



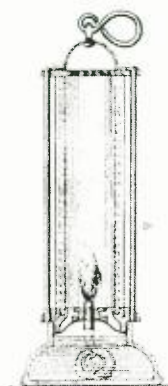
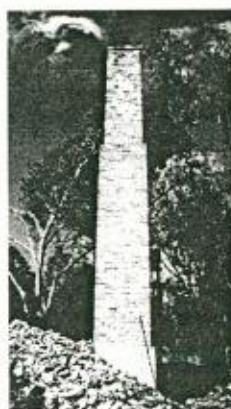
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An historical archaeological assessment of the Torrington State
Recreation Area

An historical archaeological assessment of the Torrington State Recreation Area

VOLUME ONE: Overview and recommendations



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**Prepared for NSW National Parks
and Wildlife Service**

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413171205

Chimney
for Babcock
and
Wilcox boiler,
Kathida Lodes,
the Gulf

Miner's
lamp
(from
André
1878)

One of
Jan Hin's
medicine
bottles,
Torrington

Plate
fragments
from hut site,
Carpet Snake
Creek

Rice bowl
fragment from
the site of
Jan Hin's hut,
Tungsten

EXECUTIVE SUMMARY

The Torrington State Recreation Area is located approximately 70km north west of Glen Innes, northern NSW. This report forms part of a wider cultural heritage assessment of the SRA, and details the results of a survey for historical archaeological remains. The Torrington SRA occupies an area of some 500 square kilometres and encompasses an area of high relief, rising to 1100m, known as the Mole Tableland, which consists of a massive granite outcrop containing a central sedimentary pendant, known as the Torrington pendant. The Torrington pendant is considered to be the most significant geological area for gems and minerals in NSW, and there are over 1300 mineral deposits situated within and around the Mole Tableland. There have been several different landuses within the SRA in the historic period, including pastoralism, mining, forestry, agriculture and bee-keeping, although mining is without doubt the principal of these. Tin ranks as the most important mineral deposit, followed by wolfram, silver, arsenic, bismuth, fluorite, beryl and molybdenite. The Mole Tableland also possesses the world's largest deposit of silicite, or industrial topaz.

A total of 41 sites were recorded during the survey, including tin, wolfram and bismuth mine sites, sites worked on by Chinese and European miners, and alluvial and lode mines, as well as associated settlement sites. Historic sites within the Torrington SRA are significant for their complementary aesthetic, historic, archaeological and social values. The archaeological significance of these sites is largely embodied in the existing landscape and features, particularly the spatial arrangement of the various mine sites, their relationship to each other, and their artefactual contents.

Historically, patterns of exploration and settlement across the study area demonstrate the complementary processes of opening up the landscape, initially for large scale pastoral use, but subsequently for smaller scale alternative uses, and attracting larger and more permanent populations through the exploitation of various resources within that landscape. The historic mine sites associated with the Torrington SRA are early

sites in the context of Australia's tin fields, containing the first excavated lode tin deposit in the state and the first tin crushing equipment in the colony. Many facets of the technology used at these sites demonstrate distinctive solutions to the problems encountered in working and processing tin and wolfram deposits. In part this reflects the wider processes of adapting technology to suit specific local conditions, although many solutions indicate distinct cultural preferences in technology, which also illustrate the interrelationships between the various cultural groups who lived in and worked the same environment.

The isolation of many of these sites in particular, and the remoteness of the Torrington area from other centres in general, is reflected in the fortunes of various mining ventures across the study area. In the material traces of these ventures, and in their present status as abandoned mine sites in often difficult to access locations, they reflect the difficulties associated with working, winning and transporting ore, and the hardships which accompanied the uncertain and often transient life of a miner. The ultimate failure of many sites, both individually, in relation to the nature and character of various ore deposits, and collectively, in response to the changing world market, reflects wider political and economic climates beyond the boundaries of the local mining industry, but which nevertheless closely affected the lives and lifestyles of ordinary miners and townspeople.

More recently, the various debates over the status of the study area and its eventual declaration as an SRA, demonstrate important changes in the history of the conservation movement in NSW, and represent changing community attitudes to conservation issues and an increase in public opinion over the handling of these issues. In contrast, the ability of the local community to successfully challenge proposals advocating the elevation of environmental values over economic and utilitarian values, illustrates the power inherent in community unity to successfully defy government decisions.

The Torrington SRA is held in high esteem as place which is widely known across the local communities of Torrington, Emmaville, Glen Innes, Deepwater, Tenterfield and surrounding rural areas, and which is highly valued for its long and continuing associations with local families, as well as for its important role as a recreational focus. Particular sites within the SRA are closely associated with the contemporary identity of the local Torrington and Gulf communities and with people's continued residence in those places.

The conservation approach which has been developed here is designed to take into account the Service's lack of resources for undertaking expensive capital works, except where critical to the retention of the most significant places or to the personal safety of visitors. The emphasis has therefore been placed on mitigating the most active causes of deterioration (fire, mechanical failure and theft) and actively monitoring the condition of sites to ensure that they remain stable. As all recorded sites possess cultural significance, activities should be guided by recognised conservation philosophy, such as the Burra Charter. It is critical that the place be managed in a way that permits the maximum number of appropriate conservation policies to be implemented and followed. Works at the place should be planned, directed and implemented by people skilled in conservation practice at a professional level.

