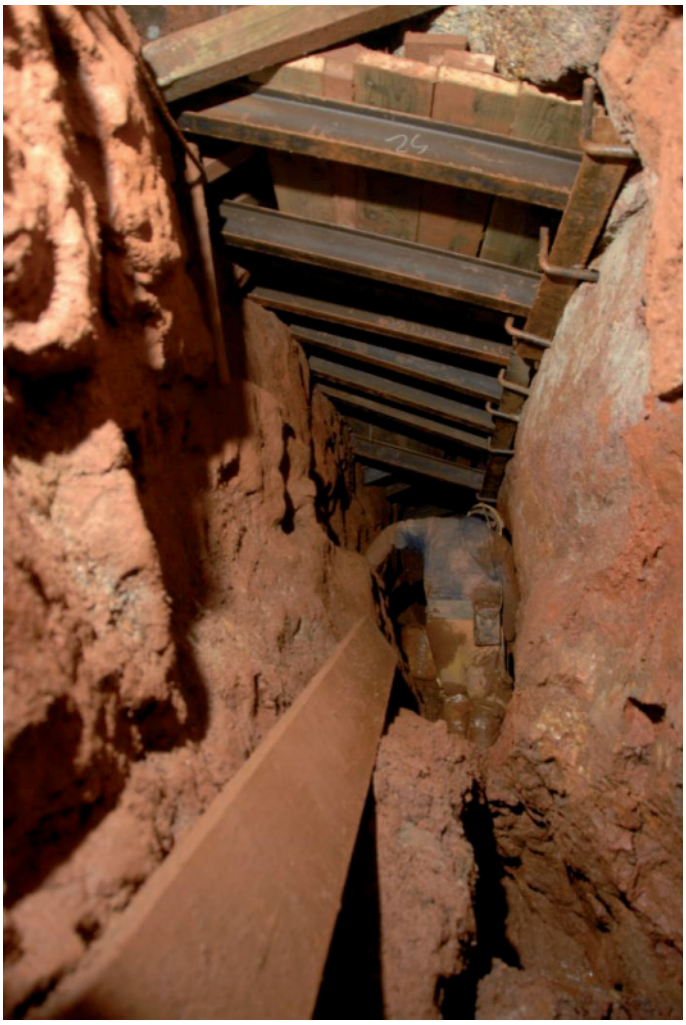
Report No: 2011R038

Wheal Mexico, Geevor, Cornwall

Archaeological consultancy and watching brief during the extension of the underground visitor tour route



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CORNWALL COUNCIL

Historic Environment Projects

Wheal Mexico, Geevor, Cornwall

Archaeological consultancy and watching brief during the extension of the underground visitor tour route

Client	**Cornish Mining World Heritage Site Team**
Report Number	**2011R038**
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Acknowledgements

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Thanks are particularly due to the Drillserve team for the work they undertook under often-trying conditions: Peter Sheppard, Ross Sheppard and Mervyn Brakespear with John Dowling, Luke Anstice, Colin Davies, Nick Hall, Pat Orient, Tony Stanton and Douglas Wheatcroft. The measured adit survey was undertaken by Sam Wood, assisted by Douglas Wheatcroft.

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

Freedom of Information Act

As Cornwall Council is a public authority it is subject to the terms of the Freedom of Information Act 2000, which came into effect from 1st January 2005.

Historic Environment, Cornwall Council is a Registered Organisation with the Institute for Archaeologists

Cover illustration

Douglas Wheatcroft making his way along the partly-excavated eastern drive in the Wheal Mexico adit system

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Abbreviations

EH	English Heritage
HER	Cornwall and the Isles of Scilly Historic Environment Record
HE	Historic Environment, Cornwall Council
NGR	National Grid Reference
OS	Ordnance Survey
PRN	Primary Record Number in Cornwall HER

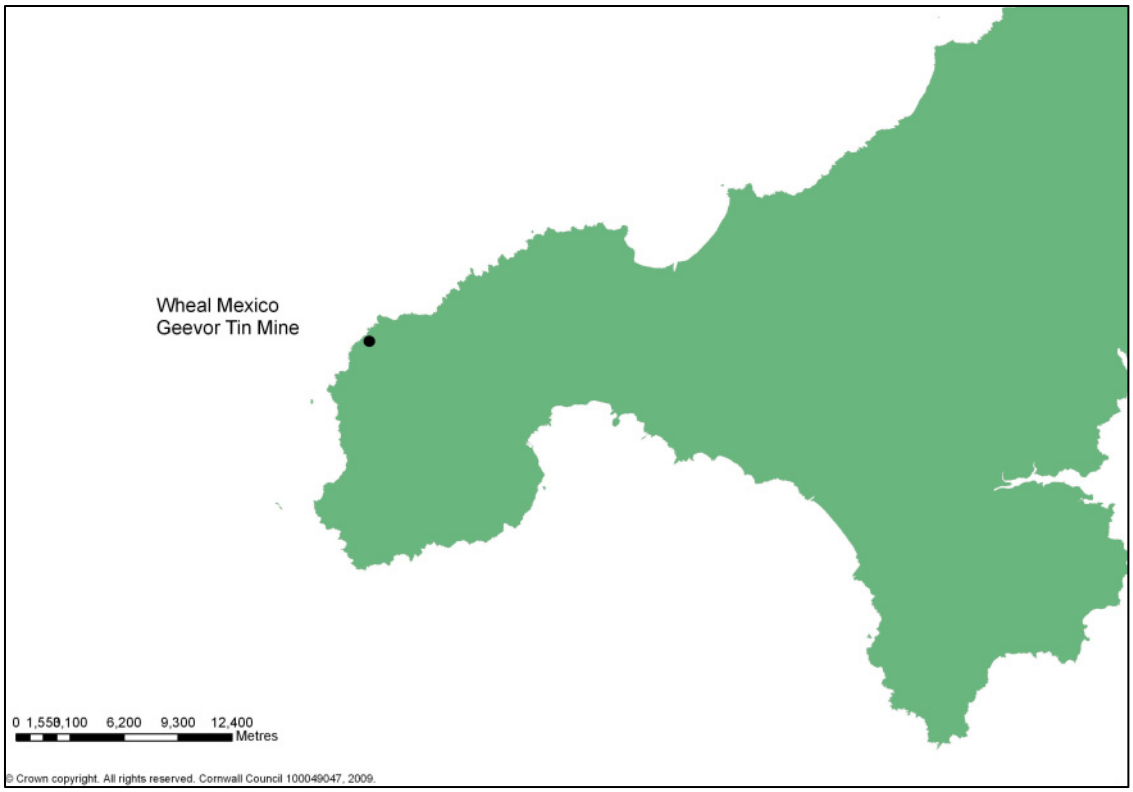

Fig 1. The location of Wheal Mexico at Geevor Tin Mine.

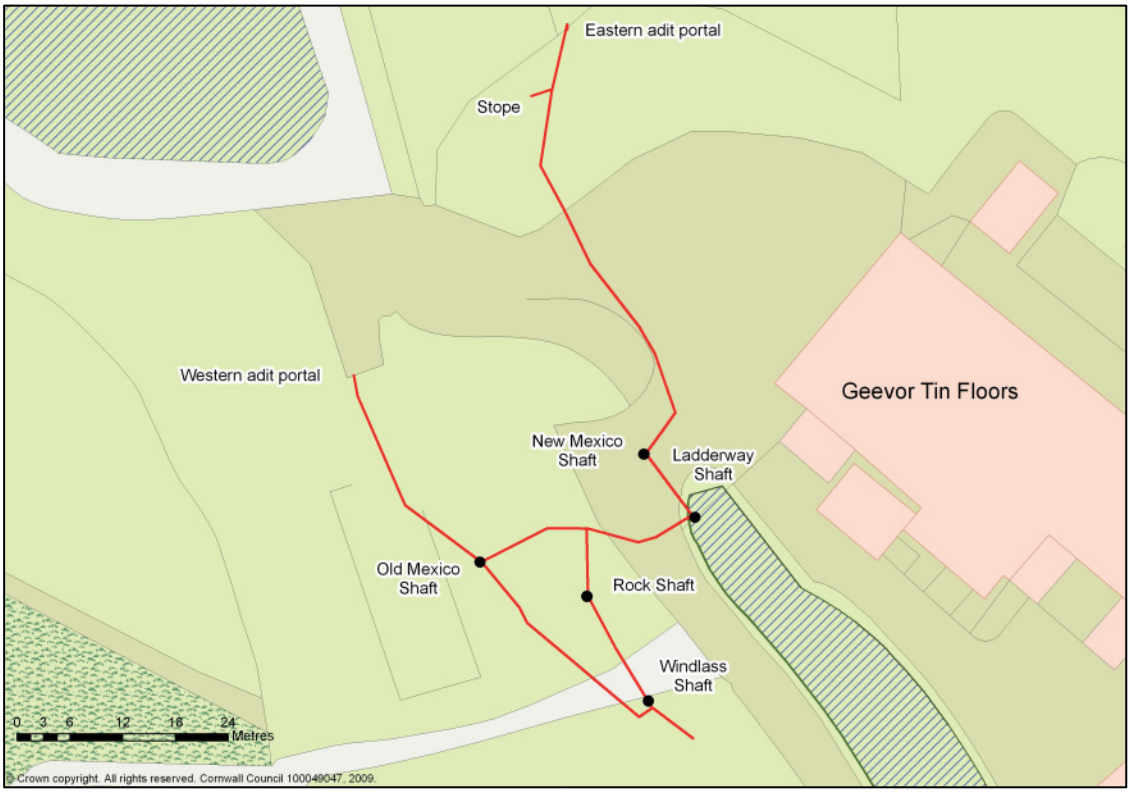

Fig 2. The extent of the project area at Wheal Mexico, showing (in red) the proven sections of the Wheal Mexico shallow adit system. The new extension is the lower section linking Old Mexico Shaft, Windlass Shaft and Rock Shaft.

1 Summary

During a round of Derelict Land Reclamation shaft safety works undertaken at Geevor during the early 1990s, work to secure New Mexico Shaft revealed parts of a shallow underground adit system. Following its initial exploration, it was recognised that this could form the basis for an underground tour route for visitors to the site. A 120m section of the adit was cleared and where necessary made safe and slightly enlarged to make it accessible to visitors. The adit tour was initially entered from a reconstructed portal to the north east and exited via the re-excavated Footway Shaft adjacent to the foot of Geevor mill. The constraints imposed by climbing the ladders in this shaft were overcome by the subsequent clearance of a further section of the adit to the west and the construction of a new portal.

The underground tour proved a success, but its limited extent and growing popularity eventually placed significant limitations on the numbers of visitors which could be accommodated at any one time, and long waiting times were identified as one of the principal reasons behind visitor dissatisfaction at Geevor. As part of the **Discover the Extraordinary** project established by the Cornish Mining World Heritage Site Team in 2009, proposals were drawn up for the clearance of sections of two spur tunnels running southwards off the existing visitor route in order to double its accessible length. Scheduled Monument Consent was granted for these works, subject to a number of provisions, these including a requirement for archaeological consultancy and a watching brief during the contract. HE Projects undertook this work, which commenced in March 2010 and continued through to the summer, and again during the winter of 2010/2011 when the final elements of the work were completed.

Clearance work on the two tunnels to south of the existing underground visitor tour revealed an extensive section of early, narrow near-surface stoping, an adit which had clearly been driven in order to get round a section of very poor ground in the stope and a small backfilled shaft. Several pieces of shaped timber were recovered from the shaft fills and placed in temporary storage following their recording pending attempts to have these scientifically dated.

A levelled survey of all of the accessible sections of the adit system was commissioned by the contractor, providing for the first time not only a plan of the accessible underground workings at Wheal Mexico, but also the location of these features projected to surface.

Considerable further work was required to bring the extended adit system into a condition where it was suitable for public access, including cleaning, lighting, drainage and structural support to unstable ground. This was finally achieved by January 2011.

The works undertaken at Geevor during 2010-2011 revealed a further section of its earliest known shallow mine workings, including near-surface stoping, areas of hand picked tunnels and a small mine shaft linking both to surface and down into as yet unexplored shallow levels within the mine. In the absence of firm evidence no date can be assigned to these workings, though given the proximity of the stoping to surface these are likely to represent workings dating back to at least the early 18th century, though almost certainly some considerable time before this. Currently backfilled extensions of the tunnels into firmer granite upslope to the south-east have the potential to reveal further important information concerning the early development of the mine, and may include potentially-useful dating evidence.

2 Introduction

2.1 Project background

One of the principal attractions for visitors to Geevor is the opportunity to undertake an underground tour in an authentic section of a Cornish tin mine. The workings used for this purpose, rediscovered in 1994/5 during shaft safety works and subsequently made suitable for visitor access, were originally developed as part of the former Wheal Mexico, and are sited just to the north of the tin floors. For most of the year visitors are conducted around the workings in small groups by Geevor guides, though self-guiding takes place during the busier times of the year to remove the requirement for visitors to wait for one of the guides to be available.

The underground tour provides a defining interpretive experience of the Cornish Mining World Heritage Site (WHS) which helps visitors understand other mine sites which they subsequently visit elsewhere in the WHS, and which is therefore relevant to Geevor's role as the Key Centre (West) for the WHS. 95% of visitors to Geevor Tin Mine express a desire to go on the underground tour.

The original underground tour was limited in extent, however, and during the high season the necessarily small size of the groups allowed on each tour results in a sometimes significant backlog of visitors awaiting their turn to go underground. Visitor numbers to Geevor are predicted to increase significantly over the next few years, the opening of the new museum in late 2008 having already triggered an average monthly rise in visitor figures of 15%. In response to this situation, it was proposed that the accessible section of the adit level should be extended through clearance and any necessary safety works to accommodate a larger number of visitors at any one time.

Preliminary searches of mine plans coupled with the results of archaeological watching briefs undertaken during the 1990s (Sharpe 1994a and 2010) suggested that the Wheal Mexico adit system extended a significant distance to the south and could be opened up without any major engineering works other than the removal of infill followed by any necessary stabilisation, surfacing and lighting. The current visitor route is approximately 120 metres in length and an extension of approximately 80 metres was proposed utilising existing known branches of the adit system. An undated mine plan in the Geevor Archive suggested that these converged inland, though inspection prior to works indicated that they were infilled with sand and slimes deriving from operations upslope which had used redundant shafts for waste disposal. Proposals for the works to extend the underground tour allowed for the driving of a tunnel through intact rock to connect the two adit branches, should this be required.

The proposed extension to the underground route was intended to provide the site management with additional operational flexibility, and was expected to alleviate waiting times. In addition, it was suggested that the proposed extended underground tour would potentially include several additional features for the tour guides to interpret, including two shafts and sections of small-scale stoping.

Scheduled Monument Consent (SMC) was sought and obtained by Pendeen Community Heritage (PCH) from the Department of Culture Media and Sport (DCMS) to clear the tunnels and to carry out investigative work in order to investigate the feasibility of extending the visitor route, a variation on this consent being agreed with the Inspector of Monuments to allow for widening of the original tunnels where required for H&S and eventual safe visitor access. A further SMC was conditionally granted should there be the requirement to undertake any excavation through virgin ground to link the tunnels,

Phase 1 of the works was intended to comprise the excavation of the infill material from approximately 35m length of each branch of the adit. This was to be removed via existing open shafts and adit portals accessing the workings, the material being deposited at a designated site approximately 50-100 metres from the exit portal immediately adjacent to an area historically used for the disposal of material

excavated from this adit system. Once the material had been cleared, an assessment was to be made of the necessity for support works, and for the requirement for the excavation of a linking tunnel between the adits.

An allowance was made for a **Phase 2** to consist of the excavation of a new connecting tunnel approximately 10m in length through solid rock to link the adit branches. In addition, both the existing adits and any new section of tunnel would require drainage and floor surfacing works to make them suitable for visitor access. As during Phase 1, the excavated material would be removed via an existing shaft or through the adit portal and deposited at the designated location on the Geevor site. The Phase 2 works were therefore provisional and dependant on the results of the Phase 1 clearance works. In the event these were not required as the two drives were found to converge within the section of the adit system proposed for clearance.

Phase 3 was to comprise the renovation of the fixed underground lighting and its extension to the newly-excavated section of the adit using a low-level LED-based lighting system, together with any safety and other works required to make the new sections of tunnel accessible to visitors to the site.

Given that Geevor is a scheduled monument (the scheduling dating to August 2005, the designation including the underground sections of the site within the scheduled area), English Heritage required that the work was to be accompanied by an appropriate level of archaeological recording and the provision of necessary archaeological expertise during operations. Jeremy Williams (WHS Projects Development Officer) of the Cornish Mining World Heritage Site Office contacted Cornwall Council Historic Environment (Projects) by email on 14 July 2009 requesting a Written Scheme of Investigation (WSI) and cost breakdown to undertake this work, as laid out in the supplied brief dated 14 July 2009. The WSI submitted for this work is included as an appendix to this report.

2.2 Aims

The principal aims of this study were:

- to gain a better understanding of the nature, extent and original features of the shallow, early underground workings making up this level of Wheal Mexico.
- To limit or prevent any negative impacts of the proposed works on the authenticity and completeness of the underground workings.

The objectives of the study were:

- To advise on proposals and to propose measures to ensure that the special qualities and importance of the historic environment of Geevor Tin Mine were preserved and enhanced by the proposed works;
- To ensure that the works had a minimal impact on the integrity and authenticity of the historical resource;
- To create a record of any areas of Wheal Mexico made accessible as a result of the proposed works;
- To advise the project team on the advisability and impacts of their proposals and where necessary, to suggest alternatives;
- To liaise with English Heritage during the works.

As set out in the brief, the historic environment consultant was to:

1. be responsible for providing historic environment consultancy supervision and watching brief of the implementation of the above works identified which are under the supervision of the Project Manager;
2. where appropriate, have the authority to halt inappropriate/below standard work, and in such a case to inform the Project Manager immediately;
3. be able to work in a team and be able to communicate with all members of the team from Project Manager and Mine Manager to the works contractors;

4. In addition the historic environment consultant was to be able to communicate his advice and proposals to the HES Planning Advice Officer at appropriate site meetings;
5. To report to English Heritage's Inspector of Monuments on the progress of works, and liaise with English Heritage as and when required during the works.

2.3 Project extent

The works were confined to the existing Wheal Mexico adit system and its shafts, together with its southern extensions, the site of the spoil dumping area and a limited number of areas of the Geevor site required for the use of the contractors during the works. These were agreed as suitable in advance of any operations and an assessment of any impacts resulting from their use was undertaken.

2.4 Methods

All recording work was undertaken according to the Institute for Archaeologists *Standards and Guidance for Archaeological Investigation and Recording.* Staff followed the IfA *Code of Conduct* and *Code of Approved Practice for the Regulation of Contractual Arrangements in Archaeology.* The Institute for Archaeologists is the professional body for archaeologists working in the UK.

2.4.1 Desk–based assessment

No extensive desk-based assessment was required for this project, as the Wheal Mexico shallow adit system had already been the subject of a report commissioned in advance of works commencing on site (Sharpe 2008b).

A number of mining maps and plans relating to the early operation of the Geevor site (for example Figs 4-11) were rectified using ArcGis 9 software to enable their detail to be plotted onto modern maps. These were interrogated to attempt to gain a better understanding of the development of the adits and shallow mine workings within this part of the Geevor site (see Section 6.1).

2.4.2 Preliminary consultation and pre-works involvement in the project

HE Projects was involved in a number of preliminary stages in the project, including feasibility considerations, advice on the drawing up of applications for scheduled monument consent for each stage of the works, and enquiries as to the necessity for planning permission for the works and for permission for the disposal of waste material on site from the Environment Agency under the CLAIRE Development Industry Code of Practice (Fig 12). HE Projects worked closely with Jeremy Williams, Projects Development Officer for the Cornish Mining World Heritage Site Team, during this initial period from February 2009 to February 2010. A brief for works and request for a WSI (Appendix 1) and costs for the subsequent consultancy and watching brief stage were received from the WHS Office in July 2009.

SMC for the Phase 1 works had already been agreed (HSD/9/2/9991 dated 11 February 2009). The rationale behind the application for an additional SMC to cover the Phase 2 works was provided to the WHS Office in early August 2009, discussed, and sent in draft to EH at the end of the month for comment (see appendices). The application for additional SMC to cover modification works to the original tunnels and for the driving of the connecting tunnel (if required) was sent to DCMS in September 2009. Consent was received from DCMS at the end of October 2009. An application for SMC for the third phase of works to make the excavated sections of the adit system safe for public access was drawn up by HE Projects in August 2010 (see appendices), consent being received from English Heritage in mid September 2010. A final SMC was submitted at the end of March 2011 to undertake additional minor surface drainage works (not reported on here).

Owing to a procurement issue which had arisen concerning the initial tender process, it did not prove possible to let the works in late 2009 as had been planned, and the

contract was re-tendered at the end of 2009. HE Projects attended a pre-contract meeting with the successful tenderer for the work (Wheal Jane International) on 9 March 2010 to ensure that the contractor was fully aware of the constraints imposed on the work by the scheduled status of the site and the requirements of the two scheduled monument consents granted at this stage (a further SMC for the works required to light the tunnels was to be submitted to DCMS by HE Projects on behalf of PCH once the location of the new connecting tunnel (if required) could be established).

The contract for the works was let on 15 March 2010, initial inspection of the previously partly-excavated sections of the two tunnels having been undertaken by HE Projects immediately before this date. The site inspection revealed that widening of the existing tunnels would be required to allow visitor access and HE Projects immediately contacted EH to request a variation to the existing SMC to allow this to be undertaken. A verbal agreement to this request was provided by return of email on 12 March 2010.

Following the resolution of a series of discussions regarding outstanding information required from the contractors, permission for the start of works on site was given to Wheal Jane International (WJI) on Thursday 18 March 2010. The works team set about preparing equipment at surface, and made an initial underground visit shortly after this date. At this point it transpired that the WJI tender had not been based on a full appraisal of the site conditions and the contractors requested additional costs to cover what they considered to be necessary variations to the schedule of works. However, no cost variations were permissible under the terms of the contract, and following negotiations with the Project Manager (Gary Jago), WJI formerly asked to withdraw from the project at the beginning of April 2010. Subject to the successful negotiation of a quit claim, this was considered to be acceptable.

The contract was therefore offered to the next approved tenderer, Drillserve Ltd., and following a pre-contract meeting on site on 15 April 2010, an immediate start of works was approved in the week commencing 19 April 2010. Work continued until the end of July 2010 when the contractors stood down during the busiest period of the visitor season, returning in late September to complete the works required as part of Phase 3 of the Project. The lighting scheme was eventually completed in March 2011.

2.4.3 Fieldwork

Preliminary record photographs were taken and an initial inspection undertaken of the accessible sections of the adits prior to the contract starting on site in early March 2010 (Figs 17-18).

Measured and scaled sketch drawings and plans of elements of the underground workings were made using a 4H pencil on A4 sized matt permatrace sheets, together with written notes.

Stage 1

- Provision of historic environment advice and supervision during the Phase 1 works to excavate sand, gravel and slimes etc. from existing sections of two branches of the Wheal Mexico adit system. This was achieved through close liaison with other members of the Project Team, English Heritage and the Cornwall Council Planning Advice Team, as well as through attendance at Project meetings.
- A watching brief was undertaken during the Phase 1 works. A measured annotated survey was made of all safely accessible sections of the re-excavated adit system and the recording and/or recovery of any artefacts revealed during the works.

Stage 2

- Historic environment advice was provided on the works proposed for Stages 2 and 3, including the drafting and submission of the SMC applications for these works.
- Preparation of Impact Assessments and proposed Mitigation Statements to accompany the SMC applications for Stages 2 and 3.
- Liaison with English Heritage in relation to SMC applications and any required variations.

Stage 3

- Provision of historic environment advice and supervision during the Phase 3 works to complete the extension to the Wheal Mexico adit visitor tour route, including the installation of safety measures and lighting.
- Undertaking an archaeological watching brief during the works, including any required additions to or modifications of the measured survey created in Stage 1 and the recording and/or recovery of any artefacts revealed during the works.
- Liaison with English Heritage as and when required during works, including preparation of an SMC for the Phase 3 works.
- Preparation of a report summarising the archaeological watching brief. This report, where possible, additionally interprets the functions of features revealed during the works in the context of existing information in the Wheal Mexico Assessment Report (Sharpe 2008b).

Fieldwork: photographic recording

Where practicable, appropriate and safe, this included:

- Colour photographs taken with a digital camera (with a resolution of 8MP or higher), to illustrate the report and for possible presentation purposes.

The photo record comprises:

- General views of the works;
- Examples of detail of operations and of features revealed.

Methodology for the archive standard photography was as follows:

- Photographs of details were taken with lenses of appropriate focal lengths;
- A tripod was used to take advantage of natural light and slower exposures;
- Difficulties of back-lighting were dealt with where necessary by balancing the lighting by the use of flash;
- A metric scale was included in archive photographs, except where health and safety or other considerations made this impractical.

The initial photography was undertaken with a high resolution weatherproof compact digital camera; however, the results from the use of this camera were felt to be sub-standard – the combination of the small lens aperture and reflections from numerous dust particles and moisture in the atmosphere underground when necessarily using the on-camera flashgun. This resulted in uniformly low-contrast images characterised by many fuzzy dots (out of focus dust particles in the air which had been caught by the flash) which were difficult to remove using photo processing software. As a result the archaeologist took the remainder of the images using his personal DSLR with a variable-power off-camera flashgun linked to the camera using a remote connection cord or long duration images using available light. Although it proved difficult to frame

images in near darkness, a range of record photographs of acceptable quality were taken during the works programme.

Artefacts were, wherever possible, brought to surface, lightly cleaned using water and a soft brush and recorded using a metric scale. Interesting sections of timber recovered during the work were immersed in a tank on the Geevor tin floors pending their conservation or dating, should future resources allow.

2.4.4 Post-fieldwork

- Digital colour photographs (stored according to HER guidelines and copies of images made available to the client);
- Preparation of finished plans;
- Report production.

3 Location and setting

Geevor Tin Mine is located on the coast near Pendeen, West Penwith, and is centred at SW 37529 34510 (Fig 1). The underground section is centred at SW 37370 34604. The site occupies a short and shallow, infilled north-trending valley which meets the sea at Trewellard Bottoms. Wheal Mexico historically worked the northern part of the area occupied by the modern Geevor site, its principal shafts being located adjacent to and to the north of the later mine's tin floors, and probably included elements of the shallow adit systems which debouch within the valley and in the cliff base at Trewellard Bottoms. Its workings also extend inland, and its adits probably met up with (and helped to drain) those within the Wheal Gevor (sic) and Stennack setts to the south and the many small and early shallow workings lying under Trewellard Hill, including those later subsumed into Wheal Carne/Maitland (Fig 3).

4 Designations

4.1 National

Geevor tin mine, Pendeen, is a Scheduled Monument (Cornwall 32990), designated in August 2005. The scheduling includes the underground workings of the mine within the scheduled area.

Geevor falls within Area 1 of the Cornwall and West Devon Mining Landscapes World Heritage Site (popularly known as the Cornish Mining World Heritage Site) inscribed in July 2006, and is the World Heritage Site Key Centre (West).

4.2 Regional/county

The whole of the Geevor site lies within the Cornwall AONB, whilst the northern (coastal) part of the Geevor site is within the Carrick Du to Carn Aire SSSI.

