel sunk to give access to the extractive areas of a mine.
SHAKING TABLE A slightly inclined, mechanically vibrated table on which fine tin (as sands or slimes) in suspension in water was concentrated by relative density.
SHEARS or shear legs. A tall timber frame carrying a pulley or sheave wheel erected in front of an engine house over a shaft and used for the installation and maintenance of PITWORK.
SHOAD or SHODE Ore weathered from the load and moved (in geological time) downslope under the force of gravity. Material reaching a river valley would be to some degree concentrated before redeposition in horizontal beds.

These beds of detrital material (placer deposits) were exploited in streamworks.
SKIP A (generally elongated) iron or steel container equipped with small wheels or brackets running on the shaft guides (buntons) and used for rock and ore haulage in later mines.
SOLLAR A timber platform in a shaft, stope or underground working (often between a series of ladders).
SPRING BEAMS The pair of longitudinal timbers extending from the rear of an engine house parallel to and on either side of the BEAM at top floor level. These served to arrest any unwanted excess indoor motion of the beam via catches set onto its rear and were extended out from the front of the house to form the foundation for the bob-plat (the timber platform from which the bearings on the outdoor section of the beam could be serviced).
STACK A chimney on an industrial site, used to carry away smoke or fumes from boilers, furnaces and calciners. Often situated at the end of a Flue.
STAMPS A mechanical device for crushing ore-bearing rock to a fine sand. Heavy vertically-mounted beams (or later iron rods) carrying cast or forged iron heads were sequentially lifted and dropped onto the prepared ore beneath them by a series of cams mounted on a rotating drum; this usually being driven by a water-wheel or rotative steam engine.
STOPE Excavated area produced during the extraction of ore-bearing rock. Often narrow, deep and elongated, reflecting the former position of the lode. Where open to the surface, these form GUNNISES or COFFENS.
STREAMWORKS An area worked for detrital (redeposited) tin deposits by shallow excavation. Often characterised by linear dumps, river diversion, and evidence for leats. Some streamworks (dryworks) exploited deposits of shoad in now dry valleys and on hillsides, where concentrations of this material were economically workable. Leats and reservoirs were necessary to work these sites, and are characteristic of them.
STRIPS (settling strips) Elongated shallow tanks in which the primary settlement and subsequent separation of tin ore from waste took place after it had been stamped.
SWEEP ROD The elongated iron rod which connected the beam of a Cornish engine to a crank and fly wheel.
TAILINGS The waste sand and slime from a mine dressing floor, not containing workable quantities of mineral.
TAILRACE The channel along which water flows after having passed over or under a water-wheel and is then generally returned to the water course.
TRIBUTE A system of payment (by percentage of value of ore broken) whereby groups of miners contracted to work at previously-agreed rates.
TUTWORK A system of payment ("by results") in which groups of miners bid against one another for contracts to work sections of the mine for a percentage of the value of the ore raised from that area.
VANNER A person employed on the surface of a mine to check or assess the tin content at each stage of the refining process. The VANNING SHOVEL was used to test the relative concentration of ore in a sample of finely crushed ore or partially dressed ore.
WATER-WHEEL Wheel fitted with buckets or paddles around its periphery, and driven by the weight or force of a stream of water directed onto them.
WHEAL also WHELE, WHILE, HUEL. A mine.
WHEELPIT A structure built to house a water-wheel, often excavated and stone-lined, but sometimes free-standing.
WHIM PLAT The level and usually circular platform on which a horse-whim was sited.
WHIM The winding gear used for hauling from a shaft; consists of a power source and a winding drum. See Horse-Whim.
WIND BORE The cast-iron strainer attached to the bottom lift of pumps