An important aspect to consider in formulating conservation policy for the SRA is the opinion of the local community who continue to use, visit and reside near the SRA and its sites. Many of the residents interviewed during this survey stressed their reliance on the mining industry for their own continued livelihoods, and expressed a desire that they not be excluded from the continuing use of the place through the conservation or management policies instituted by the NPWS. Notwithstanding this, many people were extremely concerned that their history and the history of these places be recorded and preserved for future generations.

The interpretation potential of these sites raises particular conservation and management issues. The most suitable sites for interpretation are the Bismuth Dam tailings retreatment site, and the existing area around the Blatherarm creek fossicking area. Provided that safety issues are adequately addressed, the Wallaroo Mine might also provide an opportunity for interpretation, particularly as it is easy to access and could be used to demonstrate the devastating process of the removal of material from sites and the effects this has on the archaeological remains left behind.

Because of their cultural significance, sites within the Torrington SRA should be interpreted to the public and to specialists and access should be provided. The interpretation need not attempt to present a place in any particular configuration which it possessed at any particular past time. At present, because little is known about the precise structure of the landscape and the placement of various elements within it, no conjectural reconstruction should take place. Instead, a wider investigation of unrecorded sites within the SRA should be made a priority of any further research. Physical intervention in the significant fabric will be necessary for safety and possibly structural reasons, particularly maintenance and stabilisation work. The place is also an archaeological resource and there is a need to both protect the archaeological potential of the place by controlling unrecorded excavation and demolition, and a need, if it arises, to allow properly conducted archaeological excavations. Deleterious forms of intervention need to be controlled.

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1. INTRODUCTION

This report details the results of a survey for historical archaeological remains within the Torrington State Recreation Area, approximately 70km north west of Glen Innes, northern NSW (figure 1.1). This project is one component of a cultural heritage assessment of Torrington SRA and should be read in conjunction with other specialist reports, detailing the contextual history (Rosen 1998), Aboriginal archaeology (English 1998) and anthropology (Erskine 1998). Volume One of this report contains all of the historical background information and subsequent significance assessments and management recommendations following on from the archaeological survey; while Volume Two is devoted to the individual site details and descriptions. Site information included in Volume One has been limited to summary data only. For ease of reference, and so that each volume may be read separately, certain sections have been reproduced in both volumes.

The Torrington SRA occupies an area of some 500 square kilometres on the north eastern side of the Beardy River gorge adjacent to the NSW/Queensland state border. The SRA encompasses an area of high relief, rising to 1100m, known as the Mole Tableland, which consists of a massive granite outcrop containing a central sedimentary pendant, known as the Torrington pendant (figure 1.1). There have been several different landuses within the SRA in the historic period, including pastoralism, mining, forestry, agriculture and bee-keeping, although mining is without doubt the principal of these. No evidence for historic Aboriginal use of the SRA was found during the present survey, although at least one site near Bismuth was recorded in 1991 by the NPWS as including flaked glass artefacts (Minark 12-1-12).

Historically, land management decisions relevant to the study area have been decided on an ad hoc basis, and most of the area is currently under various tenures of Crown and freehold land used for a variety of mining, forestry and agricultural activities. In recent years, significant land use conflicts have arisen over the issue of conserving the