5 Site history

Geevor Mine at Pendeen has a documented history of operations since the 18th century, though the lodes here may have been worked in a small scale fashion since the 16th century. Available documentation suggests that **Wheal Mexico**, whose operations seemed to have been focussed in the northern half of the present Geevor site, was first mentioned during the 18th century, and was partnered with **Wheal Gevor** to its south and **Stennack** to its south-west.

The immediate forerunner of Geevor Mine – **North Levant** – was developed between 1851 and 1891, amalgamating many of the earlier setts within the area now occupied by Geevor. This phase of operations on site considerably expanded the numbers of lodes worked, though progress seems to have initially been slow, development was not progressed to any significant depth and was limited to the inland sections of the lodes. **North Levant and Geevor** was formed in 1907, and was reorganised as **Geevor Tin Mines Ltd** in 1911. The mine had a highly successful career throughout

the 20th century, absorbing elements of Levant and the Boscaswell Mines during the 1960s and subsequently developing their unworked lower reserves to depths in excess of 2000 feet below surface. The mine finally ceased operations in 1991 in the wake of the October 1985 International Tin Crash, when tin prices plummeted rapidly to well below those at which the mine was economically viable and remained there for many years.

The site was acquired by Cornwall County Council in 1992 after successful efforts to ensure the preservation of a large proportion of its most significant machinery and artefacts using a grant from the National Heritage Memorial Fund. Following extensive safety works, the site was opened to the public shortly afterwards as a large-scale heritage site, showcasing the history, archaeology and social history of Cornish tin mining, and opening up many of its buildings to public access. Having been managed for a while by the Trevithick Trust, it is currently managed by Pendeen Community Heritage on behalf of Cornwall Council.

The extensive mine workings (which eventually extended down to 2,200 feet from surface) were quickly flooded to Third Level (sea level) once the pumps had been turned off in 1991, and in the early days of operation of the mine as a heritage centre visitors to Geevor wishing to experience a Cornish mine underground had to be mini-bussed to Rosevale Mine in Zennor, a small, privately-operated refurbished tin mine. Whilst popular, places on these tours were very limited and constrained by the time taken to drive between Geevor and Zennor. However, shaft safety operations in 1994/5 revealed a shallow adit system near the tin floors – part of the near-surface sections of the 18th century Wheal Mexico. Following some safety and access works, a section of the adit system was opened to the public for guided underground tours on site (Sharpe 2010). Geevor Mine quickly became a popular heritage attraction, whose visitor numbers continued to grow steadily.

Most recently (2007-8) an extensive programme of building conservation works was undertaken using grants from the Heritage Lottery Fund, enabling a new museum of hard rock mining to be opened in the mine's former Top Fitting Shop (Sharpe 2009). The limited underground experience made available from the mid 1990s onwards in the Wheal Mexico Shallow Adit had quickly reached its carrying capacity however, and although plans to create a totally new visitor tour at Third Level had been scoped out, the substantial funds required to achieve this were not available and, as an interim measure, proposals were developed in 2009 for the doubling of the accessible extent of the Wheal Mexico shallow adit tour. Specifications for this work were drawn up by the Cornish Mining Word Heritage Site Team as part of the **Discover the Extraordinary** Project to enhance visitor attractions within the WHS, this work being funded primarily by the Rural Development Programme (England) (RDPE).

6 Archaeological results

6.1 Mapped and documented information

The earliest mine plans, maps or sections in the Geevor Archive date to the mid 19th century, and thus there are no illustrative records of the underground workings associated with the various mines which had operated here prior to the establishment of North Levant in 1851, and only a very limited number dating to the second half of the 19th century when this phase of the working of the local lodes was in operation (for example Figs 6-7).

Some educated guesses as to the arrangements of the workings here can be derived from a 1788 surface plan of the setts on Trewellard Hill for which the Robyns Family were the mineral lords. This plan shows a plethora of small setts working a series of closely-set east-south-east to west-north-west trending tin lodes, the most productive of which at the time lay within the Wheal Carne sett, working the ground just to the east of the road between Trewellard and Pendeen, together with Wheals Bal and Reeth, sited just to the north of the road linking Trewellard and Woon Gumpus.

However, Wheal Carne had been mentioned by John Norden during the mid-16th century as a rich tin mine; relatively modest-scale mining operations continued on Trewellard Hill into the early 19th century.

Prior to the recovery of mine dumps on the hill for reprocessing by Geevor during the 1980s, this was one of the best-preserved and most complex pre-19th century mining landscapes to be found anywhere in West Cornwall. Fig 3 shows an extract from a 1973 aerial photograph of part of this area, and gives a good impression of the degree of landscape impact typically resulting from such intensive pre-industrialised operations.

The following mine setts were shown on the 1780 plan (from east to west, the areas being measured in acres, rods and perches):

Huel Inter 3.3.6; Hue Zandras 28.2.8; Huel Pens 8.2.24; Huel Fên 26.0.37; Huel Guare 4.1.21; Great Huel Drean 2.0.33;Little Huel Drean 0.1.6; Huel an Gothilly 5.1.37; Huel an Carn 19.1.32; Huel Vor Wartha 2.1.25; Huel Marh 0.2.36; Huel Widden 14.0.28; Huel Pitcher 1.0.32; Huel Cruat 0.3.26; Huel Game 4.3.26; Huel Bennet 3.0.37; Huel London 2.0.26; Huel Goffen 1.0.1; Hue Reeth 10.0.29; Space Bean 0.3.30; Huel Stannack 7.0.0; Huel Bâl Vean 15.1.23; Huel Bal Gôth 17.2.39, together with Tye Huel Game Stream Bounds and Bounds an Lidden Stream Bounds. Other former mine setts (perpetuated as lode names were Huel Lugon, Huel Bristol, Huel Vounder, Huel Chimbla, Huel Sampson, Huel Pons, Huel Down and Huel Cheat.

'Huel' is an alternative spelling of the Cornish work 'Wheal' meaning a mine. Most of the sett names incorporate Cornish words, suggesting that they might have been in existence for some considerable time prior to 1780. Huel London and Huel Bristol are likely to have been named after the cities from which most of their out-adventurers were drawn.

The lodes, most named for the setts they traverse, were named as follows (from south to north and east to west):

Great Huel Zandras; Little Huel Zandras, named as Huel Inter to the north; Huel Guare; Un-named; White's; Huel Pons; Great Huel Carn, named Huel London to the north; Huel Widden; Tom Numphra, named as Little Huel Carn to the north and Dor Gwaval to the north again; Lode Fug; Edmond's; North Gothilly, named as Wheal an Drean and then as North Tol Trogan to the north again; South Tol Trogan; Huel an Bal, named as South Gothilly to the north and Huel Down to the north again; Huel London, named as Huel Cheat to the north; South Huel Bal, named as Space Bean to the north; Huel Stannack, named as Lode Plat to the north; North Huel Chimbla, named as Huel Sampson to the north, Hard Shaft Lode to the north again and Huel Game at the northern edge of Trewellard Hill; South Huel Chimbla, named Lode Plat to the north; South Holt, named Lode Duw to the north and Huel Reeth to the north again; Huel Stannack; Carron; Bowels. On the third level in Wheal Carne the date 1791 has been carved into the wall (information pers. comm. St. Just Mines Research Group).

It is known that the lodes exploited on Trewellard Hill continued on towards the cliffs, many coalescing within what was to become the Geevor site, and it is very likely that a similar landscape also existed in and adjacent to the shallow valley leading down towards the sea at Trewellard Bottoms where the lodes outcropped in the cliffs. A surface plan of North Levant and Geevor dating to *circa* 1908-11 (Fig 8) depicted (from east to west) the closely-set courses of North Lode, Borlase's Lode, Mexico Lode and Geevor Lode in the northern part of the site; in the southern part of the site (and again from east to west) Fern Lode (Fên Lode on Trewellard Hill), Pig Lode (diverging from Geevor Lode on its eastern side), Mundic Lode (cross-cutting) and Black Lode (the last two little-developed), Peeth Lode, Stannack Lode and Great Common Lode (the last two being within the former sett of East Levant). On the northern part of Trewellard Hill (from east to west) the plan showed the continuation of Fern (Fên) Lode and Peeth Lode, Bristow Lode (Bristol Lode in 1780), Wheal Bal Lode, the

continuation of Stannack Lode and Wheal Bennett's Lode, whilst on the southern part of Trewellard Hill were Wheal Penn Lode, Wheal Carne Lode, an un-named lode, Wheal Widden Lode, Wheal Bal Lode and Morvahmen's Lode (the last extending southwards into the sett of the Botallack Mines Ltd.).

Many of these lodes were subsequently worked by North Levant and Geevor, though under different names. A plan of the Geevor Tin Mines Ltd. workings dating to the first decade of the 20th century (Fig 9) showed North, Borlase's, Mexico and Geevor Lodes in the northern part of the site, Fern, Pig, Mundic, Black, Peeth, Stannack and Great Common Lodes in the southern part of the site and Pane, Wheal Carne/Fern, Wheal Widden, Peeth, Bristow, Wheal Bal, Stannack, Bennett's and Morvahmen's Lodes on Trewellard Hill. In 1912, a plan in the Geevor Archive provided little detail of the northern end of the site, but workings at several levels on the courses of the following lodes were shown underlying the Trewellard to Pendeen Road (from east to west): Pig Lode, Jumbo Lode, Caunter Lode, Mundic Lode and Black Lode. A further undated plan (again probably dating about 1912) showed no detail of lodes in the northern part of the site, the workings shown suggesting that the focus of activity lay in the area around Pig Shaft and Wethered Shaft, the lodes shown as being actively worked being Pig, Jumbo, Caunter, Blue, Black and Mundic. The Geevor sett was shown as being bounded to the south by the Trewellard-Pendeen Road, with the 'Geevor Extended Sett' (the area which had just been taken on for working) running up onto Trewellard Hill. The active shafts were Robert's, Ladderway, Pig, and Wethered, with Wheal Carne Shaft shown on Trewellard Hill. The deepest workings were at the 5th Level (200' below Deep Adit).

During the first decades of the 20th century, most work was concentrated on North and South Pig Lodes, together with North Lode and Branch Lode; by the 1940s the mine had undertaken a substantial amount of prospection and the lodes reported as being worked were No 1 Branch, North, North Pig, New, No 2 Branch, Coronation, Hangingwall Branch, Wethered, Borehole, Wethered No 2, 8th Prospect South and A, B, C, D and E Lodes; in 1957 the principal lodes being worked were Coronation, No 3 Branch, Wethered, North Pig and Borehole; during 1960 Wethered Borehole, North Pig, North, No 1 and No 2 Brach lodes were being exploited; in 1963 Borehole, Grenfell, South Pig and Boscaswell Main were the lodes mentioned as being worked in the annual report, the mine having recently expanded into the old Boscaswell sett. During the late 1960s, Geevor expanded into Levant to the south and west and in 1977 lodes mentioned as being worked or developed were Simms, Boscaswell Bill, Boscaswell No 1, Boscaswell No 2 (to the east), Hangingwall Vein of the Footwall Branch Lode (adjacent to Levant), Grenfell, Prospect No 1 and Whisky, with Wethered and Coronation Lodes additionally being reported as being worked in the following year.

David Kneebone, former Mine Manager at Geevor, confirmed (pers. comm.) that the lodes which outcropped over a width of about 475m on Trewellard Hill converged as they entered the Geevor site, near the weighbridge their outcrops occupying a space of ground about 250m wide, this telescoping to about 100m in the area below the mill. In some cases these conjunctions would certainly have led to localised enrichment (as with the documented carbona near Redburrow Shaft); elsewhere some lodes might have pinched out or coalesced. As the lodes approached the killas-granite contact (this being near the foot of the mill at surface, but dipping steeply to the north) their richer zones would have been found at increasing depth as they were developed towards the sea, possibly accounting for the relative scarcity of early small shafts in the area nearer the cliffs. The waste material partially backfilling the apparently earliest workings on the lodes running into the back of Trewellard Zawn shows indications of having carried considerably more copper than any of the outcrops inland, which, near surface, seem to have been worked solely for tin where they were in the granite.

Archaeological investigation during the 1990s safety works programme (Sharpe 1994a and 2010) indicates that tin streaming had also taken place within the lower part of

this valley between the present visitor carpark and down towards the sea – both in the form of dryworks and streamworks, almost certainly as a precursor to the exploitation of the *in situ* lodes. No documentation indicating the names or dates of operation of these streamworks has been identified to date.

The landscape histories of Trewellard Hill and the Geevor site diverged during the late 18th and early 19th centuries, however, the shallow lodes on Trewellard Hill becoming substantially worked out, whilst those to the north-west became developed in depth by North Levant and Geevor and its immediate precursors. Whilst the industrial landscape of Trewellard Hill had effectively become fossilised by the mid 19th century, the continuing operations on the Geevor site had produced substantial amounts of waste material which had been disposed of in the valley leading to Trewellard Bottoms, effectively infilling and concealing it, burying the evidence for the streamworking and tin dressing operations which had taken place there.

The more intensive mode of mine exploitation which had developed across Cornwall from the mid-18th century into the 19th century required a far larger dedicated workforce than hitherto, and one of the most dramatic results of this was the enclosure of extensive areas of former open grazing land and moorland to provide the sites for the small farms and new industrial settlements occupied by the growing mining workforce (Sharpe 2008a). In the St. Just mining district much of the land suitable for this purpose had been enclosed for agriculture since prehistory, and as a result most new smallholdings and settlements were laid out on the moorland fringes and in former areas of open cliff grazing land. Around the evolving Geevor site this inevitably included some areas which had previously been affected by previous mining activity; some redundant early shafts were covered over and their spoil dumps were spread or removed during the creation of new fields and mining hamlets. Where open shafts or spoil dumps survived within the landscape they tended, therefore, to be in areas rendered incapable of agricultural improvement, too intensively worked to be capable of re-use as construction plots, or either in active use or reserved from development as having the potential as future underground access points. On the lower northern slopes of Trewellard Hill, however, such was the pressure on land during the late 18th and early 19th centuries that a patchwork of small fields developed in the areas in between the many small shafts and outcrop workings within this part of the landscape, whilst new cottages were, wherever possible, sited off the known outcrops of the lodes, such was the shallowness and potential for subsidence of their workings. This did not always prove possible, given the poor state of documentation relating to early mine workings, and the demolition of several cottages in Trewellard affected by subsidence seems to have taken place (pers. comm. St. Just Mines Research Group).

The development of the North Levant and Geevor site also resulted in the obliteration of evidence for earlier mining activity during the creation of its spoil dumps and the erection of its buildings. The only area within which any significant proportion of the pre-existing mining landscape seems to have survived was that overlying the outcrop of its principal lodes within the narrow strip of land leading from Trewellard down to the site later occupied by Victory Shaft, as is shown on the 1973 PMB aerial photographs. In the early 1980s, however, the remaining surface evidence for early mining activity in this area was cleared away as a result of the groundworks undertaken in preparation for the sinking of the proposed Botallack Decline. Nevertheless, sub-surface evidence for this activity had survived, and was the focus for much of the first round of safety works undertaken in 1994, several sections of backfilled gunnis and over 20 small and medium-sized mine shafts being treated in the stretch of ground between the mine weighbridge and the mine office (Sharpe 1994a). Some areas of shallow stoping were identified within this area at the time, but the evidence for this activity was fragmentary, and given the backfill present within these features, they could not be explored in depth at the time.

The middle part of the site (between the compressor house and the foot of the mill) had, from 1851 to the 1980s, been the focus for the establishment of dressing floors and service buildings associated with the development of North Levant and subsequently of Geevor (Figs 5, 7-9). Such was the eventual scale of these buildings that it was inevitable that all of the surface evidence for early mining activity would be obliterated, though again, the principal shaft sites within this area were recorded on mine maps, whilst some smaller-scale features were identified during construction work during the period whilst they were in operation and during the safety works undertaken during the early 1990s (Sharpe 1994). The development of Wethered Shaft as the principal focus of operations for Geevor during the early years of the 20th century resulted in the abandonment of both Pig Shaft and Gevor Engine Shaft to its north.

The lower part of the site (from the northern end of the mill to Trewellard Bottoms) seems to have been used for tailings treatment and general waste disposal for several centuries, trial trenching undertaken here during the mid 1990s (Sharpe 2010) revealing that the large volumes of waste rock disposed of here by North Levant and its predecessors were successively overlain by deposits of slimes, sands and gravels, blanketing the earlier land surface, in some cases to considerable depths. Less is known, therefore, about early features associated with underground operations in this area; the development of the few shafts documented here probably substantially relates to activities during the 19th century (though they might have had earlier origins), given the depth of the killas-granite contact where significant and payable mineralisation would have occurred. The development of Victory Shaft from 1918 as the principal shaft for the expanding Geevor Mine saw the eventual abandonment of Wethered Shaft at the southern end of the site, Robert's (or Engine) Shaft near its centre and Thorne's Shaft to the north, together with major shafts associated with its earlier operation including Redburrow (bordering the car park), Borlase's (under the grassy area near the Seco huts), and Old and New Mexico and Mexico Footway (just to the west of the tin floors). The sites of most of these earlier redundant shafts eventually became lost through capping, waste dumping or building construction, whilst evidence found during the clearance of the Wheal Mexico shallow adits suggested that tailings waste had been disposed of down at least one early shaft connecting with this system of tunnels, substantially backfilling them (Sharpe 1994a).

Most of the early (pre 1850) mining activity on site is, therefore, undocumented and hidden from view, and our understanding of the form and arrangement of earlier features on the site has to be inferred from parallels within better-preserved or better documented areas of the surrounding landscape, from rather fragmentary archaeological evidence and from what can be implied from later plans.

In relation to Wheal Mexico it has to be stressed that no firm dates can be ascribed to the currently accessible workings in the absence of documentation or other solid dating evidence. Wheal Mexico is documented as having been at work within this area during the mid 1700s, the sett remaining a recognised entity (though not necessarily still active) in 1849 (Geevor Archive). The date at which working began on this part of the site or the names under which the ground might have been previously exploited are not recorded, though given the mention of productive operations under Trewellard Hill by Norden during the 1540s there is a strong likelihood that lodes outcropping in the cliffs at Trewellard Bottoms would have been prospected and subsequently developed inland at the same time, if not some decades beforehand. The earliest activities at Wheal Mexico (as also those immediately inland) may well date to the early years of the 16th century, therefore.

The *circa* 1840 Tithe Map for St. Just (Fig 4) shows indications of mine workings on the Geevor site a decade before the formation of North Levant, extensive spoil dumps being depicted in the area between Redburrow Shaft and Borlase's Shaft (the core of the site of Wheal Gevor), a small area of spoil was also shown in the general area of the Wheal Mexico Shafts with further spoil dumps to the north on the western edge of

a field near the present explosives magazine (Magazine Shafts) and at a site probably representing Thorne's Shaft. The only buildings shown on the Tithe Map lay just above Trewellard Zawn, and were labelled 'Trewellard Mine'. This mapping seems to indicate that whilst Wheal Gever had been active to a substantial degree by this date, the Wheal Mexico workings had been centred on Thorne's Shaft and had been smaller in scale. Trewellard Mine barely registers in any documentary archives, and is assumed to have been a very short-lived working of the above sea level coastal sections of the lode outcropping at Trewellard Bottoms. A roughly contemporary map of the parish of St. Just in the Geevor Archive labels this group of buildings 'Trewellard Cliff Mine'.

The earliest useful plan of the Wheal Mexico section of the site identified to date within the Geevor Archive (an extract from this is included within this report as Fig 6) was probably drawn up during an early stage in the development of North Levant and Geevor during the 1850s (or early 1860s) and is at a scale of 32 fathoms to the inch. It includes some detail of worked and located lodes across the site, including those around the former Wheal Mexico, naming the following shafts from north to south: Thorne's, Mexico, Old Mexico, Robert's, Footway, Borlase's, Redburrow, Engine (Gevor Engine) and Law's Engine. A small number of what are probably additional small shafts are shown on the plan, but not named.

Old Mexico Shaft was shown as sunk on Old Mexico Lode, a section of the lode having been worked to its north at an unknown horizon. Mexico Shaft (New Mexico Shaft) was shown to its east as sunk on North Mexico Lode. The plan indicates significantly more development on this second lode, which was shown as intersecting Old Mexico Lode just to the north of Roberts' Shaft. North Mexico Lode was shown as having been worked as far as Borlase's Shaft, and also accessed by Roberts' Shaft, but the southern section of the ground worked from this shaft appears not to be on North Mexico Lode but on an un-named structure (possibly an elvan) linking North Mexico Lode and Borlase's Lode. In general, however, there seems to have been little development on the lodes by the date at which the plan was drawn up.

The contact between the granite and killas is shown on this plan, its location near the Wheal Mexico shafts and the known dip of the contact towards the north suggesting that the workings indicated on the plan are at a somewhat lower elevation than those cleared in 2010, possibly at a horizon equating to the Shallow Adit level in North Levant, this being about 15m below the Wheal Mexico shallow adit horizon.

The 1893 North Levant Abandonment Plan showed two adits (Shallow and Middle) above Deep Adit (3rd Level), but no indications of shallow workings between surface and Deep Adit, and it seems most likely that, by and large, the shallowest sections of the lodes had been worked out prior to this phase of operations (1851-93) on the site. Other North Levant plans and sections were almost certainly drawn up during the operation of the mine between 1851 and 1893, but, with the exception of a couple of sketch sections on shafts in the centre of the site (for example Fig 7) and the plans mentioned above, these now appear to have been lost, though a small number have been lodged with the Cornwall Record Office (Abandoned Mine Plans MRO/3030, MRO/12251 and MRO/12128. Plan X25, a plan of the Manor of Trewellard dating to 1840-1908 provides some indications of the surface arrangement of the mine).

In 1925, a plan in the Geevor Archive again made no reference to levels above Deep Adit (3rd Level), the workings shown on this source all lying between 3rd Level and 7th Level, most of these being around and to the south of Victory Shaft, extending inland to Carne Shaft on Trewellard Hill. Another mine plan in the Geevor Archive dating to 1936 showed that the mine had deepened considerably in the following decade; again, there this did not include any record of workings above 3rd Level. Whilst there are a large number of detailed plans in the Geevor Archive whose dates lie between the opening of the mine in 1911 and its temporary closure during the late 1980s, all relate to the progressively deeper workings of the mine.

Examination of Deep Adit suggest that it was driven piecemeal, and that elements of this key drainage level would probably have been amongst the earliest to have been developed. Its somewhat tortuous plan suggests that it was driven along more than one lode structure, possibly from more than one location, and there may have been some form of agreement between Mexico, Gever and Stennack mines together with Wheal Carne to develop a common deep drainage level to the benefit of all parties involved; the absence of such a feature would have considerably constrained the development in depth of the inland mines without recourse to considerable expense on pumping.

The Deep Adit plan shows that a small complex of workings seem to have been developed from the cliffs at Trewellard Bottoms; these are linked by a drive to another complex inland from Thorne's Shaft; another drive continued the adit to a further complex between Robert's Shaft and Borlase's Shaft (almost certainly continuing, though unmapped, to Redburrow Shaft and Gever Engine Shaft on Borlase's Lode). There is a connection at this level from near Borlase's Shaft out to Law's Engine Shaft in East Levant, whilst another level runs inland to workings near Pig Shaft, this eventually continuing on to drain workings under Trewellard Hill. Five potential areas which might represent the core areas of separate early mines, connected up by a common drainage level, are suggested from this plan – the first on the coast (possibly **Trewellard Mine**), the second inland from Thorne's Shaft to Robert's Shaft (**Wheal Mexico**), the third lying roughly between Robert's Shaft, Gever Engine Shaft and Pig Shaft (**Wheal Gever**), the fourth around Law's Shaft (**Stennack**, later **East Levant**) and the fifth under Trewellard Hill (**Wheal Carne**). In contrast, the courses of both North Levant Shallow and Middle Adits appear to relate to the drainage and working of Wheal Gever alone. There were almost certainly additional undocumented and now lost shallow adit systems associated with the inland mines, whose portals can be expected to have lain in the area between Geevor Mill and the St. Ives – St. Just road.

Previous archaeological reporting during investigations on the Geevor site (summarised in Sharpe 1994 and Sharpe 2010) indicates the sites of some of these shallow workings. In the southern part of the site, a plethora of small shafts, narrow, very shallow stopes, a backfilled gunnis and a small openwork were investigated in the area between the lower end of the present visitor car park and the weighbridge, as well as a substantial area of ground worked to surface on a lode outcrop in the vicinity of Pig Shaft. A small sub-surface chamber was found at the northern area of this section of ground (Sharpe 1994), whilst near-surface shallow stopes extended under the mine office. Exploration of Ladderway Shaft (near the weighbridge) by Tony Bennett and others during the mid-1990s and the St. Just Mines Research Group in recent years (pers. comm.) revealed additional undocumented shallow levels giving access to worked areas of the lodes running through this area.

A run of closely-set shafts and another openwork (on Borlase's Lode) associated with two shallow miners' chambers was found in the area between Borlase's Shaft and Footway Shaft (between the compressor house and the carpenter's shop), near-surface stoping on this feature having been recorded during the construction of the compressor house in the 1950s. Drilling confirmed extensive shallow backfilled workings extending from Footway Shaft under the carpenter's shop, whilst a fragment of a pottery bowl of possibly 16th century date was recovered from near a hearth in the underground miners' chamber near Footway Shaft, suggesting that these shallow workings were of considerable antiquity.

Further to the north, a small area of shallow workings had been exposed during the construction of the New Table Section of the mill at the end of the 1970s, these having been accessed by New Shaft adjacent to the western calciner. These appear to be on the outcrop of North Pig Lode and were re-examined during the 1990s.

Near the eastern Mexico Shaft entrance an area of near-surface stoping developed on an undocumented caunter lode structure was exposed during the works to create the new cut and cover section of the adit portal, whilst exploration of the initial section of

the eastern drive running inland from the Mexico Shaft shallow adit system showed that this had been stoped to near surface. No shallow workings have been recorded in the northern part of the site with the exception of the limited area of cliff workings in Trewellard Zawn immediately adjacent to the Deep Adit entrance.

Taken together, this evidence suggests one or more undocumented phases of early working across much of the site, some of this activity having taken the form of the exploitation of lodes from their surface outcrops using elongated, narrow gunnises and small openworks, other workings having been developed from shallow shafts, adits and stopes, some of these having been originally found through the driving of shallow prospecting tunnels. Notably, with the exception of the small amount of stoping near the mouth of Deep Adit (which shows some signs of having been worked for copper as well as tin), all of these early workings were within the granite. It can be assumed from parallel sites elsewhere in Cornwall and west Devon that development on the lode outcrops would have been preceded by prospecting activity, though most of this evidence has now been lost. The outcrop of at least one of the Geevor lodes might have been revealed in exposed bedrock during the course of tin streaming activity within the valley leading down to Trewellard Bottoms.

The archaeological evidence suggests that the principal focus for activity at these shallow levels on the Geevor site had occurred between Ladderway Shaft (near the weighbridge) and Footway Shaft (near the carpenter's shop), the most intensive operations having been centred between Borlase's Shaft and Redburrow Shaft (between the carpenters' shop and the visitor carpark), where the mine archives record the finding and working of a carbona – a locally particularly rich section of the lode; this activity probably represented activity associated with Wheal an Gevor prior to 1850.