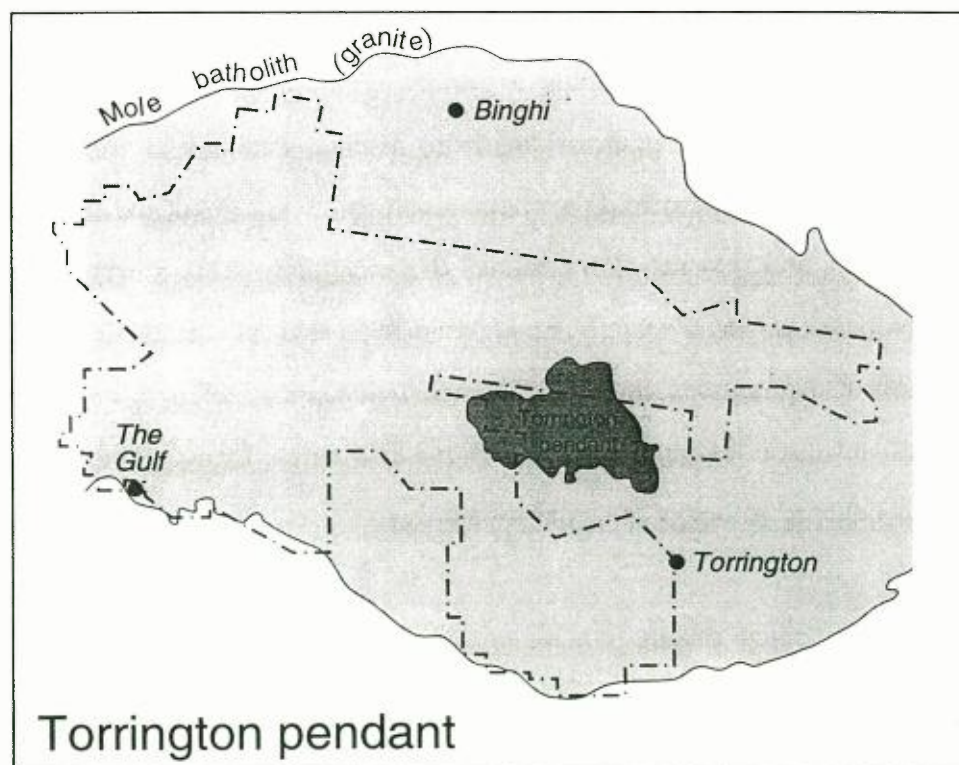
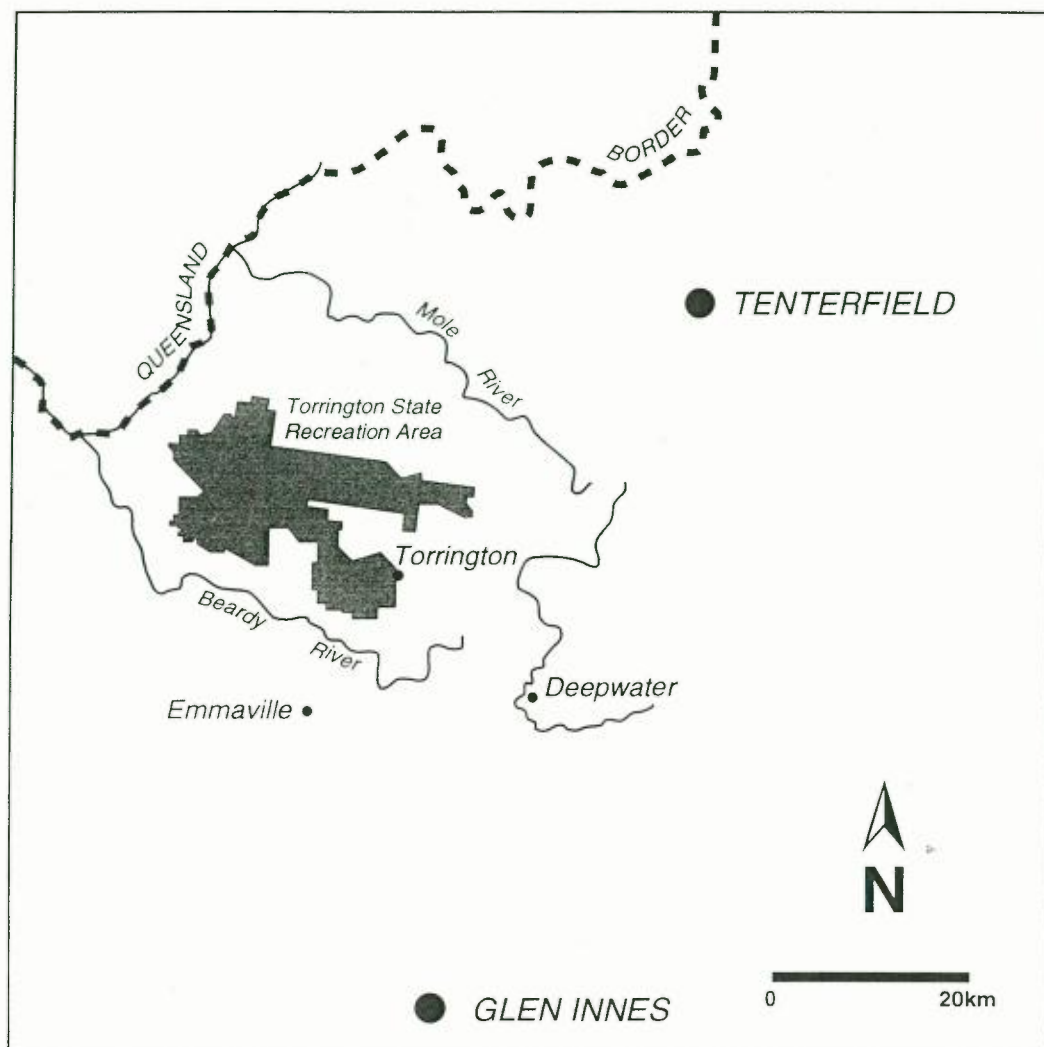


Figure 1.1: The study area

natural and cultural heritage values of the Mole Tableland as a protected area. Beginning in 1969, when it was first suggested that parts of the Mole Tableland lent themselves to the establishment of a National Park, intense community opposition has periodically resurfaced in response to proposals to include the Mole Tableland on the Register of the National Estate, to nominate the area as the Binghi Wilderness Area, or to gazette the place as the Beardy River National Park. In 1992, in response to a land assessment report for the Mole Tableland, commissioned by the Department of Lands, the Torrington Regional Reserve was established as a multiple use area under the Crown Lands Act (1989). The Reserve was managed by a Trust composed of industry groups, government departments, local residents and other stakeholders. In 1996 the Carr labour government recognised the Torrington Regional Reserve for its high conservation values and decided that the reserve should be managed by the National Parks and Wildlife Service. Although there was still considerable opposition to this proposal, the Torrington State Recreation Area was gazetted in April 1996 with provisions for mining and exploration, grazing, bee keeping and recreation.

Considered to be the most significant geological area for gems and minerals in NSW, there are over 1300 mineral deposits situated within and around the Mole Tableland (Harvey Henley pers. comm.), including antimony, zinc, wolframite (or wolfram), scheelite, bismuth, tin, lead, copper, silver, iron, arsenic, manganese, molybdenite, nickel-cobalt, gold, uranium, emeralds, garnets, sapphires, beryl, topaz and the quartz-topaz rock, zircons, and fluorite. Tin ranks as the most important mineral deposit, followed by wolfram, silver, arsenic, bismuth, fluorite, beryl and molybdenite. The Mole Tableland also possesses the world's largest deposit of silicite, or industrial topaz, currently under assessment by the Topalite mining company. The remainder of the minerals occur as minor or trace deposits only.

Most of the archaeological mining remains within the SRA relate to the tin, wolfram and bismuth mining industries. Although other minerals were mined sporadically throughout Torrington's history, all of the mining sites recorded during the present

survey relate to the extraction of these three principal minerals, and as a consequence, much of the report will focus exclusively upon these three inter-related industries.

1.1 The brief

Under the National Parks and Wildlife Service Act 1974, the Service is responsible for the care, control and management of historic heritage reserved as part of the State's reserve system. Moreover, under the National Parks and Wildlife Land Management Regulations 1995, it is considered an offence to damage or remove a non-Aboriginal relic (defined as any deposit or object which is more than 25 years old) from any land managed by the Service. Part 5 of the NPWS Act requires that a Plan of Management is prepared for each area managed by the Service. Plans of Management are statutory planning documents which provide written details of the operations which enable the Service to realise its legislative role. The Service also has responsibility for the protection of relics under the Heritage Act 1977. Under this act, a relic is defined as 'any deposit, object, or material evidence' which pertains to non-Aboriginal occupation. The NSW National Parks and Wildlife Service has formally adopted the ICOMOS Burra Charter and manages culturally significant places in accord with the Charter's principles. As a consequence, the primary aims of the historical archaeological component were to:

1. build on the information collected by the historian and identify relevant archival and published documentary material related to the mining and other land use histories of the SRA;
2. identify and interview select oral history sources to collect information about mining remains and other land uses, where relevant to understanding particular sites or evidence;
3. prioritise, survey and identify mining and other remains within the SRA for recording;

4. prepare a statement of significance for the suite of mining and other remains, and individual locations;
5. propose a conservation policy or range of policies appropriate to the significance of the mining and other remains;
6. identify conservation and management issues arising from the conservation policy;
7. identify conservation and management issues arising from condition, safety, interpretation potential and park management;
8. prepare recommendations for conservation, management and interpretation which can be incorporated into the forthcoming plan of management and management documents or which should be implemented urgently;
9. collate all materials in a specified format as an information resource for NPWS.

In short, the historical archaeology component has been designed to provide an understanding of the European heritage within the park and how important it is, to identify the management and conservation needs of the sites, to suggest how they might be interpreted and presented to the public, and to suggest how all of these facets can be carried out to complement the other management objectives of the SRA.

1.2 Collections consulted

University of New England Archives

University of New England Heritage Centre

Glen Innes History House and Land of the Beardies Museum

Mitchell Library

State Library

Inverell Mining Museum

Archives Office of NSW

Dixson Library UNE and New England Room

Fisher Library

Department of Mineral Resources Library

1.3 Sources of information

In order to reconstruct as accurately as possible the mining history and technology used at Torrington, a wide range of sources were consulted (see list below). Primary documentation is extremely rare, although the three major geological reports (Carne 1911; 1912; David 1887) contain some contemporary information, including maps, descriptions of various mines, some photographs, and cross sections and plans of some of the major mine workings. In addition, the Department of Mineral Resources in Armidale has collated various pieces of primary documentation. Mine Records held by the Department of Mineral Resources library were a valuable source of primary documentation, including maps and sketch plans, company prospectuses, mine inspection reports, lease plans and assorted notes and correspondence.

Secondary sources, such as local histories and newspaper cuttings provided background information on the history of the area, some of the major events in the operation of the various mines and works and indications of the technology employed at some sites. In particular, contemporary technical manuals (dating c1870s—1940s) provided a wealth of information regarding the standard methods and equipment available for mining and processing and the various changes to technology over time. Due to a lack of more specific and detailed references to the processes in use over time in the Torrington area, it is often from these sources that an overview of operations has been reconstructed.

Oral histories were a supplementary source of information which were able to throw light on various aspects of the area not covered by official or technical records. Personal reminiscences of people who had been involved with the Gulf and Torrington areas all of their lives were invaluable sources of mining technology and history, as

well as of complementary social information. Fortunately, there are still people alive today who have firsthand knowledge of many of the sites in the Torrington area, and in some cases many generations of the one family have continued to reside here and are inextricably tied to the history of the place. Many people were interviewed during the course of the project, although detailed notes were not taken of all interviews. In some cases this was because these people had already been interviewed by the project historian and my enquiries were simply directed towards answering supplementary questions concerning the archaeological remains at various sites. In these cases, the information supplied by these informants is contained as pers. comm. references throughout the text of this report. Some people, however, were interviewed in more detail and, although taped recordings of these sessions were not made, the detailed notes from these interviews are included as the Appendices.