In contrast, the archaeological and documentary evidence suggests that the workings associated with the Wheal Mexico area of the site were considerably smaller in scale at the shallowest levels. However, underground exploration between Deep Adit and Middle Adit undertaken by the St. Just Mines Research Group (pers. comm. Geoff Treseder) indicates that exploitation at slightly deeper levels within this area was on a very much more substantial scale, much of the ground at this horizon having been stoped away completely. The date at which these deeper operations took place is unrecorded, and they are likely to have been produced during the period when these lodes were being exploited by North Levant (1851-93) rather than being a result of the operations of Wheal Mexico.

In summary, therefore, the most intensive early mining activity around Trewellard had clearly taken place on Trewellard Hill (**Carnmeal Bal**). Sited on the granite and with economically payable mineralisation accessible at or near surface, these enterprises were in operation during the mid 16th century and probably for some time before this (given Norden's comments). To the north (on the Geevor site) there was evidently a fairly significant focus of operations on what became known as the Wheal an Gevor sett, particularly between Gever Engine and Borlase's Shafts, whilst to the north again rather smaller-scale activity had taken place between the sites of the Mexico Shafts and Thorne's Shaft. There may also have been a small-scale cliff working in Trewellard Bottoms. The south-western side of Trewellard Hill had been streamed more or less continuously from the Lidden (a pool near the summit of the hill) down to Trewellard, a dryworks had been developed in the central part of the Geevor site, whilst alluvial streamworking is very likely to have taken place in the northern part of the valley leading down to Trewellard Zawn.

Extrapolation south-eastwards of the projected course of the west-dipping lode worked southwards from East Sulphide Bay Shaft suggests that it ran roughly south-east under the Assay Hut, on under the Carpenter's Shop to Footway Shaft and Borlase's Shaft, under the Compressor House and the north-eastern side of the car park (where a gunnis was noted at the south-western end of this area, Sharpe 1994a) and on to Ladderway Shaft. Some of these workings would have been developed from surface. It

almost certainly continued on to the south-east onto Trewellard Hill. To the north-west it was probably worked from Magazine Shafts and Thorne's Shaft, though at a greater depth. It should be noted that the names given to lodes on and adjacent to the Geevor site vary from location to location, and through time.

6.2 Previous investigative work on East Sulphide Bay Shaft (known by PCH staff as Rock Shaft) and its associated workings

East Sulphide Bay Shaft collar at SW 37396 34598

The survey and subsequent clearance of the southern section of the adit system made accessible from New Mexico Shaft during the mid-1990s had revealed a blocked lode drive diverging from the adit on a heading of 190 degrees magnetic about 14.0m to the west of Mexico Footway Shaft. Before this heading was used for the temporary storage of material excavated from the adit leading westwards on to Old Mexico Shaft, it could be seen that its fills were partly composed of abraded gravel similar to that exposed in the roadway above, and that water flowed through this tunnel from time to time. Surface examination of the ground next to the roadway above had revealed a concrete repair patch on its south-western side and a number of adjacent areas of minor ground failure. It seemed likely, therefore, that a small, unrecorded shaft or collapse over stoping connecting with the lode drive must lie within this general area.

An initial trench 17.5m long had been opened up between the north-eastern wall of the sulphide bay and the edge of the tarmac road, in the process revealing two small backfilled features. The larger of these two could be seen to lie at least partly under the north-eastern wall of the sulphide bay together with a 1.0m strip along the eastern edge of the sulphide bay floor. Both the wall and the edge of the sulphide bay floor were demolished to allow for the excavation of the probable shaft. A disused power cable crossing the top of the shaft in a steel U-section girder (an extension of which had also been found running across Old Mexico Shaft during its excavation) was cut away.

Excavation of the upper fills of the shaft showed them to be composed of sand, soil and slimes, mixed with a little road gravel and mine waste - a similar mixture to that seen in the blocked lode drive below. As the excavation deepened, further deposits of sand, stone and broken brick were revealed, together with picking belt rejects, indicating an area of subsidence which had been repeatedly backfilled with available waste materials prior to the construction of the sulphide bays during the late 1960s or early 1970s. The cable found near surface was assumed to be a power supply installed during the dewatering of Levant in the 1960s - clearly the existence of this weak area of ground had been known about only three decades ago, though had been forgotten by the 1990s.

Excavation continued to 4.9m below the level of the base of the sulphide bay in unconsolidated mine waste, where a large granite boulder was found at the centre of the filled ground - evidently part of a past effort to block the shaft. A section of Eimco heavy duty galvanised corrugated steel rings was lowered into the shaft around the boulder and used as sacrificial formwork for the concrete shaft plug, which was left to cure.

Once this had been achieved, the boulder was drilled and lifted out, ladders installed in the shaft and excavation resumed by hand. At 6.4m from surface the shaft passed into reasonably competent rock, and a large, backfilled hitch was seen on the footwall to the west. This was cleared out and corresponding (though shallower) hitches were cut to carry a temporary working platform at this level. Below this platform the underlie of the lode was evidently rather steeper, and the hanging wall began to show evidence of instability. Two sections of mass-concrete 2.0m deep, 1.2m thick (to the north) and 0.5m thick (to the south) were installed to support the sides of the shaft at its north-western and south-eastern ends. Once this had cured excavation recommenced, much of the material being removed consisting of waterlogged slimes, which made for arduous mucking.

An entry into stopes had become visible on the south-eastern (uphill) side of the shaft at the level of the working platform (the top of the stope being at 4.6m below the surface of the sulphide bay. This was investigated and could be followed for 8.0m from the shaft, where it was blocked by a run from above, corresponding in its general location to the backfilled feature seen in the south-eastern end of the sulphide bay (Sulphide Bay South Shaft in Sharpe 2010). The stope averaged 0.5m in width, though towards its south-eastern end this widened to 1.3m. At this end the roof rose to within 3.9m of surface, and a granite boulder was seen in the fills of the probable backfilled ventilation shaft which could just be made out at the back of the stope. The stope fills were not revealed until a later stage of the excavation.

Further excavation eventually lowered the shaft fills to 10.0m from surface, where an apparently solid rock floor at adit level was encountered. Timber posts roughly 0.7m high were found on its hangingwall side set into the slimes which had infilled the adit, and there were indications that these had formed the supports for capping timbers. It seems probable that these features represented a walkable culvert installed from the shaft into the tunnel to ensure the continued drainage of the workings upslope when these were being backfilled.

Clearance and other safety work on the north-western section of this branch of the adit system and associated features during 1997 showed it to have been developed on a small lode on which some stoping had taken place, and which seemed to have been connected to surface by shafts at approximately 10m intervals. Small-scale stoping was found 3.5m from the intersection of the tunnel and the cross-cut adit running towards New Mexico Shaft on this lode drive, which heads towards Assay Hut Shaft upslope. Sulphide Bay East Shaft was located at 4.4m from the intersection. The stoping found beyond the shaft had been partly backfilled, rocky mine waste having been piled onto on a platform of stulls (horizontal bearer timbers hitched into the rock of the hanging wall and footwall) overlain with planks. A 1.7m high walkable access had been maintained beneath this platform, though this had subsequently become completely infilled with slimes and sands. This material was excavated for a further 6.0m before funds for this work ran out, though the workings evidently continued on upslope in this fashion for some distance. The source of the slimes and sands filling the tunnel was not identified at this time. The surface of the backfill in the upper section of the stope did not reach its roof (which averaged 5.0m from surface, but in places was a metre less than this). Access across the top of the backfilled material was possible for 8.0m where material had run through another small, choked shaft from surface (Sulphide Bay South Shaft).

Subsequently, once scheduled monument consent had been received, staff from Pendeen Community Heritage undertook some further clearance of the stoped area to the south of the shaft, installing new stulls and coverings (struts and planking) to support the fills in the roof of the cleared area of the stope for a distance of 5.3m from East Sulphide Bay Shaft.

Some clearance work was also undertaken by Pendeen Community Heritage (PCH) on the fills of a second adit or drive heading inland from Old Mexico Shaft. Its infill proved to be extremely waterlogged slimes, this proving very mobile. A sandbag dam was installed to hold back this material, water running from this adit was piped into the sub-floor drainage system within the section of the adit used as the visitor tour and further excavation was abandoned.

6.3 Pre-works measured survey of the workings

Two metres from its junction with the crosscut, the eastern drive had been driven through killas, measured 1.53m high with a curved roof profile and had a level rock-cut floor 0.75m wide. A haematised lode 50mm wide was visible in the roof of the drive. East Sulphide Bay Shaft (the feature known by PCH staff as Rock Shaft) intersects the drive 4.4m from the junction with the crosscut, and measures 2.25m north-south and 1.1m east-west at the elevation of the drive, though the floor here is

only 0.46m wide between well-defined rock walls. The granite/killas junction occurs immediately to the south-west of the shaft. The drive had been cleared by PCH for a distance of 5.3m beyond the shaft, new timber stulls and coverings having been installed as part of this work. A mannequin and a short section of ladder had been placed at the base of the shaft, together with 'candle' lighting (Fig 17). Beyond the shaft, the drive was 1.7m high and 0.65m wide in its base, with a hanging wall to the south-west and a footwall to the north-east, and was clearly a narrow backfilled stope. At its unexcavated end the stope was completely infilled with layers of sand and slimes above a mixture of slimes, small rocks and fragments of timber. The roof at this point could be seen to be supported by two original timber stulls carrying the remains of plank covers, above which was a layer of mixed slime and rock averaging between 3.0m and 5.0m deep, the stope being visible in cross-section at a higher level on the south-eastern side of the shaft. The lower section of the stope below the 'adit' was filled to floor level with compacted sand, gravel and slimes to an unknown depth.

Stoping at such a shallow elevation is interesting and unusual, the small size and location near the surface outcrop and the presence of closely-set small shafts further inland suggests an early date for its creation. It is probably notable that the lode seems only to have become payable and stoping undertaken where it passed from the killas into the granite. It was felt likely that the stoping had been carried out underhand (mined downwards) rather than overhand, as is the case in modern (19th century and later) mines.

The western drive, running south-west from Old Mexico Shaft, had an arched roof, is rock-cut and, just to the south of the shaft, measured 1.45m high and was 0.6m wide in its base (Fig 18). A strong quartz vein was found on its western wall. The drive ran at an angle of 130 degrees magnetic for 5.5m from the shaft (to the location of the PCH sandbag dam), then changed direction slightly towards the east, running for 10m to the point where the slimes which elsewhere part-filled it rose up to meet the roof, possibly suggesting an entry point from surface nearby. Water ran continuously from the chokage, being piped via a sub-floor drainage system within the underground visitor route to discharge to Mexico Footway Shaft and thence to New Mexico Shaft. Other than the quartz leader exposed in the western side of the adit roof, there were no clear indications that this adit was driven on lode, though this was felt likely to have been the case, given its intersection with Old Mexico Shaft.

6.4 Results from the watching brief

Initial works on the eastern drive

The works undertaken by Drillserve from April 2010 were focussed on both tunnels, work initially starting on the eastern drive. Given the presence of roughly 5.0m of potentially unstable backfill remaining in the upper part of the stope, for safety reasons the excavation of a section of tunnel could only be undertaken once individual stull timbers had been revealed, removed, replaced and new plank coverings installed (Figs 19, 20). The presence of backfilled stoping at floor level within the tunnel was confirmed by probing with a steel rod once the remains of original floor timbers had been removed. The rod could be very easily pushed down through the fill material, confirming that this consisted of slimes and that depths increased rapidly to the south of the apparently solid floor in the shaft, again suggesting the material had been mined using the technique of underhand stoping, the stope starting just inland from the nearby shaft. Further tests with drain rods confirmed that this material was in excess of three metres depth (the rods apparently intersecting the footwall at this depth). For safety reasons, planks were laid across the surface of the slimes to spread the weight of the men working in the tunnel (Fig 19), a safety line was set up and an air line installed to ventilate the working end of the tunnel. The hatch and grille covering East Sulphide Bay shaft were opened up and a portable Holman's air winch and gantry were set up next to the shaft to allow excavated material to be brought to

surface for disposal (Fig 25), the material being temporarily stockpiled within the sulphide bay, though subsequently permanently disposed of downslope.

Given the very confined space underground in the eastern drive (the tunnel was not only narrow and low but its walls were inclined by between 10 and 15 degrees from the vertical) the working environment was extremely cramped. In practice, one man working either in a crouched position or kneeling down excavated the slimes, sand and rocks from the face into buckets (Fig 22); these were then dragged back to the base of the shaft by another operative for hoisting to surface (Fig 23). Water flowed from the infilling slimes on a continuous basis, often mobilising the material and giving it the consistency of blancmange; as a result the workspace was not only cramped and rather airless but exceptionally muddy and potentially dangerous. The more substantial members of the workforce found these working conditions particularly trying. Once about a metre of the infill had been removed the next stull would have been revealed (Fig 20). This was carefully removed and any loose material revealed in the upper stope fills dislodged, the distance between hitches (shallow cut-outs in the rock walls to seat the stulls) was measured up and a new stull was cut to size from 100mm square tanalised timber and set in place. Short lengths of covering boards were then installed between adjacent stulls to provide a 'roof' which would support any material collapsing from the stope fills above and prevent it falling into the tunnel. Once complete, the process could be repeated and the next section of the stope fills excavated and the upper section supported.

By the middle of the second week of excavation about 7.0m of tunnel had been cleared and made safe, but at this point a pair of substantial timber stulls at waist level were encountered – these strutted the tunnel sides supporting a section of the hanging wall to the west which had clearly been recognised as particularly weak and in danger of collapse. These diagonal stulls were also topped with the remains of rotten covering boards. Some large flakes of granite were found within the infilling slimes at this point, whilst pieces of rock could be readily detached from the hanging wall by hand. Peter Sheppard (Drillserve) and Mike Simpson (Geevor Mine Manager) were asked to inspect this area on 7 May 2010, and it was concluded that it would be dangerous to progress beyond this point until the hanging wall had been made safe and the loose material removed, in the process locally widening the tunnel.

A trial of a non-explosive demolition agent was made to test the efficacy of the use of this type of material to remove the dangerous sections of rock on the hanging wall without having to have recourse to the extensive and (given the confined space) arduous use of air-powered rock breakers or the need to use conventional explosives to break up the rock, whose application would have to be carefully constrained on this busy tourist site. It was also recognised that drilling to place explosives to bring down loose material would introduce compressed air into fractures in the rock, with the potential to bring about uncontrolled collapses whilst the team were working. Non-explosive demolition agents are widely used in the quarrying and demolition industries, and are typically carefully formulated mixes of calcined oxides of calcium, silicon and aluminium which, after mixing with water and poured into prepared drill holes, create massive forces as the mix expands over the course of between 30 minutes and 48 hours, the time taken to have full effect depending on the grade of material used, the hardness of the rock to be split, the ambient temperature and the freshness of the product. The initial results at Geevor appeared to be highly successful, though in the event this material was mostly used to break up boulders too large to otherwise bring to surface.

Beyond the point where the pair of diagonal stulls propping the hanging wall were encountered vertical timbers could be seen (Fig 20) which were also supporting the hanging wall (which at this point formed a granite 'roof' over the western side of the tunnel). A small air gap was noted over the top of the slimes at this point, suggesting that it was possible that their surface level was going to reduce in height from this point on and that the shaft down which they had been disposed of had been sited in

the roof of the stope at or around this point. A substantial vertical timber prop recovered from this area was hauled to surface, where it was cleaned up, recorded (see Figs 50-52) and temporarily stored in a tank of water on the Geevor tin floors to ensure that it was in a stable environment pending decisions concerning its potential conservation. For a description of this piece of timber, which appeared to have been re-used several times before it was converted into a prop, see below, Section 10.

It was decided at this stage to undertake some local enlargement of the south-western end of the cleared section of the eastern drive/stope to allow the mid-height stulls and rotten covers to be removed. A jigger (air pick) was brought in and up to 250mm of granite was removed from the hanging wall, removing the overhanging sections and revealing that a large 'horse' (incorporated block) of killas within the granite formed the lower part of the hanging wall at this point. The granite at the contact between the granite and killas was in particularly poor condition, being rotten, haematite-stained and friable, clay-filled fractures within the rock being visible. Additional overhanging rock was removed using the non-explosive demolition agent with useful results, but when the removal of further loose, overhanging material was attempted with a jigger and bar, substantial sudden collapses of weak slabby material on the hanging wall took place, and the decision was taken on safety grounds to cease all work in this tunnel until a permanent support solution had been agreed.

A test pit in the base of the eastern drive about 4m to the south of Sulphide Bay East Shaft revealed between 250mm and 350mm of gritty sand over substantial planks forming an original floor. Below these, the fills consisted entirely of waterlogged slimes which could be probed to 2.5m from tunnel floor level, where there appeared to be further planking. The test pit filled rapidly with water following excavation. The excavation of an average of 1.0m depth of slimes from the floor of the tunnel inland beyond this point to gain sufficient height for the eventual visitor tour soon proved doubly problematic, in that this slimes material was waterlogged, resulting in the more or less continuous collapse of the trench ends, whilst there was also a danger of the excavators being sucked down into this exceptionally mobile and deep fill; this hazard was partially mitigated by the use of safety lanyards and temporary duckboards when working in this drive.

Initial works on the western drive

Some good progress was made on the clearance of the western drive during the same period, students from Camborne School of Mines having been taken on to assist Drillserve in the clearance of this tunnel from May to July. Work in this tunnel was more straightforward given its solid roof and solid floor, though the infilling slimes and sands, cramped working conditions and the presence of a steady stream of water running from the back of the tunnel again made for arduous and mucky work. All material was excavated into large flexible buckets and carried out of the inclined western exit of the adit system by hand (Fig 27) for disposal in the designated area nearby (Fig 28), about 120 buckets being the average for a day's work

By the end of the first full week of work on this tunnel the heading was clear for 17m from the point where it branched off the cross-cut, the fill material in this section of the tunnel sloping up to meet the roof to the south just beyond this point. Only one short (and obviously hand-cut) drill hole was observed in (the roof of) this first section of the tunnel (see Fig 45 for a similar drill hole), which passed from killas to granite about 5.0m from the cross-cut, the rock near the contact point being notably friable, cheesy and readily removable. A substantial quartz leader which had been noted on the western side of the tunnel at its junction with Old Mexico Shaft could be traced for several metres. Shallow pick-marks were observed on the eastern side wall over most of the length of the north-eastern end of the tunnel (Fig 46) suggesting that this end of the adit had been almost wholly hand-cut, or at least trimmed to shape by hand, the rock near the contact point between the killas and granite being relatively soft. A low-level candle recess was also revealed cut into the wall of the first section of the adit to be cleared (Fig 44).

Whilst the tunnel was in solid rock, traces of a weakly-mineralised lode were intermittently visible in the roof, and once the tunnel had passed from killas to granite, a definite hanging wall (to the south-west) and footwall (to the north-east) became evident, again suggesting that the tunnel had been developed on a lode structure paralleling that stoped out in the eastern heading. Probing the tunnel base revealed that it had been backfilled with between 600mm and 1.0m of slimes over a solid floor, the depth of this material diminishing as the tunnel headed inland. Once the team had excavated to a point 20m from the junction with the cross-cut, an airline was installed, as the O_2 monitor was indicating a slight reduction of the oxygen content of the air within the tunnel as a result of the men labouring in a cramped space lacking any through ventilation.

During the following week the tunnel was advanced a further eight metres and was found to enlarge in section and height as the tunnel passed into more competent granite. Pick marks were generally absent in this section of the tunnel, though drill marks became more evident in the roof, these indicating that the tunnel had definitely been driven from the north-east and that the average round (the distance advanced in each blast) was 18 inches (450mm).

At 24m from the junction with the crosscut, a distinct enlargement in width on the eastern side of the tunnel was found, and following some probing and trial digging it was established that a cross-cutting tunnel ran off on this side, the roof here also showing indications of drilling and blasting in this direction. Trial probing on the line of the south-west heading tunnel which had been cleaned out to this point suggested that this came to a dead end 0.6m ahead of the point reached on the afternoon of May 27. It was also noted that the slimes which had, further to the south, formed the bulk of the material requiring excavation formed a far smaller proportion of the material in the exposed face, these being replaced by coarsely gritty sands and several pieces of granite, most of these being in the upper third of the fill. It was suggested that these might have come from surface from a point not far on along the, at that time, unexcavated section of the cross-cutting tunnel.

On 1 June 2010 when the archaeologist was undertaking some trial excavation in the crosscut it became apparent that the team had intersected the western edge of an infilled shaft, the source of the increasingly bouldery material which was being excavated at this point. Both intact and broken timbers were also found in the fills of the shaft, some apparently being in good condition and in their original locations, others having clearly been broken when the shaft was infilled. A number of bricks were also recovered from the fills. The initial clearance of this material revealed that the shaft fills were fairly voided and consisted of coarse rock and boulders; however, the entry to the shaft from the adit had been bridged across on its western side at 300mm above the adit floor (about 750mm above original floor level) using carefully-set granite slabs and timbers (see Figs 30 and 48). The original function of this wall-like feature is uncertain.

Work was halted temporarily at this point during the work in order for the cleared sections of tunnel to be roughly surveyed and projected to surface and for the options for the next stage of the work to be considered. Despite some significant errors within the compass and tape survey undertaken at the time, it appeared that the eastern stope was heading in the general direction of the Assay Hut (generally trending at 140 degrees magnetic from East Sulphide Bay Shaft), and that the small feature plugged in 1994 and the shaft documented as Assay Hut Shaft just to the north of this building were likely to be on this lode structure. The western drive had been excavated an average of 10m to the west of the stope and more or less parallel to it in its northern section, whilst the backfilled shaft found on the short eastern crosscut from this adit lay more or less under the public footpath linking Geevor and Levant (path 159). This route had been trenched during the installation of the St. Just and Pendeen trunk sewer in 2005 (Fig 13), but no evidence for a shaft at this location had been noted during the archaeological watching brief which accompanied this work.

The fact that the depositional sequence of material infilling both tunnels was more or les identical, this being a layer of red slimes covered by a thin layer of fine greyish micaceous sand intermixed with thin lenses of dark brown organic clay topped with a further layer of slimes and sands, had strongly suggested a common point of origin for these fills (probably a small shaft connecting to surface) but also provided a strong suggestion that they would converge upslope. The increasingly frequent coarse material, timber and boulders in the fills as progress was made inland suggested that a connection to surface via a shaft in the stope to the east existed, though proving this would be dependant on further excavation.

Further clearance of the material in the shaft took place, this necessitating the replacement of a number of rotten original props and the installation of some covering timbers, as the shaft fills were collapsing on a regular basis, making working under them dangerous until this temporary work had been completed.

It quickly became established that the feature which had been intersected extended on to both the north-east and south-west, and suspicions became raised that the shaft had been created within a more extensive, linear feature. Excavation was concentrated on the exploration of the northern side of the shaft and in mid-June the team broke through into the eastern drive, of which it could now be seen it was clearly part. At this point it became evident that the purpose of the western tunnel was to act as a 'get-around' to avoid men having to walk through the weak, dangerous and extensively-propped ground found in the upper southern section of the eastern drive at this level. A shaft appeared to have been created through the stope fills to allow for natural ventilation of the workings, and probably also to allow waste to be hauled to surface for disposal. At this stage no assessment as to whether the shaft extended to deeper levels of the mine could be made, though its floor at the intersected level included a substantial horizontal timber covering filled ground, suggesting that the shaft continued down to deeper levels and that its infill had been bridged for safety reasons. The carefully-set boulders found on the western side of the shaft were found to continue to the south along the base of the hanging wall, where they had been used to foot the vertical timbers which held up the overhanging section of this side of the stope.

A second test pit was excavated in the floor of the western adit 3.0m to the south-west of Old Mexico Shaft. This revealed an interbedded sequence of water-deposited clays and fine sands over a rock floor. The resultant cleared adit profile was thus an average of 0.7m wide and 2.4m high (Figs 31 and 42). This is an unusual height for a Cornish adit, leading to the suggestion that a false floor might have originally been constructed in its lower section, below which water entering the mine from upslope would have been led to drain into Old Mexico Shaft. The possibility that water might have been led across the shaft into the stone-lined culvert found on its north-eastern side during the original mid 1990s safety works can probably be discounted given the elevation of its invert relative to that of the tunnel. Allowing drainage water to flow below such a bratticing floor structure, known in Cornish mines as a 'lost lovan', would have also promoted air flow above it back into the adit, assisting the ventilation of the workings inland.

Following the excavation of the test pit, the team began the task of removing the remainder of the infill material in the western adit over its full length, the work demonstrating that the adit floor sloped gently upwards to the south-east to promote drainage back to Old Mexico Shaft. In the process, a neatly-formed low-level candle niche was revealed not far from the junction with Old Mexico Shaft (Fig 44). The archaeologist working with the team simultaneously excavated the floor of the south-eastern end of the western drive to establish the relationship between the adit and the shaft in the eastern stope. This confirmed the existence of rock-cut flooring curving into the stope, though the presence of the blocking wall prevented the exact relationship between these two features being established at this time. Further detail of the junction was established through this work, however, the remains of an original

'doorway' formed by timber uprights and double-thickness timber planks at floor level being revealed (Figs 30 and 48). Large slabs on edge had been wedged into position within this frame using additional smaller stones resting on 30mm of gravelly fill material, whilst two slabs 500mm wide and a number of smaller stones had been placed on top of these uprights, but this time set on their flat sides. These appeared to have been set in position to act as a safety barrier between the adit and what may well have been a substantially open shaft/stope beyond. The whole arrangement had been wedged in place by chock stones and was partially supported by a vertically-set timber post to the south.

Within the area of the shaft were additional timbers. As well as the substantial diagonally-placed props which had been found in this part of the stope, there were also a number of upright timbers which seemed likely to have bratticed off the side of the shaft and a jumble of planks and more substantial pieces of timber within the upper fills which were thought likely to represent a collapsed shaft lining and shaft buntons (shaft runners). It did not prove possible to record the majority of these timbers, as working conditions were too dangerous for measured survey, and most of the timbers were only revealed through roof collapse. Some of these planks and other pieces of shaped timber were recovered during the subsequent excavation of this material down to the level of the adit floor and, where of interest, were taken to surface, recorded (see Figs 53-55) and placed in temporary storage in a water tank on the Geevor tin floors to prevent them deteriorating.

7 Safety works

A connection between the two tunnels had been made by late June 2010 and work had turned to the clearance of the remaining material in the floor of the western adit, this consisting of sands and fine gravels, though a higher proportion of rocky material was noted near the junction with the eastern drive. The larger boulders were broken up using drilling, use of the chemical splitting agent or jiggering once they had been examined for any interesting or diagnostic features, enabling their fragments to be removed from the adit. The adit walls were pressure washed to remove residual slimes and small pieces of loose rock (Fig 42), whilst a small sump was excavated into the floor at the northern end of the adit adjacent to Old Mexico Shaft to site the pump which would be needed to clear any water making its way into this arm of the adit system.