The following list contains the main sources in each category only. Other publications which have been referred to will be found in the Bibliography. The locations for each major source are given in square brackets.

1.3.1 Maps and plans

Sketch Plan of the Vegetable Creek Tin Mining District 1878 [Department of Mineral Resources Annual Report for 1878]

Map of the Vegetable Creek Tin-Mining field 1885 [Mitchell Library]

Geological Map of Vegetable Creek (Emmaville) Tin-field 1911 [Carne 1911]

Geological Map of the Mole Tableland Wolfram deposits 1912 [Carne 1912]

1.3.2 Department of Mines Annual Reports

Searched from 1875 until 1950 inclusive.

1.3.3 Department of Mines specialist reports

- T. W. Edgeworth David 1887. *Geology of the Vegetable Creek Tin Mining Field, New England District, NSW*. Geological Survey of NSW, Charles Potter, Government Printer, Sydney. [Mitchell Library]
- J. S. Carne 1911. *The Tin Mining Industry and the Distribution of Tin Ores in NSW*. Government Printer, Sydney. [State Library of NSW]
- J. S. Carne 1912. *Notes on the Occurrence of Tungsten Ores in NSW*. Government Printer, Sydney. [State Library of NSW]
- P. L. Rasmus 1969. *The Mineral Industry of NSW, No. 41, Tungsten*. Geological Survey of NSW, Sydney. [State Library of NSW]
- J. A. Ingram 1976. *Australian Tin Deposits*. Mineral Resources Report No. 7. Australian Government Publishing Service, Canberra. [State Library of NSW]
- Department of Mineral Resources, Mineral Deposit Data Sheets for the Inverell, Emmaville and Mole River 1:50,000 map sheets [Department of Mineral Resources, Armidale].

1.3.4 Department of Mineral Resources Mineral Deposit Data Sheet Compilations

Held in the Department of Mineral Resources in Armidale, these are included as a separate category because the more fully documented can contain a wide range in complementary sources of information. At best these data sheet compilations can include lease plans, extracts from the Department of Mine Annual Reports, Mine Inspection reports, unpublished technical reports by prospecting, exploration or mining companies, maps, and sketches.

1.3.5 Mine Records, Department of Mineral Resources

These are held by the Department of Mineral Resources Library in Sydney and were searched by both the name of the mine and by the counties of Gough and Clive. As

with the Mineral Deposit Data Sheet Compilations, the more fully documented of these contained many complementary sources of primary and secondary information. Some of the information is the same as that contained in the Mineral Deposit Data Sheet Compilations.

1.3.6 Professional and Technical Journals

W. R. Crane 1912. Index of Mining Engineering Literature 1901-1912. [State Library of NSW]

Australian Mining and Engineering Review searched for 1908-1917, afterwards known as the *Chemical Engineering and Mining Review* searched for 1918-1940 inclusive. [Department of Mineral Resources Library, Sydney]

1.3.7 Technical manuals

1871 W. P. Blake, *Notices of Mining Machinery and Various Mechanical Appliances in use chiefly in the Pacific States and Territories for mining, raising and working ores with comparative notices of foreign apparatus for similar purposes*. Charles C. Chatfield and Co, New Haven. [State Library of NSW]

1871 W. Morgans, *Manual of Mining Tools*. Lockwood and Company, London. [State Library of NSW]

1875 J. S. Phillips, *Explorers, Miners and Metallurgists Companion*. Tribner and Company, London. [State Library of NSW]

1878 George G. André, *A Descriptive Treatise on Mining Machinery, Tools and Other Appliances used in Mining* (2 volumes). E and F. N Spon, London. [State Library of NSW]

1884 A. G. Charleton, *Tin: describing the chief methods of mining, dressing and smelting it abroad, with notes on arsenic, bismuth and wolfram*. [Mitchell Library]

- 1885 H. A. Gordon, *Report on Mining Machinery in Victoria and New South Wales*. Government Printer, Wellington. [State Library of NSW]
- 1889 H. A. Gordon, *A Miner's Guide*. Government Printer, Wellington. [State Library of NSW]
- 1889 H. A. Gordon, *Mining Machinery and Treatment of Ores in Australian Colonies. Reports on mining machinery exhibited at the Melbourne Exhibition*. Government Printer, Wellington. [State Library of NSW]
- 1894 H. A. Gordon, *Mining and Engineering and Miner's Guide*. Government Printer, Wellington. [State Library of NSW]
- 1890 C. G. H. Lock, *Mining and Ore-dressing Machinery. A comprehensive treatise dealing with the modern practice of winning both metalliferous and non-metalliferous minerals including all operations incidental thereto, and preparing the product for the market*. E. and F. N. Spon Ltd., London. [State Library of NSW]
- 1894 H. A. Gordon, *Mining and Engineering and Miners' Guide*. Samuel Costall, Government Printer, Wellington. [State Library of NSW]
- 1901 C. Le Neve Foster, *A Text-Book of Ore and Stone Mining*. Charles Griffin and Company Ltd., London. [Dixson Library, UNE, Armidale and Fisher Library, University of Sydney]
- 1902 E. H. Davies, *Machinery for Metalliferous Mines. A practical treatise for mining engineers, metallurgists and managers of mines*. Crosby Lockwood and Son, London. [State Library of NSW]
- 1904 Donald Clark, *Australian Mining and Metallurgy*. Critchley Parker, Melbourne. [Dixson Library, UNE, Armidale]
- 1906 W. H. Tinney, *Gold Mining Machinery. Its selection, arrangement and installation*. Crosby Lockwood and Son, London. [State Library of NSW]
- 1908 International Correspondence School, Scranton, *Placer Mining: surface arrangements at ore mines, preliminary operations, ore mining, supporting excavations, assaying*. International Textbook Company, London. [State Library of NSW]