Consideration also turned to necessary safety works within the area of the shaft in the eastern stope. Temporary supporting timbers and planks had been installed here whiles the shaft was revealed given the weakness of the roof fills; where possible, original hitches in the footwall had been used to foot the temporary timberwork. In one case a pair of original iron pins set into the wall were used; a further pair of pins were drilled into the wall to support another temporary timber. Layers of planks were then set on top of the 100mm square timbers to protect the men working in the area of the shaft from rock falls. It was recognised that these would not be sufficiently robust in the long term to provide a secure covering once the tunnels were incorporated into the visitor tour, and the decision was taken to replace them with galvanised steel USBs (universal steel beams) carrying a combination of USB's alternating with 100mm square timbers to form a robust, permanent roof (Figs 29-32). Slight deepening and reshaping of two pairs of the original hitches in the footwall were required to seat the bearer steelwork securely. Temporary support timbers were also needed in the adjacent area of the stope where the hanging wall was in poor condition, as, following the removal of the slimes filling this area, the clay filling the cracks in the granite began to dry and the cracks started to open up, presenting a risk of substantial wall collapse occurring.

With the fills in the upper section of the shaft made secure, the blocking wall between the stope/shaft and the adit was removed. Unfortunately the stones making this up had to be broken up using stitch drilling, jiggering and the use of the chemical splitting

agent in order to allow them to be removed via the adit. The stones included one large granite slab 400m wide, 250mm thick and over a metre long together with a re-used 400mm square slab of very hard greenstone whose surface had become notably polished by abrasion.

Drillserve were asked to provide a design for discussion for any additional steelwork which would be required to support the unstable overhanging section of the hanging wall and to provide a safe floor along the open length of the eastern stope. An initial trial was made using a cut-down section of channel steelwork supported on 24mm diameter steel pins epoxy-resined into holes drilled into the foot wall. This supported USB stulls raking up to meet and strut the hanging wall, as well as additional sections of steel and timberwork placed so as to pick up and support the detaching sections of hanging wall (Fig 36).

Excavation of the stope fills down to a level suitable for the installation of a drainage system had proceeded from the north, adjacent to Sulphide Bay Shaft South (Rock Shaft), the material being excavated from the average 660mm wide stope being waterlogged slimes. A pump was required to keep water levels down and to prevent the slimes from becoming too liquid to excavate easily. As work progressed southwards, however, the western (hanging) wall of the stope became increasingly undercut, and about half way to the shaft at the junction of the two tunnels the evidence suggested that the lode had been faulted to the west, the stope hanging wall becoming undercut to in excess of 750mm (Fig 32). A small unworked pillar of rock found bridging the stope at the southern end of this section (see Figs 46 and 47) provided a strong indication that the original miners had become concerned about the increasingly fractured and unsupported hanging wall and had left this piece of the lode in place to provide some additional support to prevent its failure. Shortly after the section of the stope to the north of the pillar had been excavated the hanging wall began to collapse as clay-filled fractures in the rock began to dry out. Weak sections of rock were barred down for safety, but it became apparent that some significant support steelwork would be required if this drive was to be safely included in an extended visitor route. A meeting was therefore arranged at the end of July to determine what would be required in the way of support. It was concluded that the excavated section of the stope should be allowed to dry out without any additional support during the period from August to September whilst the contractors would be off-site; this would allow any areas of significant weakness to make themselves clearly apparent. A scheme of support work would be drawn up and agreed with the site archaeologist and English Heritage once the contract team returned to site in late September 2010.

Whilst the team was off site, Scheduled Monument Consent (SMC) was applied for and granted for the final round of works, which were to comprise safety and support works, drainage works, floor surfacing, the removal of dangerous or projecting wall rock and the installation of a low-voltage lighting scheme in order to make the newly-cleared sections of tunnel accessible to the public as part of an extended visitor tour.

Between July and September, a suspect section of the western wall of the stope collapsed along a line of weakness formed by a clay-filled fracture and the first task for the team was to excavate around a tonne of this collapsed material, bring it to surface and assess the stope wall in this area to determine its support requirements.

It was concluded that, whilst the hanging wall was unstable, it could be adequately supported through the use of steel pins and straps, coupled with sections of UB at floor and roof level, effecting forming a support framework for the most concerning section of hanging wall (Fig 40). This was agreed with English Heritage and, following its installation and the further removal of fallen rock and further slimes from the base of the excavation, a galvanised steel mesh floor was installed in the northern section of the stope, running up to and over the small section of remnant pillar (Fig 41). To the north of this, conditions allowed the installation of a timber floor on steel supports (Fig 37), this effectively covering over what appeared to be a small winze (an internal

mine shaft connecting levels) or an extension of the shaft at the junction of the tunnels which may have been served by a small hand winch (Fig 47). The southern extension of the drive was bratticed off with timberwork set in a steel frame anchored into the rock (Fig 34). This would prevent any residual fill collapsing into the visitor tour area, but was deliberately engineered so that it could be removed if further sections of stope forming an extension of the adit system to the south were proposed for future clearance.

With access and support works completed in the eastern stope, its walls were pressure washed to clean them of slimes and a sump was excavated into the slimes in the floor to site a pump to deal with incoming water. This was lined with a galvanised steel dustbin to help to keep the pumped water reasonably clean and maintain the sump sides open. The existing underfloor drainage system in the seaward section of the adit system was found to be inadequate to cope with the increased flows so produced, and flexible piping was trenched into the floor linking these two new pumps with New Mexico Shaft, where it decants, eventually making its way via this shaft into the Deep Adit drainage system.

8 Access and lighting works

In the western arm of the newly-excavated adit system, the Drillserve team had removed all of its infill down to a bedrock floor throughout. Whilst this would, theoretically, have provided a clean and walkable surface for visitors, the fractured quartz lode in the western wall of this drive was found to be a major source of water ingress following rainfall. The adit had originally been cut to drain to the north into Old Mexico Shaft, though the visitor tour floor surface in the previously excavated section of the adit at this point was about 750mm above that in the western branch. Although a sump had been created in the choked fills of Old Mexico Shaft, there was no way that water making its way into the western branch could naturally drain into this, and although a small pump had been installed to lift incoming water in the western branch into the Wheal Mexico visitor tour drainage system, it was recognised that the floor in the newly-excavated western adit would potentially be significantly wet for much of the year. As a result, perforated drainage pipes were laid in the northern section of this tunnel and coarse gravel was laid over the whole of the adit floor to provide a free-draining surface suitable for visitor access; an upgraded pump in a rock-cut sump was installed near Old Mexico Shaft under a short flight of timber steps.

In the eastern branch (the stope), no solid floor was found during the excavation of the infilling slimes, with the exception of an early, buried layer of timber planks. The waterlogged and highly mobile nature of the unexcavated slimes infilling the lower part of the stope could never form a safely walkable surface (the means by which this material was supported at depth being unknown), and the installation of a range of suspended floors (Figs 37-39, 58) was agreed with English Heritage as part of the third application for Scheduled Monument Consent (see Appendix 2). At the southern end of the excavated section of the stope it proved possible to install a section of timber planked floor founded on small galvanised UBs set into hitches cut into the rock walls (Fig 37). For the walkway northwards from the remnant rock pillar spanning the stope, sections of heavy-duty galvanised mesh floor units were recovered from the Geevor scrap pile, cut to size and set onto UBs spanning the stope at floor level (Figs 38-39, 41). This approach allowed the remnant fills of the stope to remain visible, provided a safely walkable surface and allowed for maintenance of the drainage pump and sump near East Sulphide Bay Shaft (Rock Shaft). From the shaft north-eastwards to the connection with the original visitor tour route, the rock-cut floor of the eastern drive was cleaned and covered with a thin layer of gravel to provide a non-slip, free-draining surface.

The original visitor tour route had been equipped with intermittently-sited 110 volt bulkhead lights and a number of spotlights (Fig 60) to obviate the need to issue visitors with expensive cap lamps, and to ensure that there was a failsafe emergency

lighting scheme to assist evacuation, should it be required. Whilst effective, the system was, by 2010, out-dated and expensive to run. 'Candle' bulbs had also been installed by PCH along the route, together with battery-powered lamps illuminating small interpretation panels at key points along the visitor tour.

The requirement to extend the system to light the newly-excavated sections of the adit system presented the opportunity to undertake a complete upgrade. A new system utilising low voltage LED lighting units (Fig 61) was agreed with English Heritage; these lamps would be unobtrusive, easily maintainable if required, waterproof, long-lasting, cheaper to run and were available in forms which could provide either general light or directional spotlighting (Figs 62-63). Cabling was run through the tunnels at low level, whilst the lamps were installed in standard conduit fittings clipped to the adit walls at locations agreed with the HE Projects Archaeologist, these being generally at 3m intervals about 300mm above the finished floor level. A number of spotlights were installed at key locations. The cables required to supply the various arms of the adit system, and to supply power to the two drainage pumps were trenched into the floor – these cables were wholly laid within recent fills spread across the adit floor to provide safely walkable surfaces for visitors, and hence had no appreciable archaeological impact. Power was tapped from a supply on the nearby tin floors at surface, and led via a shallow trench to Mexico Footway Shaft and thence into the workings. The power supply is split into a number of independent circuits feeding the new extension, the western and the eastern sections of the original visitor tour and the new pumps. To power the lighting circuits the 110 volt supply trickle charges batteries in control cabinets on the tin floors; these ensure a guaranteed 3 hour burn time for the lights in the event of a power failure, allowing adequate time for the Wheal Mexico adit system to be safely evacuated should this occur.

9 The adit survey

As part of their contract, Drillserve were asked to survey the whole of the existing and extension to the visitor tour in order to create a permanent record of the works, and to provide a base plan which could be used to record the location of the lighting installation, drainage system and other features. Compass and tape surveys of the existing visitor tour had been undertaken on its initial discovery and at various stages during its clearance by Adam Sharpe (CAU Archaeologist) and Geoff Noble (Clerk of Works) during the mid-1990s works, but all of these surveys were incomplete and of limited accuracy. A further compass and tape survey was undertaken by Luke Anstice and Colin Davies (CSM) during the clearance of the tunnels, but unfortunately this included a survey error which resulted in the conclusion that the southern tunnel ends were separated by a greater distance than subsequently proved to be the case.

In late July, ex-CSM trained mine surveyor Sam Wood was commissioned by Peter Sheppard of Drillserve to undertake a levelled theodolite survey of all of the excavated sections of the Wheal Mexico adit and stope system. This was successfully completed with the assistance of one of the CSM students and the results were made available in paper form to HE Projects in early August 2010. The survey (Fig 14) was scanned and digitised using TurboCad software in order to provide a base plan on which the proposals for the Phase 3 works could be plotted. The scan (as a *.jpg file) was also geolocated using ArcGis 9.2 software (Fig 15) to determine the positions of the workings at surface, in particular the backfilled shaft at the junction of the tunnels, which proved to lie beneath both the line of the St. Just pumped sewage main and a public footpath (Fig 13).

10 Artefacts recovered during the works

A small number of artefacts were recovered from the fills of the tunnels, the majority being found within the western adit or in the shaft at the junction of the tunnels. Most were recovered from the tunnel fills near the intersection with the shaft in the eastern stope, suggesting that they were residual, and had made their ways to the locations where they were found by having been disposed of from surface down an open

excavation by being incorporated into backfill material. As well as half a dozen (undated) bricks and some unidentifiable timber fragments, this small collection of material also included a large wrought iron bracket (see Fig 49) which appeared to have been a timber clamp. The object is blacksmith-made; given the nature of its findspot, no date can be assigned to it though it is likely to be 19th century in date, given its form.

A section of goose quill (Figs 56-7) which would almost certainly have been used as part of a fuse train was also recovered. The modern safety fuse was invented by William Bickford in 1831 and came into general use not long thereafter; this piece of goose quill fuse is, therefore, likely to have been used in the early 19th century or before. It therefore predates the working of North Levant, which was started in 1851, and is likely to be an artefact associated with Wheal Mexico. This section of fuse consists of two sections of goose quill, one section 73mm (3") long being inserted 35mm (1½ ") into a second section of quill 103mm (4") long, giving a total length of 137mm (5½"). The shorter section of the quill had been cut off cleanly at its outer end, and had become filled with fine pink clay (probably slimes). The longer section of quill had split at the sleeving point and was empty of any material.

This appears to be a short length of unfired/unused goose quill fuse; it is probable that individual goose quills would provide, at best, three to four inch lengths which could be filled with powder and built up in lengths to provide a handy (if not always very reliable) time delay fuse when blasting. The quill fuse was found by one of the excavators (John Dowling) within the slimes in the western drive near Old Mexico Shaft, and so is likely to have been transported there by water from a site further up the adit.

During the stripping of the original timber supports, one of the larger and better-preserved timbers within the eastern drive was considered by the project archaeologist to be of interest, given that it showed signs of at least two phases of reuse. This was winched to surface, where it was cleaned and recorded (see Figs 50-52) prior to temporary stabilisation storage in a water tank on the Geevor tin floors. The timber measured 1360mm (4' 6") long, though had probably been cut down from its original length), had slight tapers at each end, and had originally been 230mm x 200mm (10" x 8") in section. It had been made of dense softwood, probably pine, and was completely waterlogged, having rotted at its lower end. A pair of 24mm (1") diameter holes had been drilled through the timber at the centre of two sides at 185mm (7.25") centres 190mm (7.5") from one end, on one side cut-outs 45mm (1.75") square and 20mm deep had been cut around the drill holes to allow square washers or bolt heads to be seated flush with the surface of the timber. A further 25mm hole had been drilled into the timber 563mm (22") from this pair of holes. On the opposite face a plugged hole was found 560mm from the end and a further hole 790mm (31") from the end. These holes may have been used to clamp this timber to another timber, possibly suggesting that it had been part of a series of pump rods.

The timber had subsequently been re-used, however, as suggested by a series of shallow but carefully-made cut-outs and chamfers which were noted on these faces of the timber (see Fig 50-52). One cut-out at the centre of the timber measuring 295mm x 100mm (11.5" x 4") and 30mm deep (1.2") is likely to have allowed the end of a plank to be socketed into the timber. A more complex cut-out 70mm (2.75") in from the end of the opposite face measured 270mm x 160mm (10.5" x 6.3") and was 50mm (2") deep. Immediately adjacent to its long edge was a shallow elongated socket 250mm x 60mm (10" x 2.35") in plan. These sockets had been carefully cut to allow either another timber, or, more likely, an unidentifiable piece of ironwork to be fitted to the timber. Chamfering of one corner of the timber was also noted on this side. During this phase, the re-used timber might have been part of a frame, possibly for a piece of machinery.

The timber has clearly been truncated, and had suffered considerable rot and consequent loss of detail during its final use as a simple vertical prop in the eastern

drive. Nevertheless, it seems to have had three clear phases of use – firstly probably as a section of pump rod, secondly, in a cut-down form, perhaps as part of the framing for piece of mine machinery and finally, truncated yet again, as a prop to hold up a weak section of the upper part of the hanging wall in the partly backfilled eastern stope to allow continued access through this section to other workings inland. The hangingwall support timbers were found to have been footed onto a series of substantial planks set onto the gravel and slimes floor at this point, these timbers evidently having been used to spread the load imposed by the props on this inherently soft material.

Some of these waterlogged planks were recovered during excavation, and where sufficiently intact, were transported to a water-filled tank on the Geevor tin floors for temporary storage to prevent deterioration through drying out. In addition, the excavating team had been asked to keep an eye open for any shaped timberwork and to reserve these for recording. Two sections of planking with large mortises at their ends were recovered (Figs 53-55), as well as the end section of a 100mm square timber with a tenon whose size broadly matched the cut-outs in the planks (Fig 53). These timbers were recovered from the jumble of material forming the shaft fills, however, and were clearly not *in situ* as recovered. Their form suggests a frame of some sort – probably not a shaft sett given their sizes. It has been suggested from their location adjacent to the small shaft continuing down through the floor of the stope at this point and from two documentary drawings (in Agricola 1556) that they might have been part of the framing for a small windlass or alternatively the treads of a wide rope ladder. Given the method by which they were recovered (i.e. by contractors and not through archaeological excavation), either might have been the case.

Another larger prop was also recovered and was found to be in sufficiently good condition to potentially be used for dendrochronological (tree ring) dating. However, following discussions with a specialist, it was felt that given that no reliable dendrochronological sequence for the species from which the prop had been made existed, this would not be practicable. The timber has been retained for potential coring to provide material for C^{14} dating.

11 Interpretation and significance

The shallow workings which have, during a series of rounds of clearance and allied safety works over two and a half decades, been made partly accessible around Old and New Mexico Shafts probably represent some of the earliest yet found on the Geevor site and are likely to relate to the operation of Wheal Mexico during the 18th century or earlier. In this respect they are likely to be the earliest mine workings which can be publicly accessed anywhere in Cornwall at present.

The scale of the workings as found is typical for such a period, being just wide enough to allow miners to work and to remove the lode, waste and ore being raised to surface for processing or disposal (as appropriate) during their creation via a series of relatively closely-set shafts, these also having been used for access and ventilation (the miners almost certainly using hand barrows to transport material back from the working faces). The height of the western drive is unusual, however, the reason for this not yet being fully explicable. The elevation of its floor suggests that it was cut when the floor of the eastern stope was also at this general elevation. Whilst this might have been at an early stage during the development of the stope, perhaps when the weakness of the hanging wall had become apparent and the need for a get-around tunnel had become apparent, the presence of a planked floor buried within almost the whole of the stope fills at more or less this elevation (which also matches that of the floors within the rest of the Wheal Mexico adit system) suggests that the cutting of the western adit took place at a time when it was still necessary to maintain a walkable access into other (as yet unexcavated) workings further inland at this horizon. The

stope below this level might have continued to be developed at this time, or it might have been abandoned and backfilled.

The narrowness of the workings indicate that most, if not all of the work was undertaken by hand, almost certainly using hand drills, picks and gads in the relatively soft granite encountered at this elevation. It is unclear whether blasting was employed when driving all sections of the headings, as no clear drill marks were seen during the clearance of the stope, though some became apparent the further the western adit extended inland and the granite became harder further from its contact with the killas outcropping to the north.

The stopes created on payable sections of the lodes were narrow and were unlikely to have produced particularly rich ore, given their shallow elevations, though had been developed with some vigour. Their full depth is unknown.

Evidence for multiple phases of activity

The excavation of the two new sections of tunnel at Wheal Mexico has allowed a tentative analysis of their likely development sequence, as follows:

- Underhand stoping developed on the eastern drive on a lode outcrop which became payable to the south of the killas/granite contact near Sulphide Bay East Shaft (Rock Shaft).
- Covers and stulls were put in for protection before the next stage of underhand stoping was carried out – probably because of weak ground encountered in the hanging wall and to obviate the danger of roof and/or wall collapse onto men working below.
- A shaft was maintained to surface through the stope fills 25m from the crosscut, probably for ventilation and waste haulage. Other small shafts are known to lie further upslope along the strike of the lode, though were not accessed underground during this round of exploration and clearance.
- The lower section of the stope was either boarded over at adit level or backfilled, but the shaft was probably maintained.
- A walkway was maintained at level of Mexico Shallow Adit through the worked-out stope and on inland, but additional propping was found to be needed in an area of bad ground, making future access through this section difficult for the miners.
- A work-around adit (western drive) was cut from Old Mexico Shaft to the ventilation shaft in the stope beyond the worst section of bad ground
- Gravels and sands were washed down or dumped into the shaft (possibly following coning of the shaft throat, more likely deliberately) and began to backfill the sections of the adit and stope nearest the shaft. Boulders within the fills nearest to the shaft suggest a phase of deliberate backfilling from surface, the natures of the other shaft fills also support this scenario.
- Highly mobile slimes were disposed of down the (possibly already loosely backfilled) shaft; these ran over the surface of the already-present materials, filling the western drive, as well as almost completely backfilling the lower section of the eastern stope, these possibly being deposited on a surface formed by a timber floor 2.5m down from the Mexico Shaft Shallow Adit level. The slimes had flowed on into the Mexico Shallow Adit system downslope, by and large filling it. Much of this material was excavated during the 1990s when the visitor route was created. The source of the slimes is uncertain as the shaft would have been sited upslope from the lower sections of all documented dressing floors, suggesting that they were created and disposed of in the early to mid 19th century at the latest, originating from an undocumented dressing floor whose working predates the working of North Levant. As an alternative,

they may represent the disposal of very muddy water pumped up from Robert's Shaft upslope, in which case they would date to the mid to late 19th century during the working of North Levant. The substantial volume of slimes and the often well-defined layers within which they (and interbedded fine sands) were found to fill the tunnels strongly suggests deposition over an extended period resulting from the operation of dressing floor equipment on an undocumented site.

- Although potentially datable material buried by these slimes was found, no funds are presently available to place any of the above sequence of the development of the operation and subsequent infill of the adit within the history of the development of the Geevor site.

12 Further recommendations

12.1 Unexcavated sections of the Wheal Mexico adit system

The as-yet unexcavated parts of the Wheal Mexico Adit system to the south (inland) of the current and proposed areas of the visitor tour present the potential for further archaeological investigation of what, on current knowledge, are likely to be the earliest potentially-accessible underground workings on the Geevor site, if not in Cornwall. The clearance of the tunnels undertaken in 2010 has already exposed sections of stoping at levels far nearer surface than had previously been anticipated to be likely, together with an undocumented small shaft and evidence of multi-phase working. It was noted during the project that the granite walls of the tunnels became notably more competent as the tunnels progressed inland, further from the granite/killas contact zone and deeper below surface. This should imply that the workings in the currently unexcavated inland section of the adit system are likely to have been driven through more competent granite and will be well-preserved. Further sections of either open or backfilled stoping are likely to exist, as well as additional shafts to surface and other features associated with their development and working. Whilst it is clear that slimes and other materials deposited into the ventilation shaft will have flowed into the currently unexcavated sections of the stope/adit, those areas further inland may well be substantially clear of such material and may well contain discarded tools, shaped timbers and other potentially datable artefacts, as has been found to be the case in other early mines explored elsewhere in Cornwall (pers. comm. St. Just Mines Research Group and others).

12.2 Opportunities for the recovery of datable material

The presence of further support timberwork in the unexcavated section of the Wheal Mexico adit system is strongly likely, presenting opportunities, if budgeted for, to obtain material suitable for dendrochronological or C^{14} dating which would provide dated evidence for levels of expertise in the development of underground mining technologies at Geevor, indeed in Cornwall. Other timber artefacts, some potentially *in situ*, may aid considerably in our understanding of the generally undocumented or poorly documented technologies utilised by early hard rock miners in Cornwall. The relatively recent finding and subsequent C^{14} dating (to the mid-1500s) of a section of timber pipe column at Wheal Hermon not far to the south considerably added to our understanding of the development of hard rock mining in Cornwall, and given the particular layout of Wheal Hermon) the surprisingly early date at which under-sea mining must have been taking place there. Another pair, which have very recently been discovered in the mouth of a shaft sunk into the beach at Polberro near St. Agnes, although undated, seem to confirm this theory. Early dates cut into adit and stope walls have also been found from time to time in Cornwall, some of these also being at Wheal Hermon. Opportunities to date early mining features within Cornwall have been very limited to date, but the *in situ* Wheal Mexico timberwork provides precisely such an opportunity, and has the potential to shed considerable light on a poorly-documented pre-industrial phase of early mining activity in Cornwall.

12.3 Conservation works to artefacts recovered during the 2010/11 works programme

The clearance work undertaken on the Wheal Mexico adit system in 2010/11 revealed a substantial number of pieces of waterlogged wood, which, from their findspots, can be assumed to be of some antiquity, possibly dating from the period when this shallow area of the mine was first being worked. Many examples were undiagnostic in form or so badly affected by rot that they were discarded. A few examples, however, appeared to be of greater interest. These were brought to surface by the contractors, photographically recorded, measured and drawn and then stored in a water tank on the Geevor tin floors in order to stabilise them.

However, at the time when the bid for funds to undertake the extension of the visitor tour were being put together, no expectation of the discovery of potentially significant artefacts was made, and hence no allowance for their conservation included within the budget.

It is recommended, however, that a grant be sought for the conservation of either all or selected timber artefacts recently found at Geevor (those shown in Figs 52-3) through long-term stabilisation using the polyethylene glycol impregnation method (or similar) for eventual display on site at Geevor. Given the size of the timber artefacts this may well be a fairly costly process. Enquiries should also be made as to any likely deleterious effects on the artefacts through their continued submergence in the water tank at Geevor should the funds to undertake this work not be forthcoming in the relatively near future.

It is further recommended that should any future extension of this adit system be considered, a contingency sum to cover the costs of artefact conservation should be allowed for within the relevant project budget.

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13.3 Websites

http://www.imagesofengland.org.uk/ English Heritage's online database of Listed Buildings

http://geevor.com/ the website relating to Geevor Mine which is maintained by Pendeen Community Heritage

14 Project archive

The HE project number is **2010029**

The project's documentary, photographic and drawn archive is housed at the offices of Historic Environment, Cornwall Council, Kennall Building, Old County Hall, Station Road, Truro, TR1 3AY. The contents of this archive are as listed below:

1. A project file containing site records and notes, project correspondence and administration.
2. Electronic drawings stored in the directory R:\Historic Environment (CAD)\CAD Archive\Sites G\Geevor underground tour extension works 2010029
3. Digital photographs stored in the directory R:\Historic Environment (Images)\Sites.E-H\Geevor underground tour extension works 2010029\
4. This report text is held in digital form as: G:\Historic Environment (Documents)\HE Projects\Sites\Sites G\Geevor underground works 2010029\Report\Wheal Mexico underground extension report.doc
5. Artefacts retrieved during the project are currently stored at Geevor.

Fig 3. A 1973 PMB aerial photograph of the complex of mine workings on Trewellard Hill just to the south of the Geevor site, showing the huge number of small shafts which developed on many sub-parallel lode outcrops, many sunk during the 16th and 17th centuries. It is likely that the early mining landscape at Geevor would have been similar in form and appearance.

Fig 4. An extract from the c1840 rectified St. Just Tithe Map showing the area from the St. Ives road to the coast at Geevor, mine buildings on the coast at A) Trewellard Bottoms, and spoil dumps at B) Thorne's Shaft, C) Magazine Shafts, D) Borlase's Shaft and gunnis, E) Wethered Shaft.