- 1912 W. R. Ingalls, *Handbook of Mining Details*. McGraw-Hill Book Company, New York. [State Library of NSW]
- 1916 G. J. Young, *Elements of Mining*. McGraw Hill Book Company, New York. [State Library of NSW]
- 1919 G. J. Young, *Mining Practices: compiled from the Engineering and Mining Journal* [State Library of NSW]
- 1927 A. F. Taggart, *Handbook of Ore Dressing*. John Wiley and Sons, New York. [State Library of NSW]
- 1928 C. G. Moor, *Tin Mining: a complete guide for all actively interested or engaged in tin mining*. Sir Isaac Pitman and Sons Ltd, London. [State Library of NSW]
- 1936 The editorial staff of the Chemical Engineering and Mining Review, *Mining Handbook of Australia No 1*. Tait Publishing Company, Melbourne. [State Library of NSW]
- 1944 T. Bryson, *Mining Machinery. An elementary treatise on the generation, transmission and utilization of power for candidates for the under-manager's certificate*. Sir Isaac Pitman and Sons, Ltd., London. [State Library of NSW]

1.3.8 Secondary accounts

- C. Lyne 1882. 'Tin Mining', in *The Industries of New South Wales*, Sydney. [Heritage Centre, UNE, Armidale]
- G. W. Griffin 1888. 'Tin', in *New South Wales: Her Commerce and Resources*, Sydney. [Heritage Centre, UNE, Armidale]
- E. F. Pittman 1901. 'Tin', in *The Mineral Resources of New South Wales*, Sydney. [Heritage Centre, UNE, Armidale]
- Christine Alt 1981. *Old Torrington. A History of Torrington and District 1881-1981*. Torrington Centenary Committee, Glen Innes.

1.3.9 Newspaper accounts

Glen Innes Examiner

Armidale Express

Town and Country Journal

1.3.10 Oral histories

Supplementary interviews:

Bev Bower

Mal Bower

Manuel Bringas

Don Burton

Rex Clifford

Stephen Elliott

Beryl Elliott

Alvena Gibbs

John Griffey

Bill Sherratt

Sue Stelzer

Detailed interviews:

Ginger Burton

Terry Clifford

Geoff Finnigan

1.3.11 Limitations

There were various limitations on each of these data sources, which restricted both the quality and quantity of information available. Maps, which are most useful for

locating old sites on the ground and relating them to contemporary and more recent sites, were principally limited by their accuracy. Nineteenth century maps and plans do not match more current survey data very accurately and not all useful topographic features were marked. Where they were, features such as creeklines were often noticeably different.

The annual reports for the Department of Mines became less detailed over time as the industry grew, and the amount of information which each needed to cover increased. By the 1930s, 40s and 50s these reports essentially were only mentioning major ventures, and not the many smaller and individual mines. In addition, because the reports were written for a specific purpose they didn't always focus on areas which are useful to archaeology, and coverage of such areas as machinery plant or rebuilding/removal episodes is rare.

The many specialist reports to come out of the Geological survey are limited by similar factors. Because they were written by and for specialists they (understandably) focus on the geology, and do not always provide details on the works or the process.

The Department of Mineral Resources Mineral Deposit Data Sheets were among the most useful sources, given that they often contained a wide variety of complementary information. Unfortunately, not all Mineral Deposits were recorded equally comprehensively however—about some no historical information is known, while about others there is very little. Many deposits, while recognised in the field, have no historical information attached to them at all. These limitations are compounded by the ultimate goal of the Department of Mineral Resources to transfer all the compiled information to a computer database, available for purchase in CD-ROM format, which necessitates summarising the information available from the hard copies of the data sheet compilations. Data for the Inverell deposits (including the southern part of the study area around the Gulf) have already been published in such summarised book

form. The abbreviated nature of these published entries simply provides a list of references to producers, periods and features, rather than the actual plans, reports, or maps themselves. Information on sites at the Gulf, for example (Kathida/Yankee lodes, Company's Hill), was only made available from published entries, and consequently no lease plans or contemporary primary data accompanied the files for these sites.