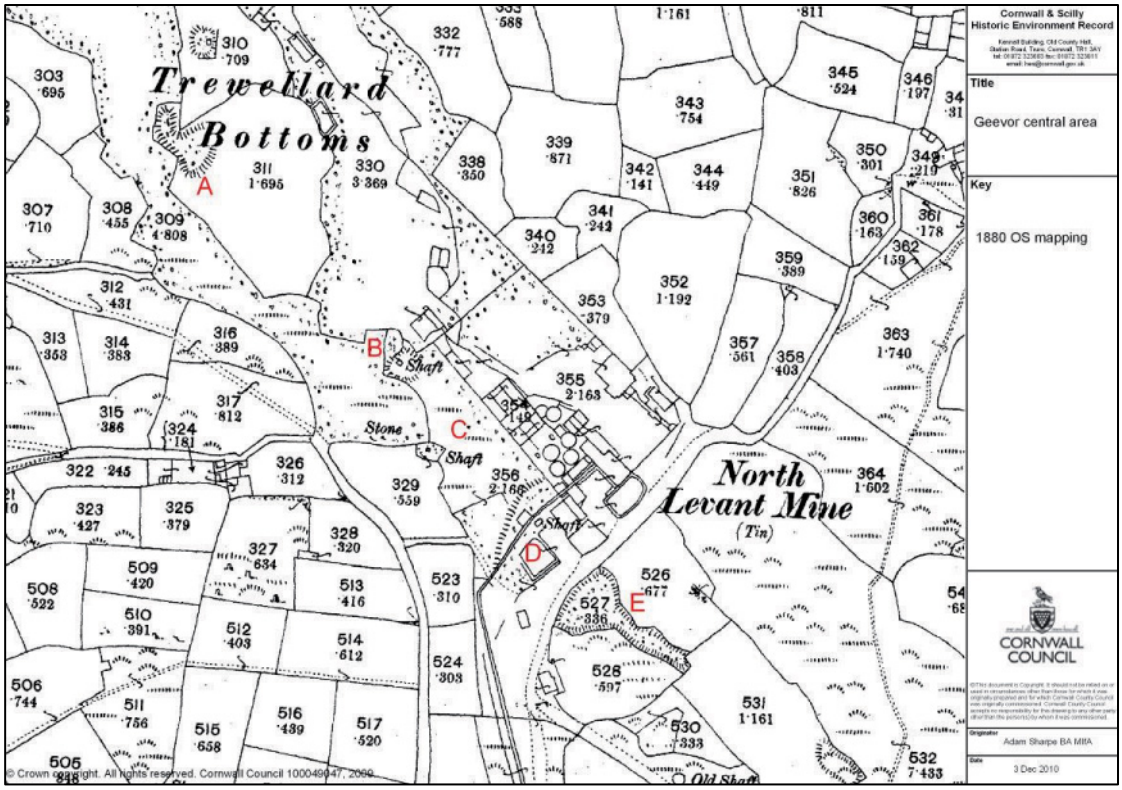

Fig 5. The central part of the Geevor site (working as North Levant) in 1880. A) Thorne's Shaft, B) New Mexico Shaft, C) Assay Hut Shaft, D) Roberts' Shaft, E) Borlase's Shaft. Extract from OS 1st Edition 25" to a mile mapping.

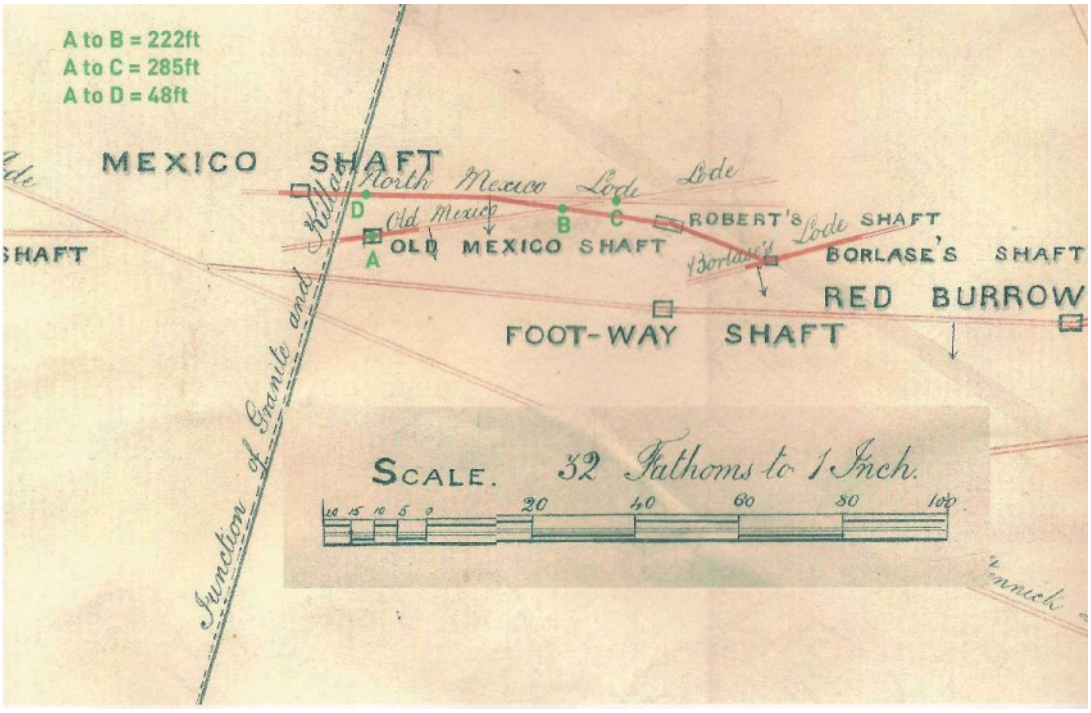

Fig 6. An extract from an undated plan drawn up when North Levant was at work showing levels driven on North Mexico and Old Mexico Lodes, and also showing Mexico Shaft (New Mexico Shaft), Old Mexico Shaft, Roberts', Footway and Borlase's Shafts. The annotation in green was digitally added to this image by Peter Savage, PCH. North is to the left. Geevor Archive.

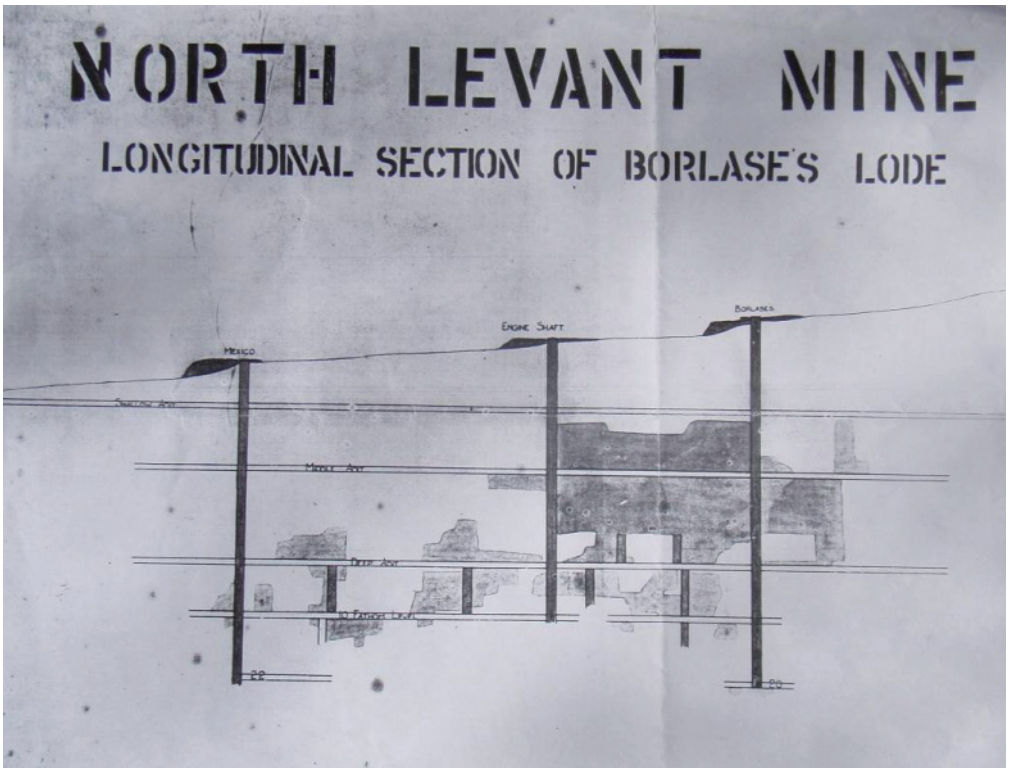

Fig 7. An undated but probably late 19th century longitudinal section on Borlase's Lode in North Levant between Mexico Shaft and Borlase's Shaft. Engine Shaft is another name for Roberts' Shaft. The Mexico Shaft shallow adit is not shown, being at a higher elevation than the 'Shallow Adit' shown here. Geevor Archive.

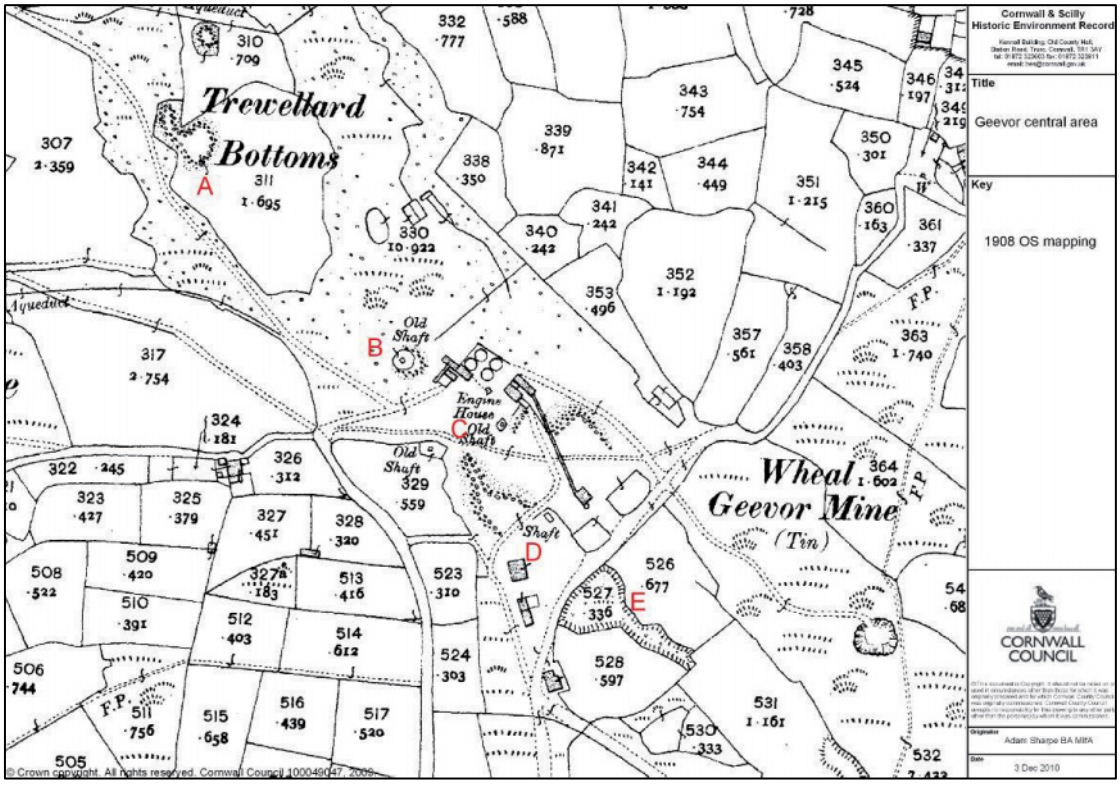

Fig 8. The central part of the Geevor site in 1908 shortly after the opening of Wheal Geevor. A) Thorne's Shaft, B) New Mexico Shaft, C) Assay Hut Shaft, D) Roberts' Shaft, E) Borlase's Shaft. Extract from OS 25" second edition mapping.

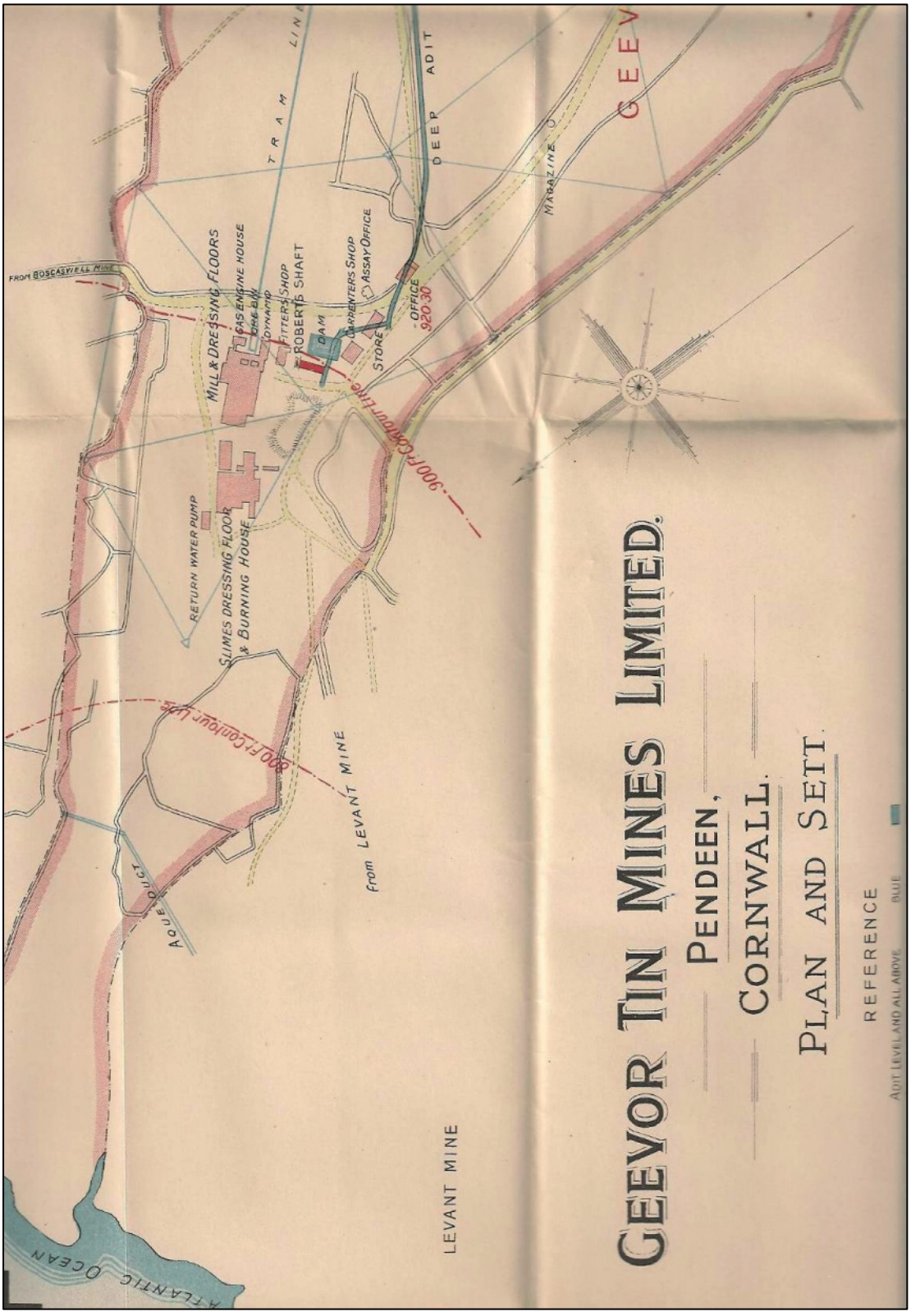

Fig 9. An undated plan of the Geevor surface and underground arrangements, probably drawn up circa 1915. None of the Mexico Shafts were indicated on this plan, which showed that the focus of operations lay between Pig and Wethered Shafts to the south, though Robert's Shaft was shown as in active use. Geevor Archive.

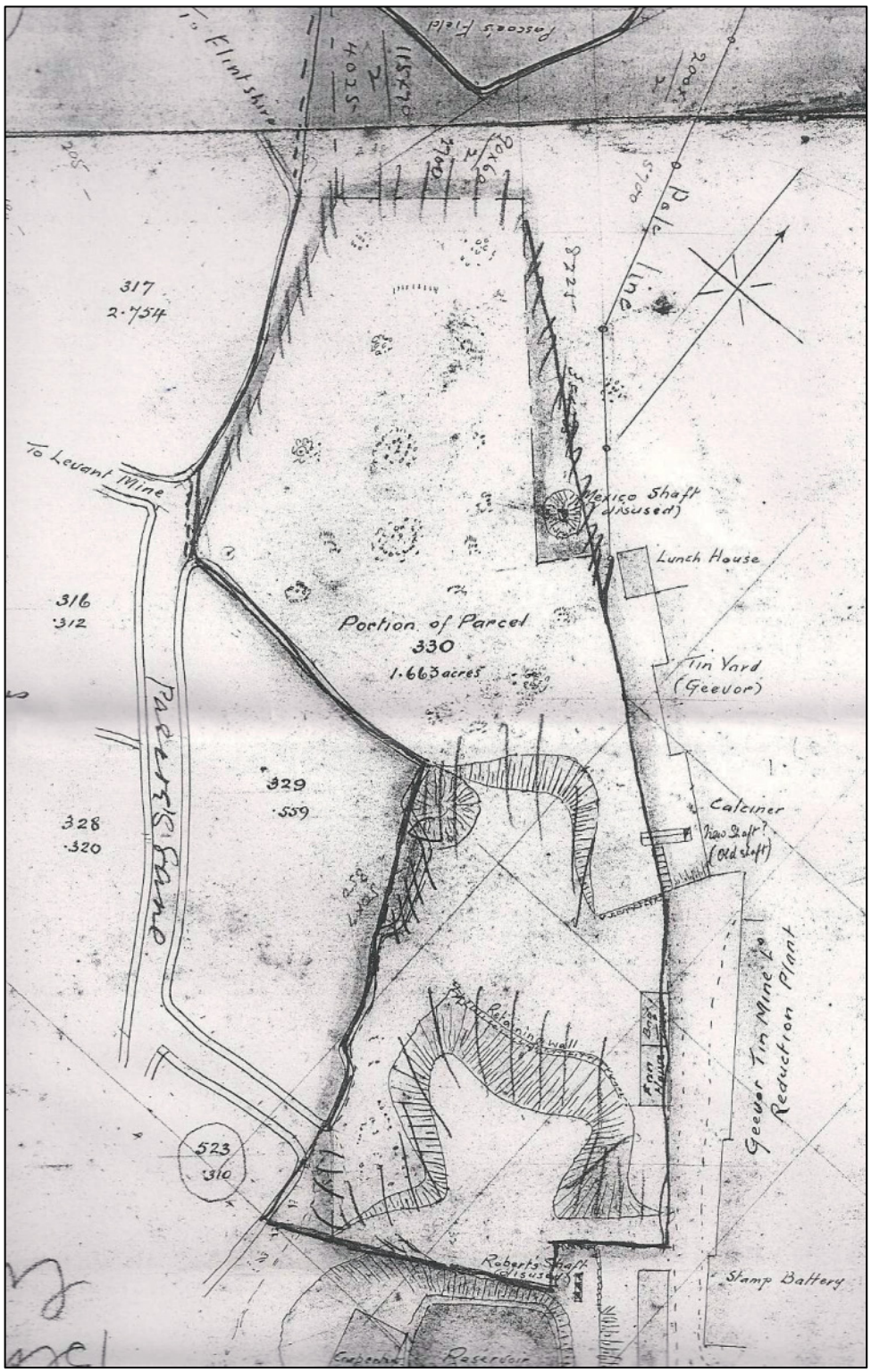

Fig 10. An undated plan of the lower section of the Geevor site (probably drawn up circa 1920) showing a parcel of land within and adjoining which were (New) Mexico Shaft (shown as disused), Assay Hut Shaft (centre), New Shaft (Old Shaft) and Robert's Shaft (also shown as disused). Site north is at the top. Geevor Archive.

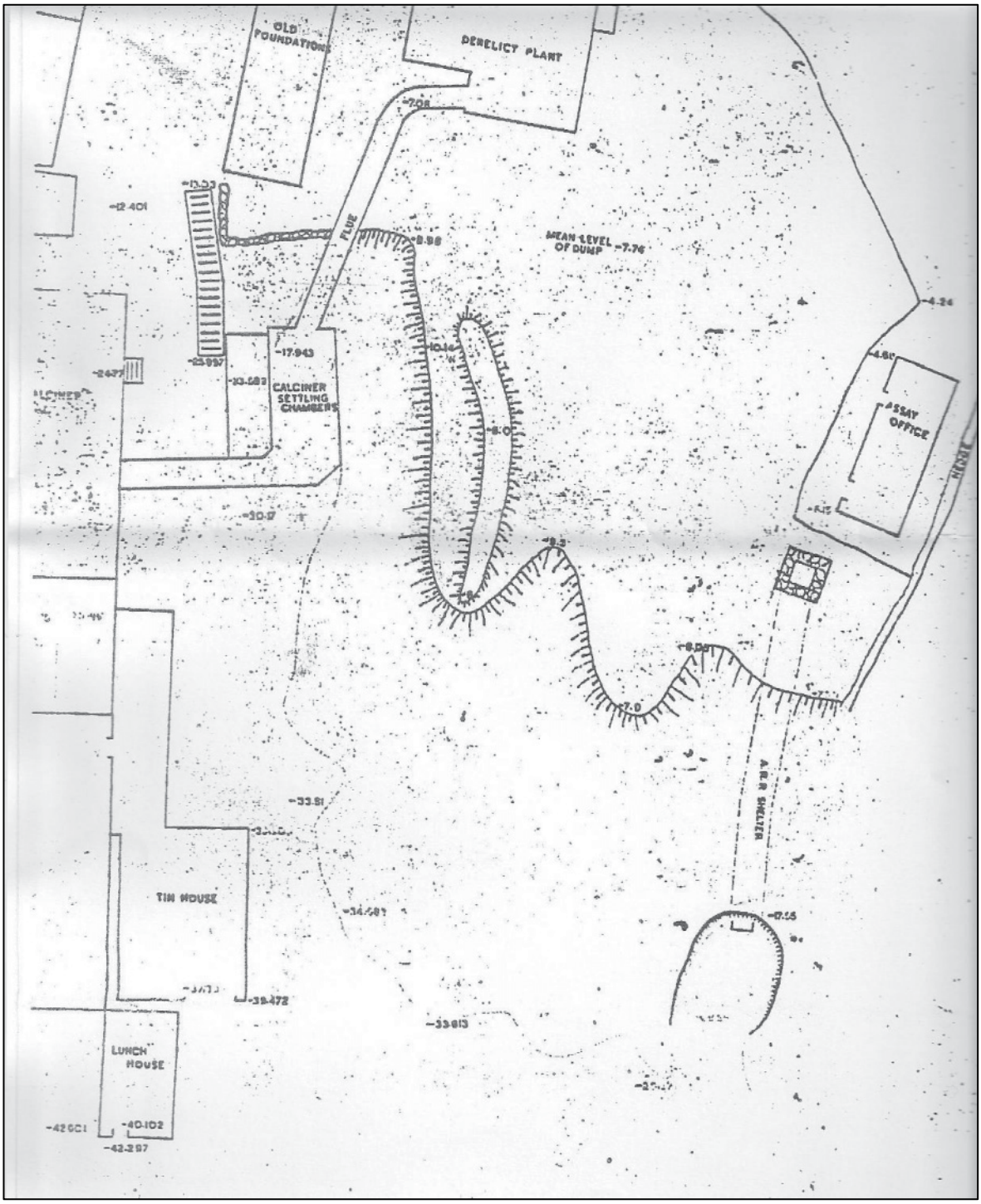

Fig 11. An undated plan of the lower section of the Geevor site (probably drawn up circa 1940 given the presence of the air raid shelter). Site north is at the bottom. The plan shows an ARP (air raid precaution) shelter adjacent to the Assay Hut (centre right) accessed by a very shallow level adit and ventilated by the upper section of Assay Hut Shaft. Geevor Archive.

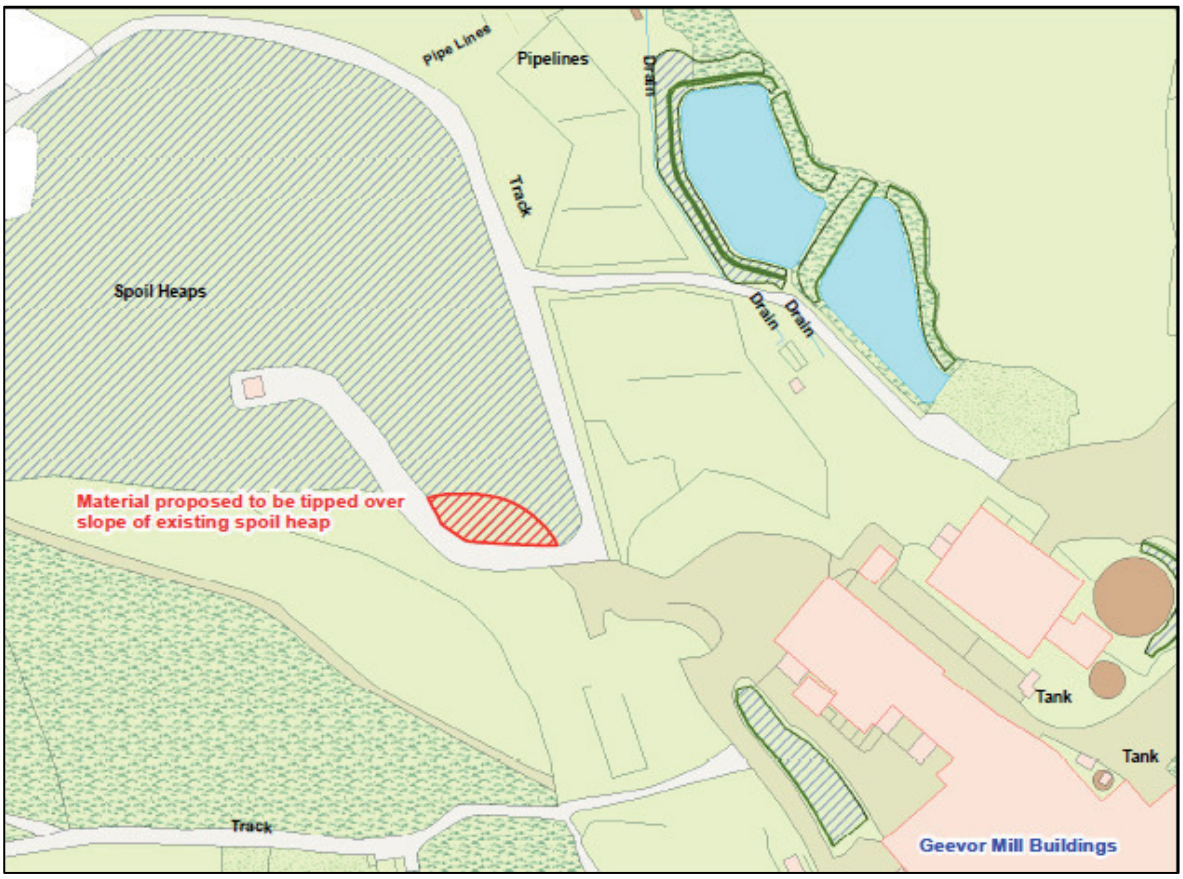

Fig 12. A copy of the plan submitted with the CLAIRE application, showing the location proposed for the disposal of the arisings from the tunnel excavations.

Fig 13. A 2005 Cornwall County Council aerial photograph of the lower part of the Geevor site showing (red line) the route of the main sewer and the locations of A) Mexico adit entrance, B) Mexico adit exit, C) New Mexico Shaft, D) Old Mexico Shaft, E) Mexico Ladderway Shaft, F) Sulphide Bay East Shaft. © Cornwall Council.

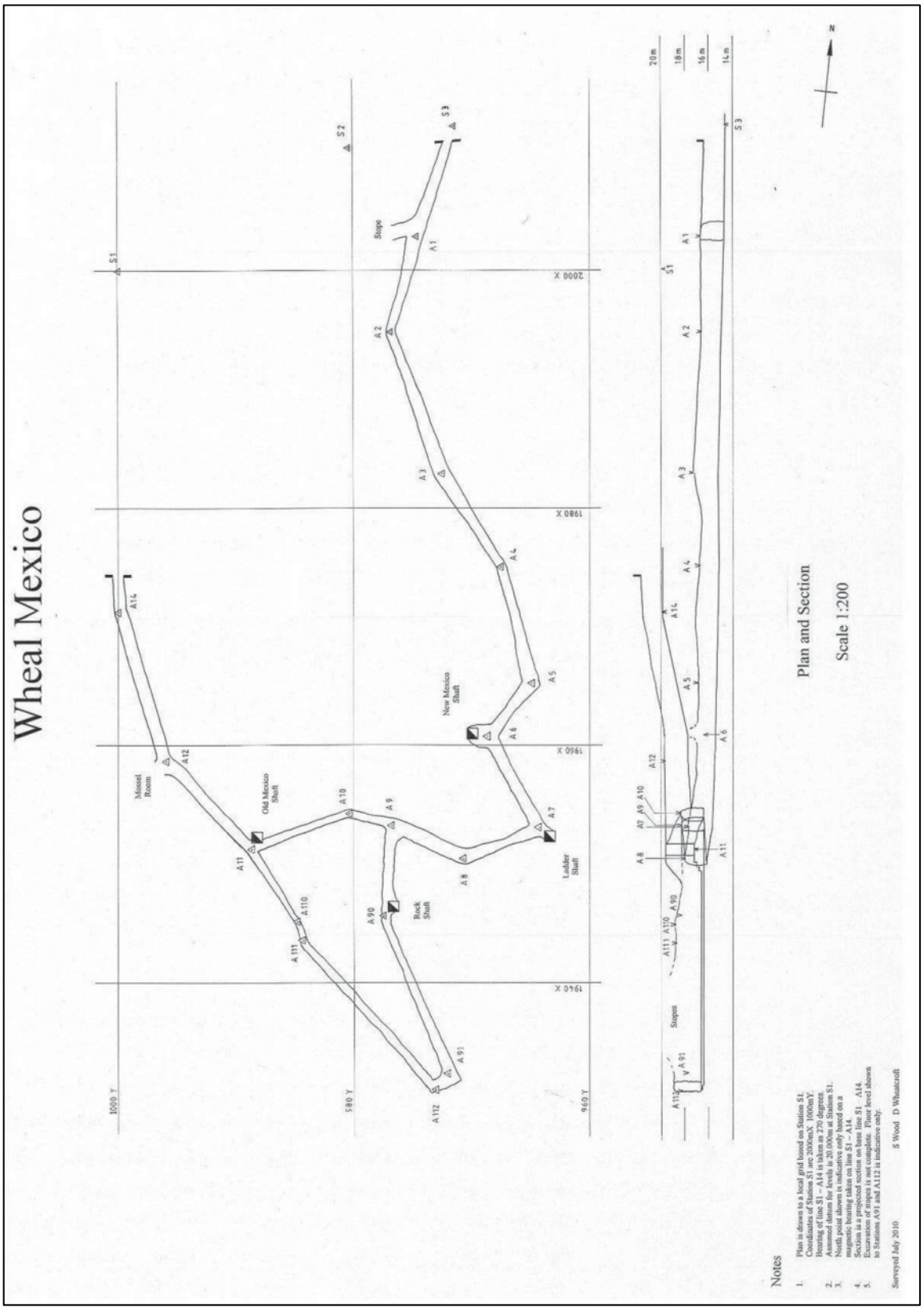

Fig 14. The 2010 Drillserve plan and section of the Mexico Shaft adit system. The diagonally-divided black and white squares indicate the locations of shafts, whilst the triangles mark survey stations. The grid is local to this survey only. Fig 15 rectifies this survey to the National Grid using the locations of the adit portals.

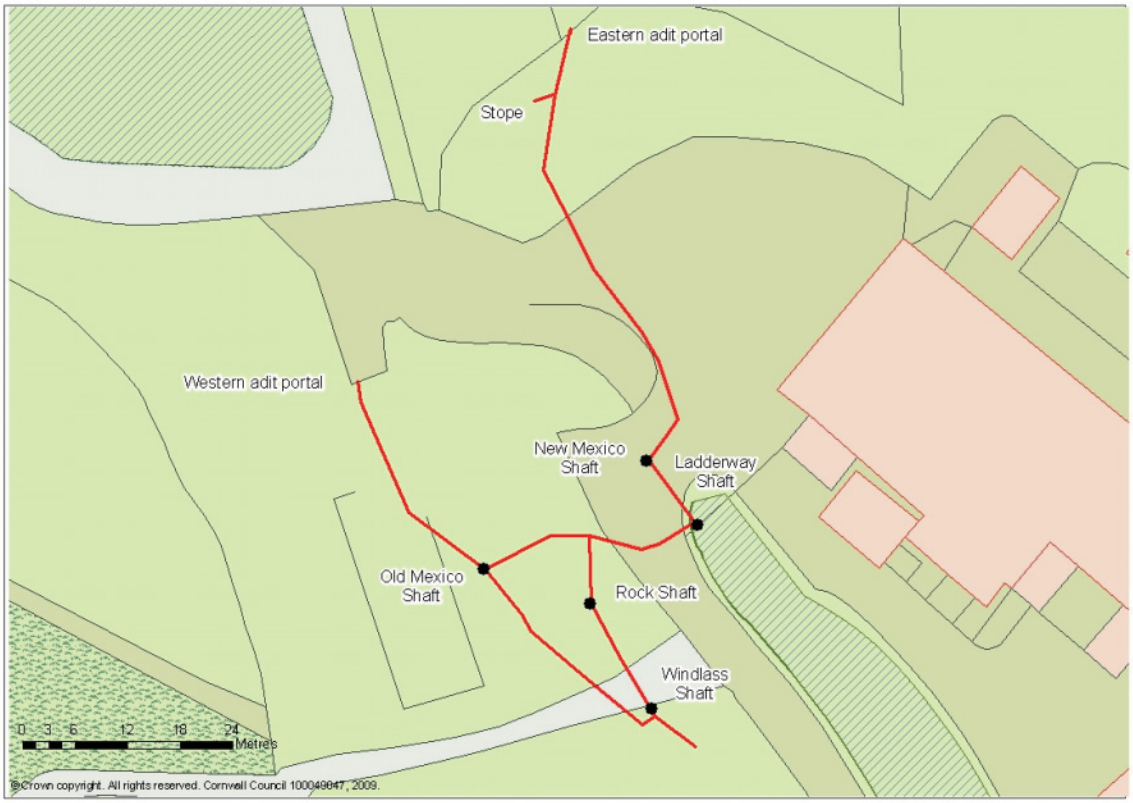

Fig 15. A rectified version of the 2010 Drillserve adit plan. A rectification algorithm incorporated into ArcGis 9.2 was used to geolocate the survey onto the OS Mastermap base. It should be noted that the position of the path from Levant (in grey, bottom of image) does not accurately reflect the position of this feature, which lies a little way to the south.

Fig 16. Features associated with the Wheal Mexico adit system. A) Adit entrance, B) Adit exit, C) New Mexico Shaft, D) Sulphide Bay, E) Assay Hut, F) Carpenters' Shop.

Fig 18. Looking south from Old Mexico Shaft into the western drive before work began, showing the water standing in it and the 'candles' installed by PCH. The drive was blocked a few metres upslope.

Fig 17. A view from the crosscut on the original visitor tour to Sulphide Bay East Shaft on the eastern drive prior to works, where PCH had set up a tableau including this mannequin.

Fig 20. Some of the original timber stulls in the eastern drive. Note also the timber support lower right, which supported an overhanging section of the hanging wall.

Fig 19. Looking up the eastern drive at an early stage of the works, showing the timber stulls on which the cover boards were set. The planks on the floor kept the contractors from sinking into the slimes filling the base of the stope.

Fig 21. The area at the toe of the waste dump agreed as the site for the disposal of the material excavated from the Wheal Mexico adit system.

Fig 22. Nick Hall, one of the CSM students working with the contractors, excavating spoil from the western branch of the adit system.

Fig 23. Mervyn Brakespear (Drillserve) attaching a bucket of spoil excavated from the eastern drive to the hoisting cable in East Sulphide Bay Shaft prior to it being hauled to surface for disposal.

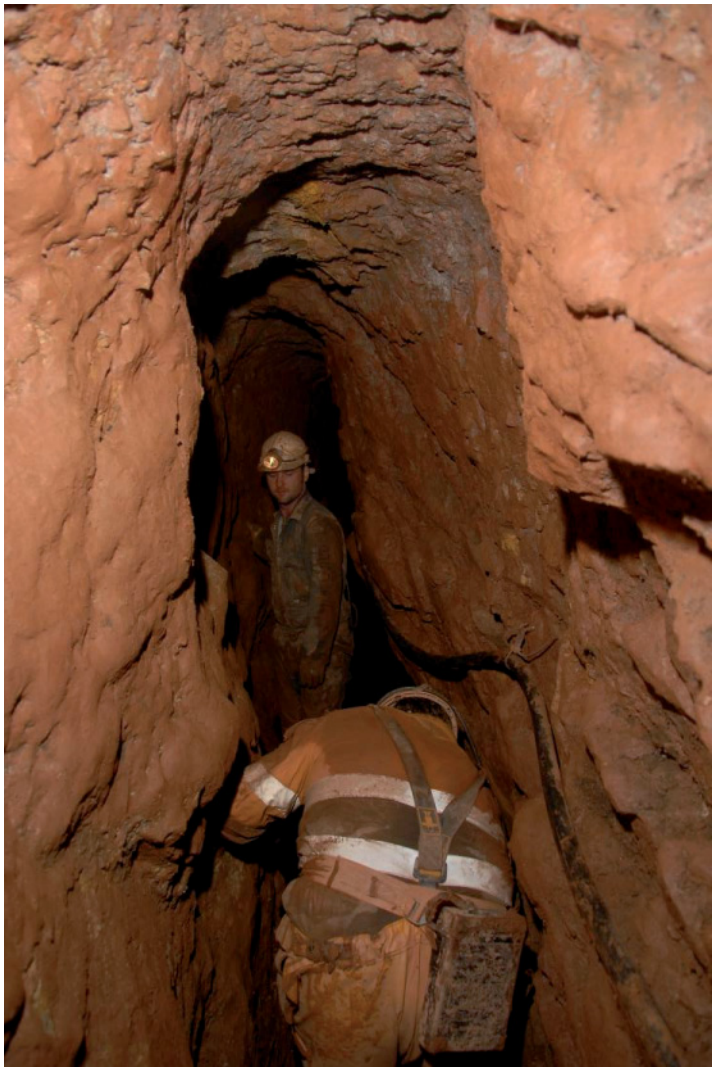

Fig 24. A chain of contractors (here Luke Anstice and Colin Davies) hauled buckets of material excavated from the western drive back to Old Mexico Shaft, from where it was carried to surface for disposal. The narrowness of the adit is readily apparent.

Fig 25. Douglas Wheatcroft and John Dowling using a compressed-air Holmans' winch and gantry to haul buckets of spoil up from the eastern drive via Sulphide Bay East Shaft. This approach greatly reduced the amount of manual work involved in clearing the spoil in this drive, as well as limiting impacts on the visitor tour.

Fig 26. The air winch was also invaluable in getting heavy or bulky materials underground, in this case the UBs used to support the coverings over Windlass Shaft. From L-R Colin Davies, Douglas Wheatcroft, John Dowling and the Author. Photo © and courtesy of Bernie Petterson.

Fig 27. All material excavated from the western drive had to be manually removed using a bucket chain (here showing John Dowling and Luke Anstice). AJ, one of the Geevor guides, looks on.

Fig 28.Once carried by bucket to the adit exit, the material was barrowed to the agreed dumping area not far downslope (Nick Hall tipping the barrow).

Fig 30. Looking from the southern end of the western drive into the connection with the eastern stope. The steelwork in the roof was installed to support the loose material above, which runs to surface. The stone wall between the two tunnels survived at this time.

Fig 29. This view southwards in the eastern drive gives a good impression of the amount of timberwork needed to support the hanging wall during clearance operations. Further low-level props are being installed in this view.

Fig 32. Work under way in the eastern drive, showing the permanent and temporary timberwork to support the hanging wall (Mervyn Brakespear and John Dowling shown at work).

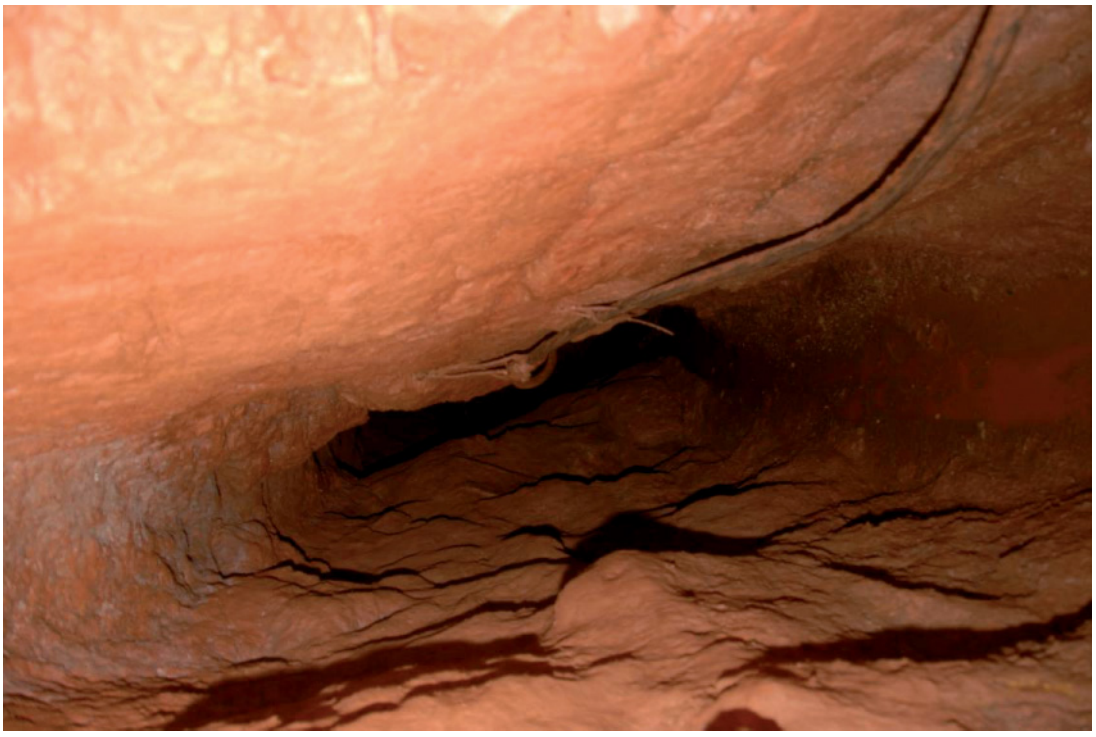

Fig 31. Looking south along the western drive following its excavation.

Fig 34. The limits of excavation on the eastern stope once the unexcavated fills had been bratticed off and the timber floor had been partially constructed.

Fig 33. Work under way at the southernmost extent of the excavated part of the eastern stope. Mervyn Brakespear is standing on the fills of 'Windlass Shaft', whose curved eastern wall is just visible to his left.

Fig 36. Looking north from Windlass Shaft down the eastern stope, showing the substantial roof support required at this point.

Fig 35. Looking south in the eastern stope. The plank is resting on the rock pillar found at this point.

Fig 38. Pat Orient flame cutting a low level floor support UB to length in the eastern drive.

Fig 37. Mervyn Brakespear constructing the planked floor at the southern end of the eastern drive.

Fig 40. The steel channels and strapping used to create the necessary support for the weak section of the hanging wall in the eastern stope.

Fig 39. The steel mesh floor set on UBs installed over most of the length of the eastern stope.

Fig 42. Nick Hall pressure washing slimes from the walls of the western drive.

Fig 41. The completed steel mesh flooring in the eastern stope, showing the greatly reduced headroom between the floor and the roof support at this point in the adit system.

Fig 43. Sam Wood undertaking the survey of the Wheal Mexico adit system.

Fig 44. A low-level candle niche excavated into the footwall of the western drive.

Fig 46. A section of the wall of the western drive showing evidence for having been dressed with a pick.

Fig 45. A hand-cut drill hole in the roof of the western adit near its southern end.

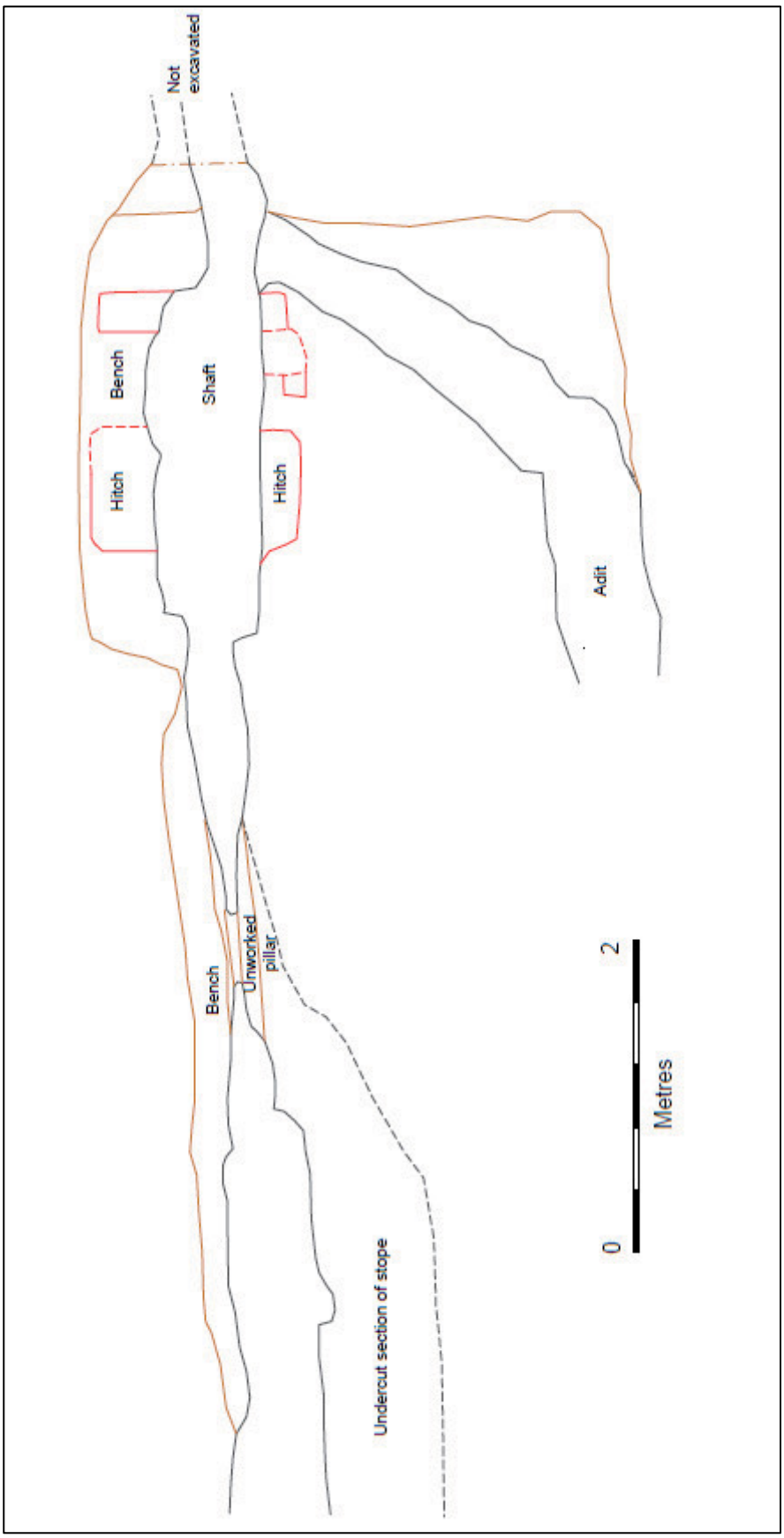

Fig 47. A measured plan of the area of the junction of the eastern and western drives. Site north is at the bottom. Key: dark grey - drive width at floor level; brown – maximum drive width; red – floor level hitches interpreted as the location for a windlass over the small shaft in the floor of the eastern drive.

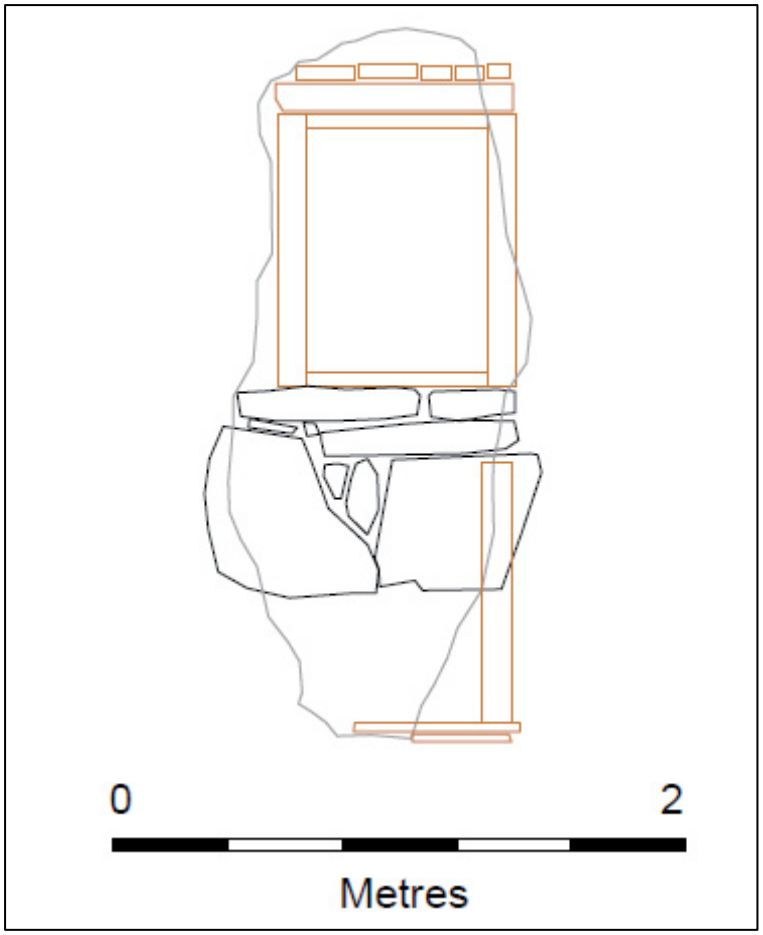

Fig 48. A measured elevation of the junction between the western adit and the eastern drive, viewed from the west and showing the timber framed 'doorway' and stone wall which were found at the connection. The profile of the tunnel at the junction is shown in grey. The lower timbers were found immediately to the west of the walling.

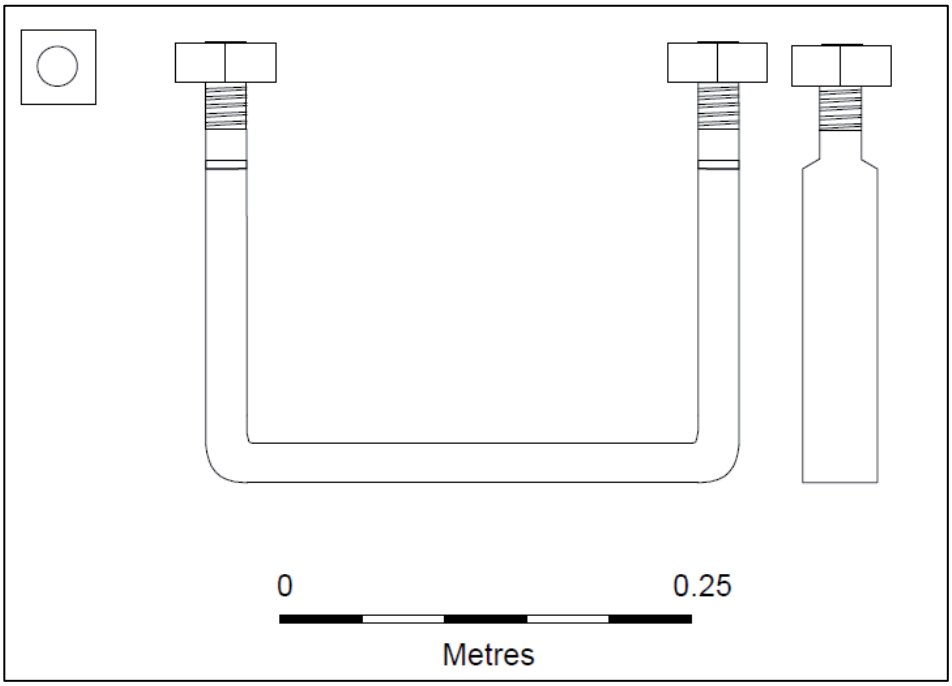

Fig 49. A blacksmith-made wrought iron bracket, evidently originally paired with a plate or a pair of plates which would have fitted over the threaded sections. This may have been a clamp to fix two long timbers together, and was found in the backfill of the probable shaft adjacent to the junction of the tunnels.

Fig 50. One of the timbers recovered from the eastern stope. Although last used as a prop to support the hanging wall, it had clearly previously been used for other purposes.

Fig 51. A carefully cut mortise in one face of the recovered timber, as well as one of the holes drilled through it.

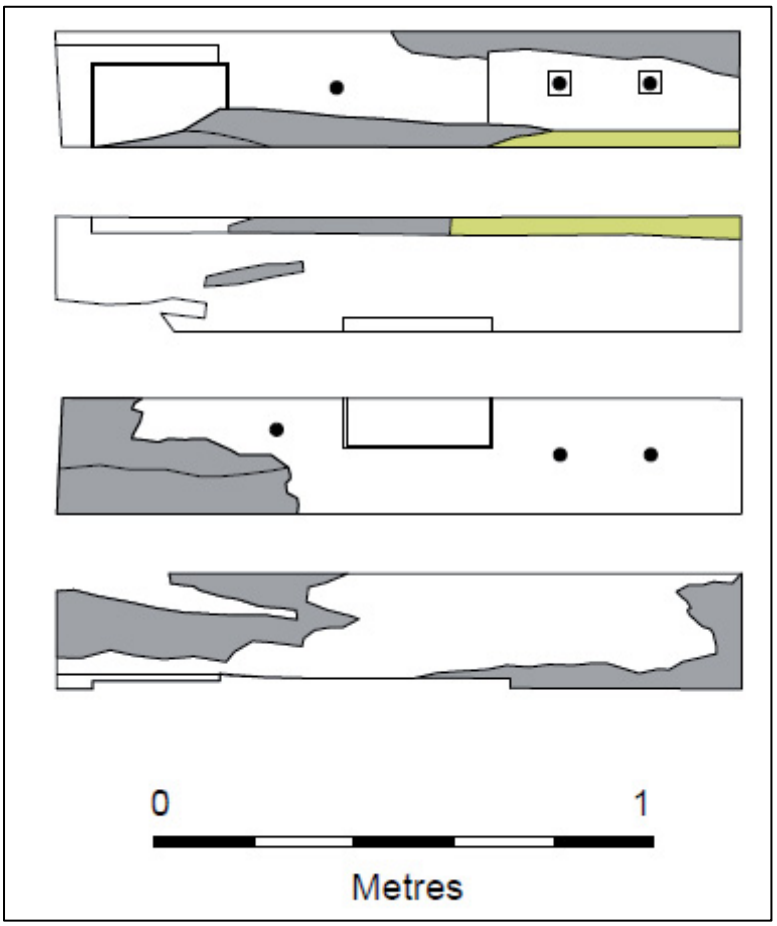

Fig 52. A measured drawing of the piece of timber reused as a prop in the eastern drive. Key: Grey shading – areas of timber which had rotted away; Yellow – chamfer.