Similar problems relate to the Mine Records held by the Department of Mineral Resources library in Sydney. Unfortunately some records were missing from the library collection entirely and for others, the folders were present, but empty. Like the Mineral deposit data sheets, the quality and quantity of information contained in each Mine Record varied widely. Some contained correspondence between the mine and the Department of Mineral Resources, others merely photocopied extracts from the Annual Reports. For sites at the Gulf for example, very little primary information was located.

Professional and technical journals contained some excellent and rare contemporary information, including contemporary photographs of the Butler and Block 14 (Bismuth) mine and contemporary descriptions of these sites and plants in particular and of the tin field in general. Unfortunately, these references are rare and only relate to one phase of the operations at these sites.

Technical manuals were excellent sources of contemporary descriptions of various parts of the milling and concentrating process, but did not deal specifically with either wolfram or bismuth processing, or with any of the sites within the study area. Most of the details included in this report have therefore been culled from a wide range of publications and from a wide variety of mineral technologies (including gold, silver and tin).

The use of secondary accounts is attended by the usual problems of the reliability of information and the narrow focus of many secondary accounts. In any case, secondary accounts referring to the Torrington field are rare.

Within the time frame of this report there was no opportunity to search all of the back issues of the three major regional newspapers, relating to the study area (the *Armidale Express*, the *Glen Innes Examiner* and the *Tenterfield Star*). Consequently the location of articles was highly opportunistic, although some articles turned out to be merely secondary accounts, or histories anyway.

Oral history was one of the most rewarding sources of information with the potential to provide a level of site specific information unmatched by other sources. The limitations on this data source was restricted to the accuracy of people's memories, their willingness to talk to a stranger and their store of knowledge about aspects of sites which related to the archaeology of these places.

1.4 Acknowledgments

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2. HISTORICAL BACKGROUND

2.1 Pastoralism and agriculture

Although several Europeans had passed through the Mole Tableland area as part of exploratory surveys, the first to actually settle land in the region were, characteristically, squatters seeking to occupy land outside of the Limits of Location, or the recognised (and legal) limits of settlement. The first pastoralists in the wider New England region arrived in the late 1830s and several early pastoral stations had boundaries on or near the Mole Tableland: Wellington Vale, taken up by Robert Cunningham-Robertson in 1838; Maidenhead, established by A. A. Leycester in 1839, but transferred to George Bowman by 1845; Aitken Vale, also taken up by George Bowman (Lobsey 1972, 61; Rosen 1998, 12-13), and Wallaroo station, taken up by Charles Kerr and Alfred Leigh McCowan in 1889 (Alt 1981, 81).

With the passing of the Robertson Land Acts in 1861, the areas formerly occupied exclusively as pastoral land were made available to other smaller scale selectors. This series of acts was designed ostensibly to alienate all Crown Land for the purchase of any selector and to regulate the amount of land which could be held by any one selector, large or small. As a result, many landholders took up portions of grazing land and altered the former system of land use. Under the terms of the Acts, selectors were required to live on their selection for at least three years and, over that time period, to erect improvements to the value of one pound per acre (Rosen 1998, 13). Improvements generally consisted of a hut or house, and fencing of boundaries or paddocks. These measures theoretically led to an increase in the density of settlement of an area and to the material remains left behind by this particular land use. In practice, however, while holdings could either be used for agriculture or grazing, the small size of the initial Robertson holdings (from 40 to 320 acres) rendered them unprofitable for the latter (Rosen 1998, 13). From the 1920s onwards, the smaller holdings were amalgamated into larger concerns (Rosen 1998, 13).

2.1.1 The material traces of pastoralism

A recitation of the early pastoral stations is more than just a record of the earliest permanent European presence in the region. Pastoral properties also left behind distinctive material traces, related to both their spatial characteristics and labour conditions. In terms of their spatial arrangement, the initial pastoral properties in New England were both extensive and poorly serviced. Many of them were first established by employees sent by pastoralists into new areas to claim land on their behalf, and most of their capital was invested in stock and wages. Goods were brought in by bullock dray and many pastoralists established private stores, inns, mail contracts, flour mills and stock agencies to supply their stations (Oppenheimer 1977, 158). The characteristic spatial patterning of the pastoral period was exemplified by a small nucleus of accommodation surrounding a headstation, with rudimentary service providers and several scattered outstations. This pattern was repeated on each station and the workforce was widely scattered. Many of the larger properties in the nineteenth century formed self-sufficient communities, complete with schools, public houses and churches. Prior to 1852, the squatters and their stores were supplied with goods exclusively from either Sydney or Port Macquarie and communications at this time were rudimentary: in the 1840s mail was carried in on a packhorse and all goods by bullock dray. Although all the major overland roads were established by the mid-1850s, Cobb and Co. did not begin passenger runs to the New England area until the late 1850s. Prior to the connection of the Great Northern Railway to Glen Innes in 1874 and Tenterfield in 1877, the Mole Tableland area was serviced exclusively by Cobb and Co. (National Parks Association 1976, 14).

The initial physical traces of pastoralism were in almost inverse proportion to the size and financial importance of the pastoral industry in the colony: consisting of scattered outstations composed of huts and yards manufactured from readily available 'bush' materials (i.e. bark, timber, hessian or galvanised iron), rather than more durable stone or brick; combined with boundary fences, access routes to and from various parts of

the property and strategically placed sets of stockyards. Unless continually maintained, none of these remains are likely to be particularly durable.