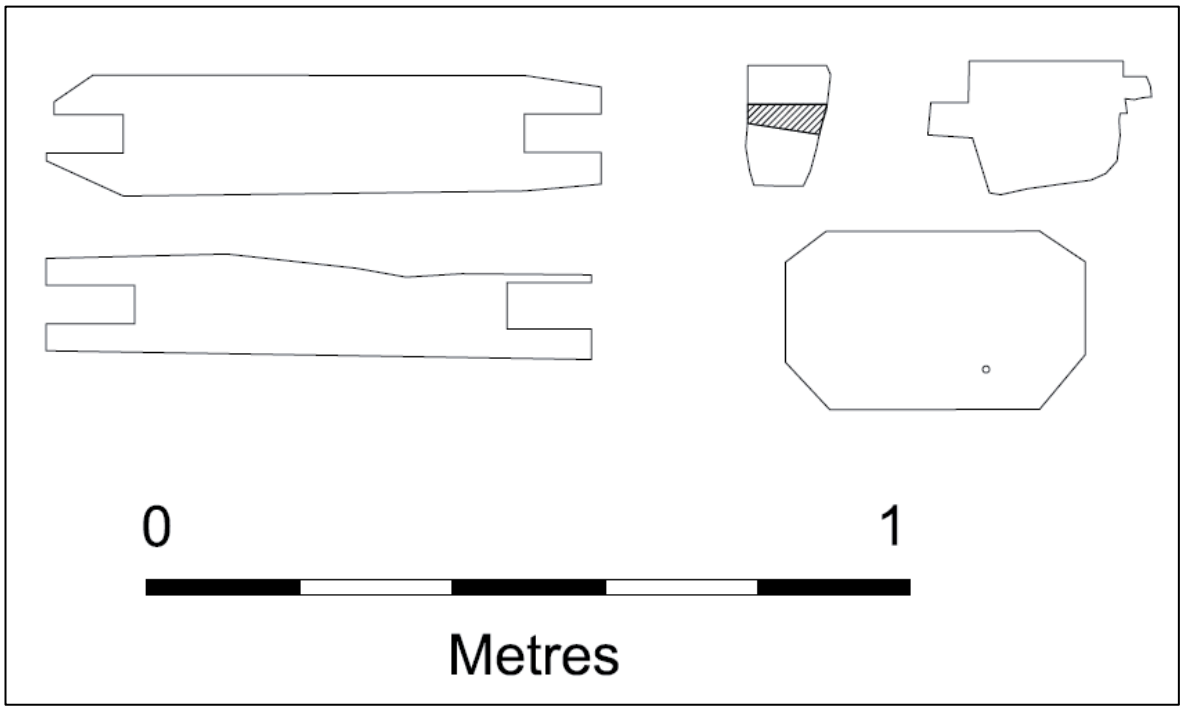

Fig 53. Sample timber artefacts recovered during the excavation of the eastern drive. Left – the two possible windlass components; above right – the remains of a section of timber with two tenons found adjacent with its end section; below right – a carefully-shaped panel, possibly the end of a small hand barrow.

Fig 54. One of the timbers recovered from the stope fills near the internal shaft. It has been suggested that the paired cut-outs and careful shaping suggest that it was part of an early windlass support, though it may be part of a ladder. 500mm scale.

Fig 55. A less well preserved piece of timber, but clearly intended to perform the same function as that shown in Fig 54.

Fig 56. The goose quill fuse found in the western adit backfill. 100mm scale.

Fig 57. The disassembled goose quill fuse. The material protruding from the left hand end of the upper section is the dried clay which fills it, whilst its reddened section indicates the extent to which it was inserted into the lower piece of quill. 100mm scale.

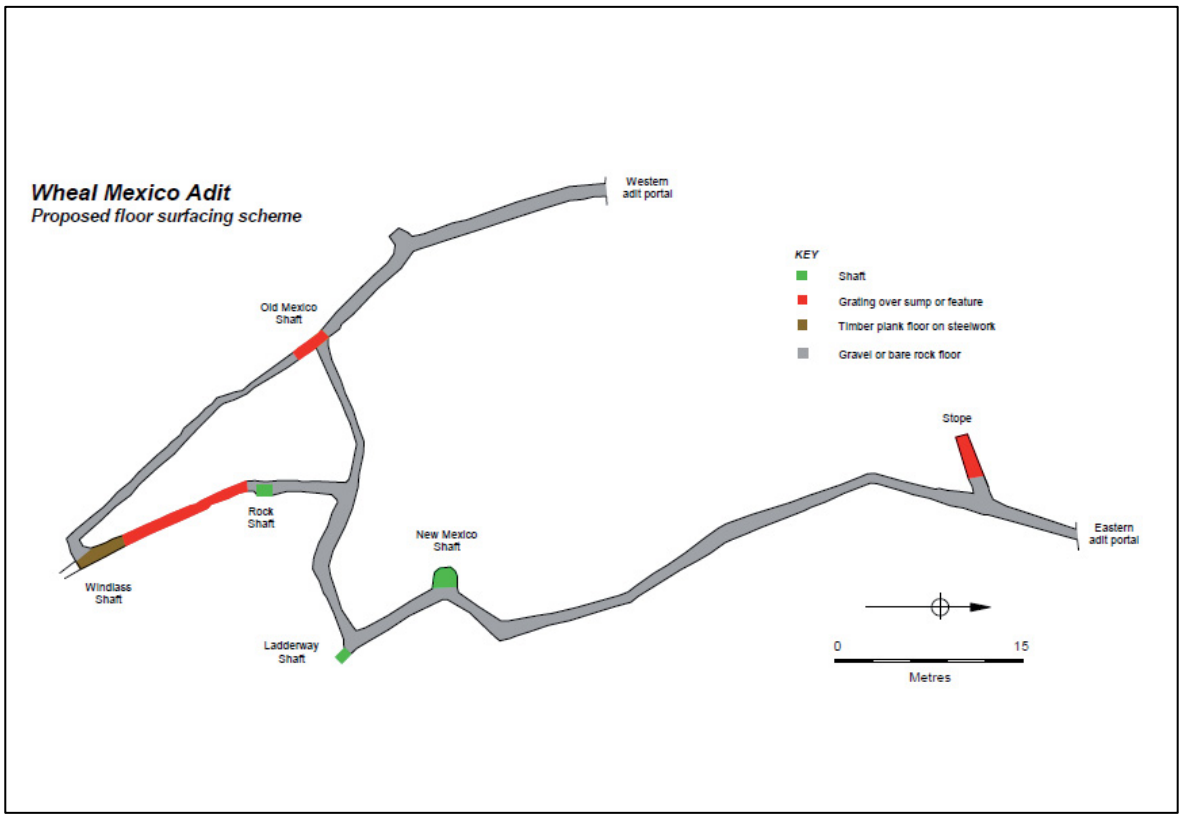

Fig 58. The floor surfacing scheme adopted in the visitor tour following the completion of the works to its new extension.

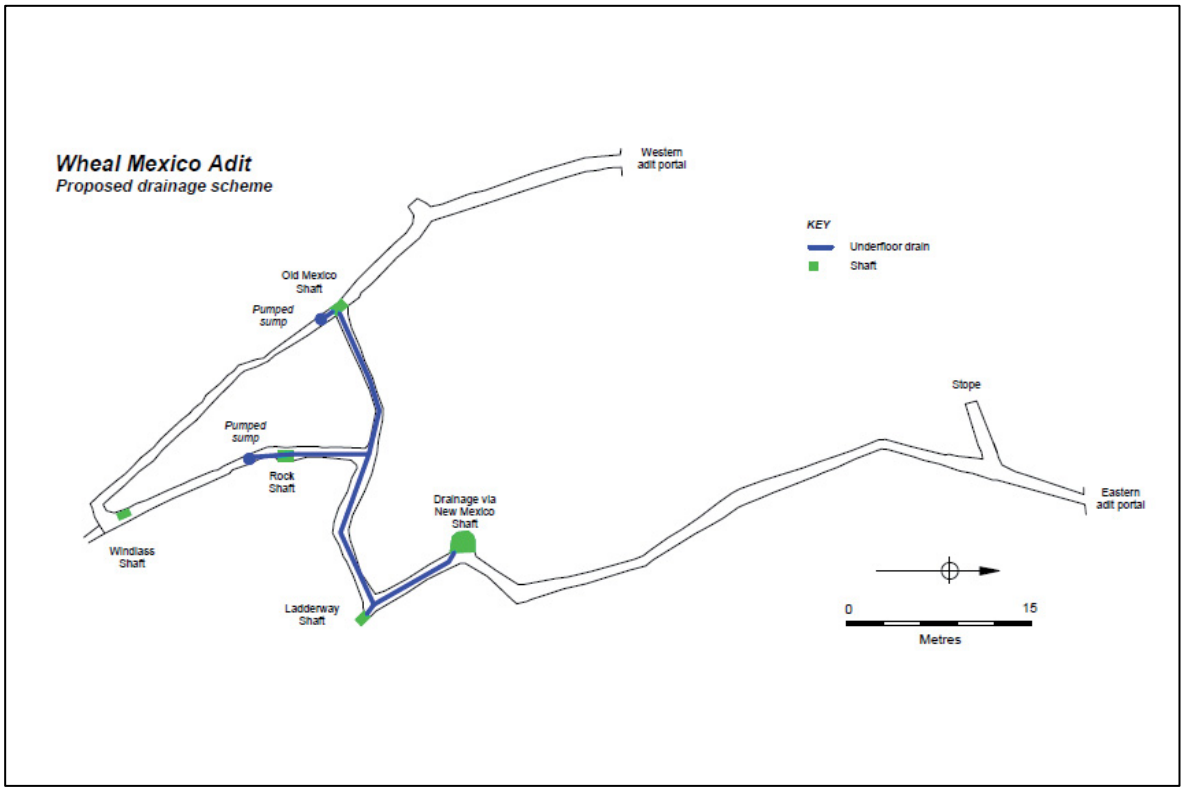

Fig 59. The improved drainage scheme installed on completion of the excavation of the visitor tour extension. 110 volt electric pumps equipped with float switches are sited in the two sumps; water is conveyed to New Mexico Shaft using 1.5" diameter compressed air hoses buried in the floor.

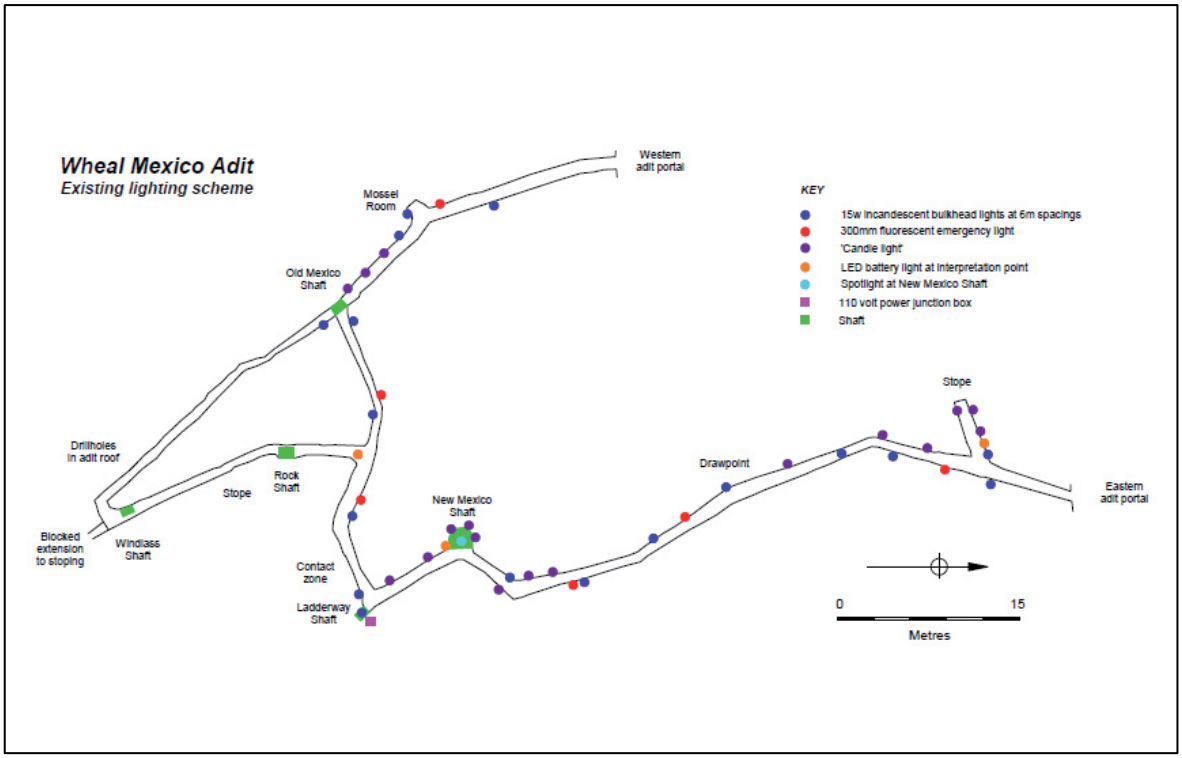

Fig 60. The original lighting scheme installed in the Geevor underground visitor tour, a mixture of 110 volt bulkhead and emergency lights, spotlights, 'candle' lights, and battery-powered LED torch lights at interpretation points.

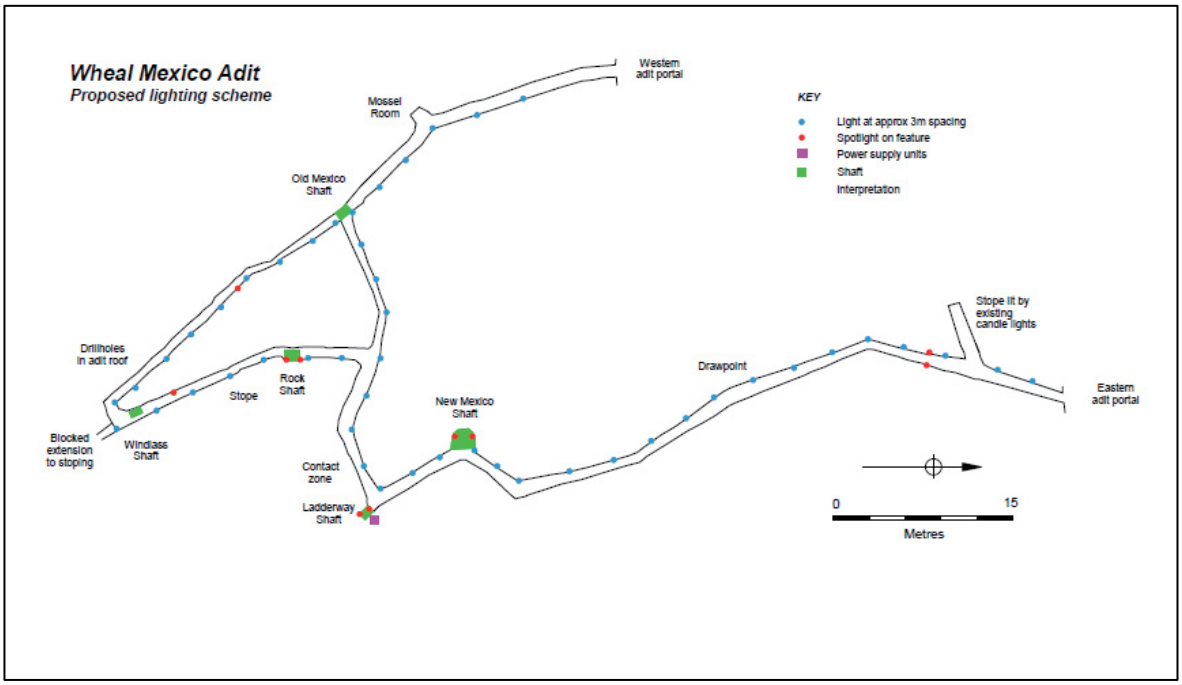

Fig 61. The simplified lighting scheme installed in the original visitor tour and the new extension, based on two types of low voltage LED lights to provide general low level lighting and spotlights to pick out specific features.

BLUES™
SYSTEM

BlueDome Opaque

Specifications

- Polycarbonate Opaque Dome giving 180° light throw
- Available in Luxeon standard LED's and the New K2 LED
- Power consumption 2.7 Watts
- Colours—Warm White K2, Cool White K2, Green, Cyan, Blue and Royal Blue
- Onboard Dimming
- RoHS Compliant (Restriction of Hazardous Substances)
- CUL Compliant
- EMC Compliant (Marine Standard)
- 88,000 hour lamp life (with data available at 68,000 hours
- Maintenance Free operation for up to 15 years

Global Design Solutions
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The Opaque Dome is virtually unbreakable, made from Poly Carbonate it is the ideal replacement for a standard Bulk Head fixture for general lighting wall mounted. It can also be used as a ceiling light for corridors and low level work for both emergency lighting and ambient lighting. With unprecedented thermal, drive and current light output capabilities, it offers lighting industry leading lumens per package and enclosed in the BlueDome housing it offers a totally flexible IP68 solution for any type of application.

The Opaque Dome is ideal for using as guide lighting, architectural or close working light as it is softer in appearance to look at.

IES Information available from website — gds.uk.com

Global Design Solutions, gds.uk.com

Fig 62. The product information sheet for the Blue Dome unit which was used at roughly 3.0m spacings to provide background lighting for the visitor tour at Wheal Mexico. These are run via a battery backup system to provide emergency lighting should there be a power failure.

BLUES™
SYSTEM

BlueBeam 10 °

Specifications

- Ideal Projected distance is from 2m(6.5ft) – 6m (19ft)
- Available in Luxeon standard LED's and the New K2 LED
- Power consumption 2.7 watts
- Colours—Warm White K2, Cool White K2, Green, Cyan, Blue and Royal Blue
- Onboard Dimming
- RoHS Compliant (Restriction of Hazardous Substances)
- CUL Compliant
- EMC Compliant (Marine Standard)
- 88,000 hour lamp life (with data available at 68,000 hours
- Maintenance Free operation for up to 15 years

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The 10 Degree Beam fixture is a very versatile fixture in the range and can be used for anything from emergency lighting to ambient lighting from 2m to 6m. With unprecedented thermal, drive and current light output capabilities, it offers lighting industry leading lumens per package and enclosed in the BlueBeam housing it offers a totally flexible IP68 solution for any type of application.

At an average mounting of 3m using the K2 Warm White the size of the beam would be 1.4m Diameter with a light level of 34 LUX.

This fixture is ideal for low level ceilings and rear auditoriums, cinemas and areas of controlled light level delivering a good punch of light.

IES Information to follow:

Global Design Solutions, 176 Brynland Avenue, Bristol United Kingdom BS7 9DY
Tel: +44 870 2244822 Email: hello@gds.uk.com

Fig 63. The product information sheet for the Blue Beam LED spotlight, ten of which have been installed at Wheal Mexico to light specific features of interest.

Fig 64. One of the Blue Dome LED lighting units, fitted with a cowl which effectively directs the light. The majority of the cowls on the low level lights were angled so as to light the route ahead.

Fig 65. A view down the western drive showing the subtle mood effect given by the new lighting units.

Fig 67. Looking south along the eastern drive showing the mesh flooring over the stope and the steel roof supports.

Fig 66. Looking north along the western drive showing the gravel flooring and a timber prop supporting the wall.

Appendix 1: Application for Scheduled Monument Consent

Ancient Monuments and Archaeological Act 1979 (as amended) Section 2

1. Applicant details

Full Name: Cornwall Council

Address: Adam Sharpe BA MIfA, Historic Environment, Cornwall Council, Kennall Building, Old County Hall, Station Road, Truro, Cornwall

Postcode: TR1 3AY Telephone No: 01872 323603; Mob: 07968 892146

2. Occupier of the Monument

Full Name: Pendeen Community Heritage

Address: Mr. Michael Simpson, Mine Manager, Pendeen Community Heritage, Geevor Tin Mine, Pendeen, Penzance, Cornwall

Postcode: TR19 7EW Telephone No: 01736 788662

3. Monument to which this application relates

Name of the Monument: Geevor Tin Mine

Address: Pendeen, Penzance, Cornwall TR19 7EW

County / National Monument No: 32990 National Grid Ref: SW 37529 34510

5. List of plans and drawings accompanying the application

- Plan showing the proposed disposal site for the waste material removed from the adit extensions.
- Plan showing the very approximate location of the proposed new tunnel linking between the two existing mine adits, which would be required if the excavation of the two sections of the mine adits proves that the two mine adits do not already connect. The exact location of the proposed new tunnel, if required, will only be known after the two existing mine adits have been excavated of backfilled material.

6. Any other information relevant to the application

A methodological impact statement and mitigation strategy was set out in a document produced by Adam Sharpe BA MIfA, Senior Archaeologist, Historic Environment (Projects), Cornwall Council on 14 January 2008 and was submitted with the original SMC application covering the Phase 1 works to the adit system, and referred to in Paragraph 1 of the Scheduled Monument Consent for those works. It is not considered that there is any requirement for additional mitigation in relation to the disposal of the waste material from those works, as set out above. In relation to the driving of any new tunnel and the minor works to prepare the tunnel extensions for visitor access, the agreed archaeological watching brief will cover this work as described in the Historic Environment methodological impact statement and mitigation strategy and the HE WSI (attached).

I hereby apply for scheduled monument consent for the works described in this application and shown on the accompanying plans and drawings

Signature_____

Date_____

Adam Sharpe BA MIfA, Historic Environment, Cornwall Council

*on behalf of Pendeen Community Heritage

Appendix 2: Application for Scheduled Monument Consent

Ancient Monuments and Archaeological Act 1979 (as amended) Section 2

1. Applicant details

Full Name: Cornwall Council

Address: Adam Sharpe BA MIfA, Historic Environment, Cornwall Council, Kennall Building, Old County Hall, Station Road, Truro, Cornwall

Postcode: TR1 3AY Telephone No: 01872 323603; Mob: 07968 892146

2. Occupier of the Monument

Full Name: Pendeen Community Heritage

Address: Mr. Michael Simpson, Mine Manager, Pendeen Community Heritage, Geevor Tin Mine, Pendeen, Penzance, Cornwall

Postcode: TR19 7EW Telephone No. 01736 788662

3. Monument to which this application relates

Name of the Monument: Geevor Tin Mine

Address: Pendeen, Penzance, Cornwall TR19 7EW

County / National Monument No: 32990 National Grid Ref: SW 37529 34510

5. List of plans and specifications accompanying the application

- Plan 1 showing the location of the adit system projected to surface
- Plan 2 showing the proposed layout of the new and replacement lighting scheme.
- Plan 3 showing proposed flooring arrangements
- Plan 4 showing locations of sumps, pumps and other elements of the drainage system.
- Specification for lighting units to be installed at Geevor.

6. Any other information relevant to the application

A methodological impact statement and mitigation strategy was set out in a document produced by Adam Sharpe BA MIfA, Senior Archaeologist, Historic Environment (Projects), Cornwall Council on 14 January 2008 and was submitted with the original SMC application covering the Phase 1 works to the adit system, and referred to in

Paragraph 1 of the Scheduled Monument Consent for those works. It is not considered that there is any requirement for additional mitigation in relation to the minor works to prepare the tunnel extensions for visitor access, as the agreed archaeological watching brief will cover this work as described in the Historic Environment methodological impact statement, mitigation strategy and the HE WSI (attached to the application for SMC for the Phase 2 works).

A copy of a plan showing the locations of any additional support work required in the stope and adit will be supplied on completion of the works, together with a description of the nature of the materials used for the support work.

I hereby apply for scheduled monument consent for the works described in this application and shown on the accompanying plans and drawings

Signature: Adam Sharpe BA MIfA

Date: 17 August 2010

Adam Sharpe BA MIfA, Historic Environment, Cornwall Council, on behalf of Pendeen Community Heritage

Appendix 3: WSI for archaeological recording

Historic Environment (Projects), Cornwall Council

Geevor Tin Mine, Pendeen: Written Scheme of Investigation for archaeological recording prior to and during works to extend the underground tour.

Client:	Cornish Mining World Heritage Site Team
Client contact:	Jeremy Williams, World Heritage Site Projects Development Officer
Client tel:	01872 32 3608
Client email:	jwilliams@cornwall.gov.uk

Site history

Geevor Mine at Pendeen has a documented history of operations since the 18th century, though was probably worked in a small scale fashion since the 16th century, and finally ceased operations in 1991 in the wake of the International Tin Crash of 1985. It was acquired by Cornwall County Council in 1992 after efforts to ensure the preservation of a large proportion of tits machinery, buildings and artefacts and, following extensive safety works, was opened to the public as a large-scale heritage site, showcasing the history, archaeology and social history of Cornish tin mining. It is currently managed by Pendeen Community Heritage on behalf of Cornwall Council.

Although the extensive mine workings (which extended down to 2,200 feet from surface) are now flooded below Third Level (sea level), shaft safety operations in 1994/5 revealed a shallow adit system near the tin floors, and following some safety and access works, this was opened to the public for guided underground tours. Geevor Mine is now a popular heritage attraction, whose visitor numbers continue to grow steadily.

Project background

One of the principal attractions for visitors to Geevor is the opportunity to undertake an underground tour in an authentic section of a Cornish tin mine. The workings used for this purpose, rediscovered in 1994/5 and subsequently made suitable for visitor access, were developed as part of the former Wheal Mexico, and are sited just to the north of the tin floors. The visitor tour is conducted in small groups by Geevor guides, though there are proposals to allow self-guiding on a trial basis during the summer of 2009.

The underground tour provides a defining interpretive experience of the Cornish Mining World Heritage Site (WHS) which helps visitors understand other mine sites which they subsequently visit elsewhere in the WHS, and which is therefore relevant to Geevor's proposed role as the Key Centre (West) for the WHS. 95% of visitors to Geevor Tin Mine want to go on the underground tour.

The underground tour is limited in extent, however, and during the high season the necessarily small size of the groups allowed on each tour results in a sometimes significant backlog of visitors awaiting their turn to go underground. Visitor numbers to Geevor are predicted to increase significantly over the next few years, the opening of the new museum in late 2008 having already triggered a average monthly rise in visitor figures of 15%. In response to this situation, it has been proposed that the accessible section of the adit level is extended through clearance and any necessary safety works to accommodate a larger number of visitors at any one time.

Preliminary searches of mine plans suggest that the Wheal Mexico adit system extends a significant distance to the south and could be opened up without any major engineering works. The current visitor route is approximately 120 metres in length and an extension of approximately 80 metres is proposed utilising existing adit tunnels. An undated mine plan suggests that these converge inland, though inspection indicates that they are currently infilled with sand and slimes deriving from operations upslope which used redundant shafts for waste disposal.

The proposed extension to the underground route will provide the site management with additional operational flexibility, and will help to alleviate waiting times. In addition, it is expected that the proposed extended underground tour will potentially include several additional features for the tour guides to interpret, including two shafts.

Scheduled Monument Consent (SMC) was sought and obtained by PCH from the Department of Culture Media and Sport (DCMS) to clear the tunnels and to carry out investigation work in order to investigate the feasibility of extending the visitor route. Once the existing tunnels have been excavated, an application for Scheduled Monument Consent will need to be submitted to DCMS for any works required to make the tunnels part of the underground tour.

These latter works will not be able to be progressed until this permission has been obtained; both DCMS and English Heritage have stated that they cannot provide SMC for these latter works until the excavation is complete and the exact position and nature of any other additional works can be specified. English Heritage have provided Cornwall Council with a letter stating that they are supportive of the project in principle as it has a low archaeological impact and will add value to the visitor experience at Geevor, and that they will work with Cornwall Council to help the applicant to obtain SMC for Phases 2 and 3 at the appropriate time.

Phase 1 of the works comprises the excavation of the infill material from approximately 35m length of each branch of the adit. This will be removed from the workings either via an existing open shaft or via the adit exit portal, the material being deposited at a designated site approximately 50-100 metres from the exit portal immediately adjacent to an area historically used for the disposal of material cleared from this adit system. Once the material has been cleared, an assessment will be made of any necessity for support works, and for any requirement for the excavation of a linking tunnel between the adits.

Should this be required, Phase 2 will consist of the excavation of a new connecting tunnel approximately 10m in length through solid rock to link the adit branches. In addition, both the existing adits and any new section of tunnel will require drainage and floor surfacing works to make them suitable for visitor access. As in Phase 1, the excavated material would be removed via an existing shaft or through the adit portal and deposited at the designated location on the Geevor site. The Phase 2 works are provisional and dependant on the results of the Phase 1 clearance works.

If Phase 2 takes place, Phase 3 will comprise the renovation of the fixed underground lighting system and its extension to the newly-excavated section of the adit using a low-level LED-based lighting system.

Given that Geevor is a scheduled monument (the designation including its underground sections), English Heritage requires that the above work is accompanied by an appropriate level of archaeological recording and the provision of necessary archaeological expertise during operations. Jeremy Williams of the Cornish Mining World Heritage Site Office (Project Co-ordinator) contacted Cornwall Council Historic Environment (Projects) by email on the 14 July 2009 requesting a Written Scheme of Investigation (WSI) and cost breakdown to undertake this work, as laid out in the supplied brief dated 14 July 2009. Given the provisional nature of Phases 2 & 3, a request was made to provide discrete costs for undertaking each stage of the Project (see separate cost breakdown).

Project extent

The proposed works will be confined to the existing Wheal Mexico adit system and its shafts, together with its southern extensions, the site of the proposed spoil dumping area and any other areas of the site required for the use of the contractors during the works. These will be agreed as suitable in advance of any operations and an assessment of any impacts resulting from their use will be undertaken.

Previous relevant work

Historic Environment (Projects) has accumulated considerable knowledge of the Geevor site, having been involved in all phases of work on site since the closure of the mine. Relevant published reports summarising this work include:

Sharpe, A. 1992, *St. Just: an Archaeological Survey of the Mining District*, Cornwall Archaeological Unit report.

Sharpe, A. 1993a, *Geevor and Levant: an Assessment of their Surface Archaeology*, CAU report.

Sharpe, A. 1993b, *Geevor and Levant: A Consideration of the Archaeological Potential of Geevor and Levant Mines, West Penwith, and an Outline Brief for Future Archaeological Works and Other Related Developments*, CAU report.

Sharpe, A. 1993c, "Geevor Mine", *Cornish Life*, August 1993

Sharpe, A., 1993d, "Geevor Mine, Pendeen, West Cornwall", *Rescue News* Nº 65

Sharpe, A. 1994, *Levant Calciners: an Archaeological Survey*, CAU report.

Sharpe, A. 1994, "Recent Work at Geevor Tin Mine, Pendeen, Cornwall*", Journal* of the Post-Medieval Society

Sharpe, A. 1994, *Geevor Mine: DLG Works, 1994*, CAU report.

Sharpe, A. 2008a, *Geevor and Levant, Cornwall: Historical Landscape Development*, HES report

Sharpe, A. 2008b, *Mexico Shaft Shallow Adit: its history, relationship with other adit systems and shafts on the Geevor site and potential for further development*

Sharpe, A. 2009, *Geevor Mine, Pendeen, Cornwall: Historic Environment Consultancy and archaeological watching brief during conservation* works, HES report

Sharpe, A. 2010, *Land reclamation works at Geevor Mine, 1995 to 1998*

Aims and objectives

- The principal aims of the study are:
- to gain a better understanding of the nature, extent and original features of the shallow, early underground workings making up this level of Wheal Mexico.

- To limit or prevent any negative impacts of the proposed works on the authenticity and completeness of the underground workings.

The objectives of the study are:

- To advise on proposals and to propose measures to ensure that the special qualities and importance of the historic environment of Geevor Tin Mine are preserved and enhanced by the proposed works
- To ensure that the works will have a minimal impact on the integrity and authenticity of the historical resource
- To create a record of any areas of Wheal Mexico made accessible as a result of the proposed works.
- To advise the project team on the advisability and impacts of their proposals and where necessary, to suggest alternatives.
- To liaise with English Heritage during the works.

As set out in the brief, the historic environment consultant will:

- be responsible for providing historic environment consultancy supervision and watching brief of the implementation of the above works identified which are under the supervision of the Project Manager.
- where appropriate, have the authority to halt inappropriate/below standard work, and in such a case to inform the Project Manager immediately.
- be able to work in a team and be able to communicate with all members of the team from Project Manager and Mine Manager to the works contractors. In addition the historic environment consultant should be able to communicate their advice and proposals to the HES Planning Advice Officer at the appropriate site meetings.
- report to English Heritage's Inspector of Monuments on the progress of works, and liaise with English Heritage as and when required during the works.

Working methods

All recording work will be undertaken according to the Institute for Archaeologists *Standards and Guidance for Archaeological Investigation and Recording.* Staff will follow the IfA *Code of Conduct* and *Code of Approved Practice for the Regulation of Contractual Arrangements in Archaeology.* The Institute for Archaeologists is the professional body for archaeologists working in the UK.

Desk-based assessment

No desk-based assessment will be required as this has already been carried out by the Project Officer (Sharpe 2008b).

Consultancy and watching brief

Stage 1

Provision of historic environment advice and supervision during the Phase 1 works to excavate sand, gravel and slimes etc. from existing sections of branches of the Wheal Mexico adit system. This will be achieved through close liaison with other members of the Project Team, English Heritage and the Cornwall Council Planning Advice Team, as well as through attendance at Project meetings.

- A watching brief will be undertaken during the Phase 1 works. A measured annotated survey will be made of all safely accessible sections of the re-excavated adit system and the recording and/or recovery of any artefacts revealed during the works.

Stage 2

- Historic environment advice will be provided on the works proposed for Stages 2 and 3, including commenting on the draft SMC application.
- Preparation of an Impact Assessment and a Proposed Mitigation Statement to accompany the SMC application for Stages 2 (if required) and 3.
- Liaising with English Heritage in relation to the SMC application.

Stage 3

- Provision of historic environment advice and supervision during the proposed Phases 2 and 3 works to complete the extension to the Wheal Mexico adit visitor tour route, including the installation of safety measures and lighting.
- Undertaking an archaeological watching brief during the works, including any required additions to or modifications of the measured survey created in Stage 1 and the recording and/or recovery of any artefacts revealed during the works.
- Liaison with English Heritage as and when required during works.
- Preparation of a report summarising the archaeological watching brief. This will, where possible, additionally interpret the function of features revealed during the works in the context of existing information in the Wheal Mexico Report (Sharpe 2008b).

Fieldwork: photographic recording

Where practicable, appropriate and safe, this will include:

- Archive black and white photographs using a 35mm camera on fine grain archive quality film.
- Supporting colour photographs taken with a digital camera (with a resolution of 5MP or higher), to be used to illustrate the report and for possible presentation purposes.

The photo record will comprise:

- general views of the works
- examples of detail of operations and of features revealed.
- Methodology for the archive standard photography will be as follows:
- Photographs of details will be taken with lenses of appropriate focal lengths
- a tripod will be used to take advantage of natural light and slower exposures
- difficulties of back-lighting will be dealt with where necessary by balancing the lighting by the use of flash
- a metric scale will be included in all views, except where health and safety or other considerations make this impractical.

Creation of site archive

To include:

- Archiving of black and white photographs to HER standards. All monochrome photographs will be archived using the HE photo database
- digital colour photographs (stored according to HER guidelines and copies of images made available to the client)
- preparation of finished plans.

Archive report

The results of the archaeological recording will be brought together in a single archive report. This will contain the results of the archaeological watching brief and photographic recording. The terminology used will be consistent with the English Heritage Thesaurus.

The report will contain the following:

Contents list, location map, site plan, grid reference, non-technical summary description of the adits and the results of the archaeological watching brief. The report will be illustrated with photographs, elevations, plans and sections as appropriate concentrating on the areas of intervention.

The report will contain a summary of the interventions and the recording work, and state the location of the deposited archive.

The Consultant will send the Historic Environment Planning Advice Team a draft of the recording reports, and take account of their comments.

Five paper copies of each completed report will be produced. Each copy will include a CD containing an electronic copy of the report and the archive of digital photographs taken. A summary of the results of the consultancy and recording should be prepared within two weeks of the end of each major contract period and sent to the HE Planning Advice Officer

Following approval of the archive report by the HE Planning Advice Officer, the 5 copies of the archive report will be distributed as follows:

- One copy deposited with the Cornwall and Scilly Historic Environment Record
- one copy deposited with the project archive at the Royal Cornwall Museum (or Geevor Tin Mine – see below)
- one copy to the National Monument Record Centre at Swindon
- one copy to the English Heritage SW Regional Office
- one copy to the Project Manager.

Archive deposition

An ordered and integrated site archive will be prepared in accordance with: *Management of Research Projects in the Historic Environment (MoRPHE) English Heritage 2006* upon completion of the project. The requirements for archive storage shall be agreed with the appropriate organisation. This will be established at the outset of the project.

The archive will include all finds, field drawings, photographic negatives, prints, context sheets and field description and electronic data. They will be appropriately catalogued and stored in suitable archive standard storage.

Photographic negatives and context sheets are included in the HE photo database and storage system; from time to time the photographic collection is transferred to the Royal Cornwall Museum for long-term curation.

The archive will be offered for curation either to the Royal Cornwall Museum or the Geevor Tin Mine archives, as appropriate. The RCM does not accept archives which do not include artefacts. The standard HE Projects practice for documentary archives is to deposit at the Pound and Co repository at Penryn, for deposition with the Cornwall Record Office in due course.

Timetable

All 3 stages of the consultancy work are expected to take place during the period October 2009 to April 2010. The exact timing will depend upon the contractor for the main works.

Monitoring and Signing Off Condition

Monitoring of the project will be carried out by a nominated Historic Environment Planning Advice Officer. Monitoring points during the study will include:

Approval of the WSI

Completion of fieldwork

Completion of archive report

Deposition of the archive

Historic Environment (Projects)

Historic Environment (Projects) is the contracting arm of the Historic Environment of Cornwall Council (HE). HE employs some 20 project staff with a broad range of expertise, undertaking around 80 projects each year.

HE is committed to conserving and enhancing the distinctiveness of the historic environment and heritage of Cornwall and the Isles of Scilly by providing clients with a number of services including:

Conservation works to sites and monuments

Conservation surveys and management plans

Historic landscape characterisation

Town surveys for conservation and regeneration

Historic building surveys and analysis

Maritime and coastal zone assessments

Air photo mapping

Excavations and watching briefs

Assessments and evaluations

Post-excavation analysis and publication

Outreach: exhibitions, publication, presentations

Standards

HE (Projects) follows the Institute for Archaeologists' Standards and Code of Conduct and is a Registered Organisation.

As part of Cornwall Council, the HES has certification in BS9001 (Quality Management), BS14001 (Environmental Management), OHSAS18001 (Health, Safety and Welfare), Investors in People and Charter Mark.

Terms and conditions

Contract

The HE projects team is part of Historic Environment, Cornwall Council. If accepted, the contract for this work will be between the client and Cornwall Council.

The views and recommendations expressed will be those of the HE projects team and will be presented in good faith on the basis of professional judgement and on information currently available.

Project staff

The project will be managed by a nominated Senior Archaeologist (Adam Sharpe BA MIfA, CV appended) who will:

Discuss and agree the detailed objectives and programme of each stage of the project with the client and the field officers, including arrangements for health and safety.

Monitor progress and results for each stage.

Edit the project report.

Liaise with the client regarding the budget and related issues.

Work will be carried out by a suitably qualified and experienced member of HE field staff (Adam Sharpe BA MIfA).

Copyright

Copyright of all material gathered as a result of the project will be reserved to Historic Environment Cornwall Council. Existing copyrights of external sources will be acknowledged where required. Use of the material will be granted to the client.

Freedom of Information Act

As Cornwall Council is a public authority it is subject to the terms of the Freedom of Information Act 2000, which came into effect from 1st January 2005.

HE will ensure that all information arising from the project shall be held in strict confidence to the extent permitted under the Act. However, the Act permits information to be released under a public right of access (a "Request"). If such a Request is received HE may need to disclose any information it holds, unless it is excluded from disclosure under the Act.

Health and safety statement

HE follows the Council's *Statement of Safety Policy*. For more specific policy and guidelines HE uses the manual *Health and Safety in Field Archaeology* (2002) endorsed by the Standing Conference of Archaeological Unit Managers and also the Council for British Archaeology's Handbook No. 6 *Safety in Archaeological Field Work* (1989).

Prior to carrying out on-site work HE will carry out a Risk Assessment.

Insurance

As part of Cornwall Council, HE is covered by Public and Employers Liability Insurance.

Adam Sharpe

Senior Archaeologist

Thursday, 16 July 2009

Historic Environment (Projects)

Cornwall Council

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Email: asharpe@cornwall.gov.uk

Curriculum Vitae – Adam Sharpe BA MIfA

Proposed roles for this project: Project manager, Historic Environment Consultant

Place/Date of Birth: Leeds, 21st January, 1953

Current Job Title: Senior Archaeologist (Projects)

Work Address/Tel N^{O}: Historic Environment, Kennall Building, Old County Hall, Station Road, Truro, Cornwall TR1 3EX; 01872 323603. Mob. 07968 892146

Education

1963 - 1971 Kingsbridge Grammar School (became Kingsbridge Comprehensive School in 1965), Waverley Road, Kingsbridge, Devon.

O Levels: English Language, English Literature, Geography, History, Mathematics, Physics, Art, Latin. A Levels: English, Geography, French, Art.

1971 - 1974: Leeds University, Leeds, Yorkshire, English Literature and Language, Class Upper 2:1 (Honours).

Career summary

I joined the Cornwall Committee for Rescue Archaeology (CCRA) in May 1984 as the first member of the newly-created archaeological survey team. Whilst the majority of the survey work we undertook for English Heritage and other clients during the mid-1980's was focussed on extensive areas of upland in West Penwith and Bodmin Moor, my long-term background interest in and knowledge of the archaeology of mining provided CCRA with the professional expertise to provide advice on industrial sites and to take on measured and other surveys of these sites for the first time. The recording, analysis and management of the industrial heritage of Cornwall soon became my principal responsibility within the successor to CCRA – the Cornwall Archaeological Unit (CAU, subsequently Cornwall County Council's Historic Environment Service and now Historic Environment, Cornwall Council).

Since 1984 I have carried out archaeological recording, assessments, management surveys small-scale excavations, watching briefs and consultancies on mine sites across the whole of Cornwall, including the majority of those managed or owned by the former Kerrier and Carrick District Councils, have undertaken management surveys on almost all new acquisitions for the National Trust in West Cornwall and provided archaeological consultancy during subsequent extensive work programmes on these sites.

During the past fifteen years, I have increasingly concentrated on the development of sustainable and appropriate approaches to the management of industrial structures and landscapes. This has necessarily involved spending time learning from other disciplines in order to produce workable, holistic proposals, and during the past five years I have focussed on the development and application of sustainable building conservation techniques, particularly the uses of lime mortars and other traditional materials, working closely with engineers, architects, conservation specialists and contractors. I was responsible for the production of a guidance manual on the conservation of mine buildings in Cornwall for the Cornwall Industrial Heritage Partnership. This is still widely used, and has recently been reprinted in an international edition.

I have been directly involved with the conservation of over 70 historic structures in the St. Just District alone as part of the West Penwith Heritage Coast Project, and more recently through the Objective One funded St. Just Project, in particular scheduled and other mine structures at Botallack, Levant and in the Kenidjack Valley. Other structural conservation projects have included the adaptive conversion of Sara's Shaft engine house, Wheal Kitty, those associated with the current phase of the Mineral Tramways Project, both Stages 1 and 2 of the HLF/Objective One funded conservation works at Geevor and the recent works at Trewavas for the National Trust. My involvement in recording and advising on safety works to over 100 mine shafts across Cornwall has led to the development of new approaches to these works which take into account the archaeological, ecological, amenity, access and other values of such sites, seeking to ensure that a holistic and sustainable approach is taken wherever possible.

I have also been involved with several major industrial heritage initiatives in Cornwall. I developed and ran the initial phase of the Minions Project, and was responsible for the writing of the project report and area management plan. With Nicholas Johnson

(Historic Environment Manager) and John Smith (colleague) I was responsible for the initial development of the Mineral Tramways Project and undertook both background research and fieldwork to determine its feasibility. I subsequently undertook detailed survey on all of the engine houses within its project area, worked with the project team in evolving further elements of the project including a number of major conservation and safety projects, and am (2006-2009) undertaking Historic Environment consultancy during the current phase of the project which is enabling the conservation of structures, provision of access and interpretation on a large number of sites.

In the early 1990's I undertook a heritage asset audit of the St. Just Mining District, producing a full inventory of its sites and a structure for the future management of the area. This was adopted as the basis for The National Trust's long-term acquisition and management strategy in West Penwith. I have subsequently worked closely in an advisory capacity with the NT on all of its conservation and management projects in this area, as well as other projects undertaken by them on industrial sites elsewhere in Cornwall.

I was closely involved with the bid to acquire and develop Geevor into a heritage site following its closure as a working mine, assisted with the identification of key items of equipment to be purchased using a grant from the National Heritage Memorial Fund and subsequently spent several years helping to develop the management works required to achieve the transformation of the site, undertaking asset audits, surveys and other recording prior to several rounds of safety and conservation works (including the most recent), for which I have provided consultancies and watching briefs. I have continued to be involved in all subsequent projects on the site, have provided *ad hoc* consultancy to site managers, was a founder member of the Geevor Action Group and sat on its successor: the Geevor Partnership.

From 2000 to 2003, I was in charge of the data collection, research and mapping team which put together the Cornish Mining World Heritage Site Bid, being particularly responsible for the determination of the site boundaries and the writing of the first draft of the nomination document. I handed the management of this initiative on to its current co-ordinator in late 2003, following which I undertook site and building recording and providing specialised consultancy to the three year St. Just Objective One project, working in close liaison with other members of the project team. I am currently concluding a similar role on the HLF-funded Mineral Tramways Project.

I have written over 100 professional reports as part of my work for CCRA/CAU/HES/HE, contributed many articles to local and national journals as well as interviews to the media, and led guided walks for and given talks to a wide variety of groups. I am competent in most office software, as well as CAD, GIS and the use of GPS survey and am a competent photographer.

I was elected an Associate of the Institute of Field Archaeologists (AIFA) in 1988 and became a full Member (MIFA) in 1991. I am a member of the IfA Historic Buildings Group, and have long been a member of the Trevithick Society, as well as a member of the Dartmoor Tinworks Research Group, The Association for Industrial Archaeology, the Cornwall Underground Access Advisory Group, the Cornwall Archaeological Society, the St. Just Pendeen and District Liaison Group and the Geevor Advisory Group (now the Geevor Partnership). I have lived and worked in Cornwall for the past 32 years (for the last 20 years being based in West Penwith), though from time to time provide specialist advice to industrial site managers elsewhere in Britain. I am jointly responsible for health and safety within the Historic Environment Service.

Summary of projects:

Site and landscape surveys (Prehistoric, medieval and post-medieval sites)

- Nanquidno, Bodrifty, Carnaquidden, Caer Bran, Boswens Common, Carnyorth Moor, Truthwall Common, Dry Carn, Woon Gumpus, Boscawen-Un, Ballowall Barrow and Goldherring (West Penwith)

- Roughtor, Butterstor, Kerrow, King Arthur's Hall, Garrow, Stannon Down, Louden Hill and Showery Tor, also aerial photograph plotting (Bodmin Moor)
- Various prehistoric and medieval sites, Isles of Scilly
- Stithians Reservoir cupmarked stone scatter
- Carn Brea

Site and landscape surveys (military sites)

- Pendennis and St. Mawes Castles, Plymouth's 19th century defences.

Site and landscape surveys and assessments (Industrial and other)

- Wheal Coates, Trevellas Coombe, Wheal Charlotte, Wheal Kitty and Blue Hills (St. Agnes)
- Burnt Heath, Bodelva and Glyn Valley china clay works (Bodmin Moor)
- Trethowel clay works, Chapel Mill china stone works, Queens Mine (Hensbarrow)
- Gunnislake Clitters, Hingston Down, East Kit Hill, Wheal Benny, Prince of Wales (Harrowbarrow), New Consols, Phoenix United and Hardhead Downs (Bodmin Moor and the Tamar Valley)
- Derelict mine sites owned by Carrick District Council (St. Agnes parish)
- Mineral Tramways Project (various phases) – project design, site and buildings surveys
- Wheal Busy, Chacewater
- Industrial sites owned by Carnon Consolidated in mid and west Cornwall
- The Red River Valley
- Coastal Slate Quarries, Tintagel to Trebarwith
- Geevor and Levant mines (West Penwith)
- Tresavean (Lanner), Wheal Tye (Portreath), Marriott's Shaft (Basset Mines), Dudnance Lane (South Crofty) Tolskithy Valley (Redruth), Wheal Ramoth (Perranporth), West Basset Mine (Redruth), Basset Mines (Redruth), Higher Carnkie (Redruth), Bissoe Arsenic Works (Truro), Wheal Briggan (Scorrier), Daubuz' Shaft (Camborne), Boscarn Parc (Carn Brea Mine dressing floors), West Wheal Seton (Redruth), Marriott's Shaft Asbestos clearance (Troon)
- Chapel Jane, Giew, Ballowall, Letcha, Nancledra School, Wheal Owles, Geevor and Levant
- St. Just Mining District mine sites
- East Pool and Agar Mine, Pool, Redruth
- Narabo Quay, Devoran
- Cape Cornwall, Boscregan Farm, Nanjulian Farm, Letcha Farm and the Cot Valley, Kenidjack Head, Kenidjack settlement and Wheal Owles, Levant Fields, Ballowall (property management surveys for National Trust, St. Just in Penwith)
- Lanivet Stamps, Bodmin
- Steeple Wood and Trelyon Downs (St. Ives)
- Rosewall and Trevalgan Hills (St. Ives)
- West Penwith Environmental Improvements Project sites including Botallack, Levant, Kenidjack Valley, Wheal Cock, Wheal Hermon
- United Hills (Tywarnhayle)
- Robinson's Shaft, South Crofty
- Dudnance Lane to Station Road, Pool
- Betty Adit
- Wheal Peevor, Unity Wood, Grenville United Stamps and Marshall's Shaft engine house surveys
- West Basset Trail
- Pool Heartlands
- NT Mounts Bay Properties
- Land off Trevithick Road (Part of East Pool Mine)
- Wheal Fortune and Cusvey, Consolidated Mines
- Conker Bottoms (West Wheal Providence)
- Pool Heartlands (building and artefact surveys)
- St Agnes National Trust western coastal properties
- Tregargus Valley CMP
- Cornwall-wide solar pv farm assessments

Excavations (prehistoric, medieval and post-medieval sites)

- Gannel River smelting site and Trethellan Farm (Newquay)
- Carne Farm, Bosiliack chambered cairn, Boswednack Farm, Rosemorran Farm (West Penwith)

- Giant's Hedge (Looe)
- St. Dennis Church
- Tintagel Island and churchyard
- Stannon Downs (Bodmin Moor)
- St. Mary's, Isles of Scilly
- Botallack power line undergrounding
- Gaverigan Barrow, Penhale Round, Queen's Mine and Penhale Moor (Indian Queens)
- St. Michael's Mount
- Trelowthas Barrow (Probus)
- St. Just area re-sewerage pipeline watching brief including Roscommon Roman-Cornish tin smelting site
- Geevor Mesolithic site
- Boscaswell beaker site

Excavations (military sites)

- Pendennis Castle and St. Mawes Castle

Excavations (industrial sites)

- Perran Foundry (Perranarworthal)
- Letcha, Ballowall, Wheal Edward, Geevor Mine (West Penwith)
- South Carn Brea Mine, Cook's Kitchen Mine (Camborne)
- Lanow (St. Kew)
- Ale and Cakes and Cupboard Hill (United Mines)
- Scorrier WTS and HWRP Project (Wheal Chance)
- Levant

Watching briefs and consultancies (industrial sites)

- Mineral Tramways Phase 1 sites: Tresavean, Wheal Tye, Marriott's Shaft, Dudnance Lane, Tolskithy Valley, Wheal Ramoth, West Basset Mine, Wheal Basset, Binner Downs, Higher Carnkie, Bissoe Arsenic Works, Wheal Briggan, Daubuz' Shaft, Boscarn Parc, West Wheal Seton, Marriott's Shaft Asbestos clearance, Pennance Mine (Lanner),Carn Brea
- Porthleven Wheal Pool
- Wheal Coates, Chapel Jane, Giew, Ballowall (two phases), Wheal Edward, Letcha, Nancledra, Wheal Owles, Wheal Drea, Geevor and Levant DLG and LRF works (4 phases), Sancreed Beacon (2 phases), United Hills (Tywarnhayle), Great Work, Porthleven Wheal Rose, Watch Croft (Morvah Consols), Steeple Wood and Trelyon Downs
- Sara's Shaft, Wheal Kitty, Red River mine water remediation
- ST. Just Objective One/HLF Project: Botallack, Wheal Hermon, Levant, Wheal Cock, Baker's Pit, Kenidjack Valley arsenic works
- Wethered Shaft, Geevor
- Geevor Stage I conservation works
- Geevor Stage2 bid creation project
- Geevor Stage 2 conservation works
- Mineral Tramways HLF Project sites: Betty Adit, Wheal Peevor, Thomas' Shaft, Penhallick Leats, Unity Wood, Marshall's Shaft, Condurrow, Wheal Fortune, Cusvey.
- Trewavas consolidation project
- Kennal Vale SM conservation project
- Geevor Wheal Mexico adit extension project

Major projects

- West Penwith Project
- Bodmin Moor Survey
- Minions Project
- St. Just Mining District Project
- Mineral Tramways Project (initial phases)
- English Heritage Monument Protection Project (MPP)
- Geevor Project 1992-2006
- National Trust West Penwith acquisitions and management project
- Cornish Mining World Heritage Site Bid
- St. Just Heritage Coast Project 1995-2005
- Mineral Tramways Project (2006-8 phase)
- Geevor HLF/Objective One Project
- Cornish Mining World Heritage Site assessment of Outstanding Universal Value
- Cornish Mining World Heritage Site Photomonitoring Survey