While pastoralism was a distinctly different landuse to mining, it is interesting to note that they were not necessarily separate in terms of who conducted each. In some instances land holders chose to operate mines on their properties, as part of the general rush for tin wealth which saw members of almost every class take part in the search: 'squatters made mineral conditional purchases on their pastoral stations, wealthy storekeepers applied for extensive mineral leases, and even the coroner of Armidale ... transferred himself to speculations at Cope's Creek' (Walker 1964, 399). Among the squatters who took advantage of the tin rush were Irby (who had interests in the Rose Valley mine and later the Little Wonder and Little Britain mines), Dumaresq (Catarrh Ck), and among the storekeepers were notable Armidale figures, John Moore (Y-waterholes and the Great Britain mine, later also the Rothschild mine), Peter Speare and James Salmon (*Armidale Express* 2/11/1872; Department of Mines Annual Report 1876, 114; 1878, 126-130).

2.1.2 The material traces of agriculture

Similar to the material traces of pastoralism, the material remains of agriculture relate to boundary markers (fencelines), stock management (yards), food crops (orchards, ploughed fields), and domestic and associated structures and features (huts, outbuildings, gardens, exotic plantings). Because the material traces of agriculture essentially relate to the period after the introduction of the Robertson Land Acts, they are both smaller in scale than pastoral remains and slightly different in emphasis. With the arrival of large numbers of small settlers, the focus shifted somewhat, from large flocks of sheep scattered across vast tracts of land with a few strategically placed outstations, to more densely clustered, but relatively small (a maximum of 300 acres initially, but later up to 1200 acres) and self contained farms.

Although there is little precise information as to what was being cultivated on agricultural holdings within the SRA, a range of foodstuffs would have been produced independently on each farm, including grain crops, fruit, vegetables and meat. Although this may have been primarily intended for family use, the excess may have been traded and sold within the wider mining community. The Turners on their farm at Bismuth, for example, grew corn and other crops, cultivated an orchard, and ran sheep, supplying the meat to their butcher shop in Bismuth town for sale to the mining settlement (Rosen 1998, 15).

Other potential material remains which may relate to either the pastoral or agricultural use of land are the features associated with the long distance transportation of stock animals, particularly routes of transportation across the landscape (such as the bullock track linking the various sets of stockyards on Maidenhead station) and associated watering holes or wells.

2.2 Mining

2.2.1 Tin

Tin was the first mineral to be discovered and extensively worked on the Mole Tableland, from the time of the proclamation of the Vegetable Creek tin field in 1872. The recognition of tin crystals had been reported in Australia as early as 1788, although it was not until 1851 that the Reverend W. B. Clarke officially claimed to have discovered it (Carne 1911, 4-8). Two years later, Clarke reported finding wolfram and 'oxyde of tin' near Dundee, but it wasn't until some twenty years later that reports of payable quantities of tin were reported from various locations in northern NSW. Early deposits were described near Inverell and the Mitchell River in 1871, and near the source of Vegetable Creek in March 1872 by a Thomas Carlean (or Carline) (Carne 1911, 20). In the same month, Charles Pattison, a stockman from

Maidenhead Station reportedly found tin in the granite country between the Beardy and the Mole Rivers (*Armidale Express* 2/11/1872).

Deposits on the Mole Tableland were recorded by the Department of Mines as early as 1872 and 1873, and, although the individual locations of these deposits were not identified (Department of Mines Annual Report 1876, 114), they were presumably alluvial creek deposits. In November 1872, a Black Swamp correspondent wrote to the *Armidale Express* (*Armidale Express* 2/11/1872) describing some of these areas:

Of the creeks taken up for mineral purposes the principal are Black, Gulf, and Reedy Creeks. ... On Catarrh Creek Messrs. Dumaresq, Rodgeron and McNamara have a very rich claim of 1000 acres, about two miles from Mr. Burns's store. ... W. Fraser and party on Black Creek Gap and J. Logan adjoining them, have very rich lodes. Different claims, such as the Bald Rock and Black Swamp on a branch of Reedy Creek, and a few on Carpet Snake, the main tributary of Black Creek, are looking very well.

Flagstone Creek was being worked by 1873 (*Town and Country Journal* 12/9/1874) and by 1875, alluvial deposits in several creeks had already been extensively tested, including Gulf Creek, Blatherarm, Catarrh Creek, Carpet Snake Creek, Bark Hut Creek, Black Creek, Reedy Creek and Lottery Creek (*Armidale Express* 2/11/1872; Carne 1911, 149; David 1887, 65; Department of Mines Annual Report 1875, 107; *Town and Country Journal* 12/9/1874). By 1875, three larger lode deposits had also been discovered on the tableland: the Dutchman, Byrne's Lode, and Battery Mountain (David 1887, 5-6). At Battery Mountain the Planet Tin-mining Company opened the first tin lode in the state and erected the first tin crushing machinery (an 8-head stamper battery) in the Colony (Carne 1911, 43, 163; David 1887, 5-6; *Town and Country Journal* 30/10/1875).

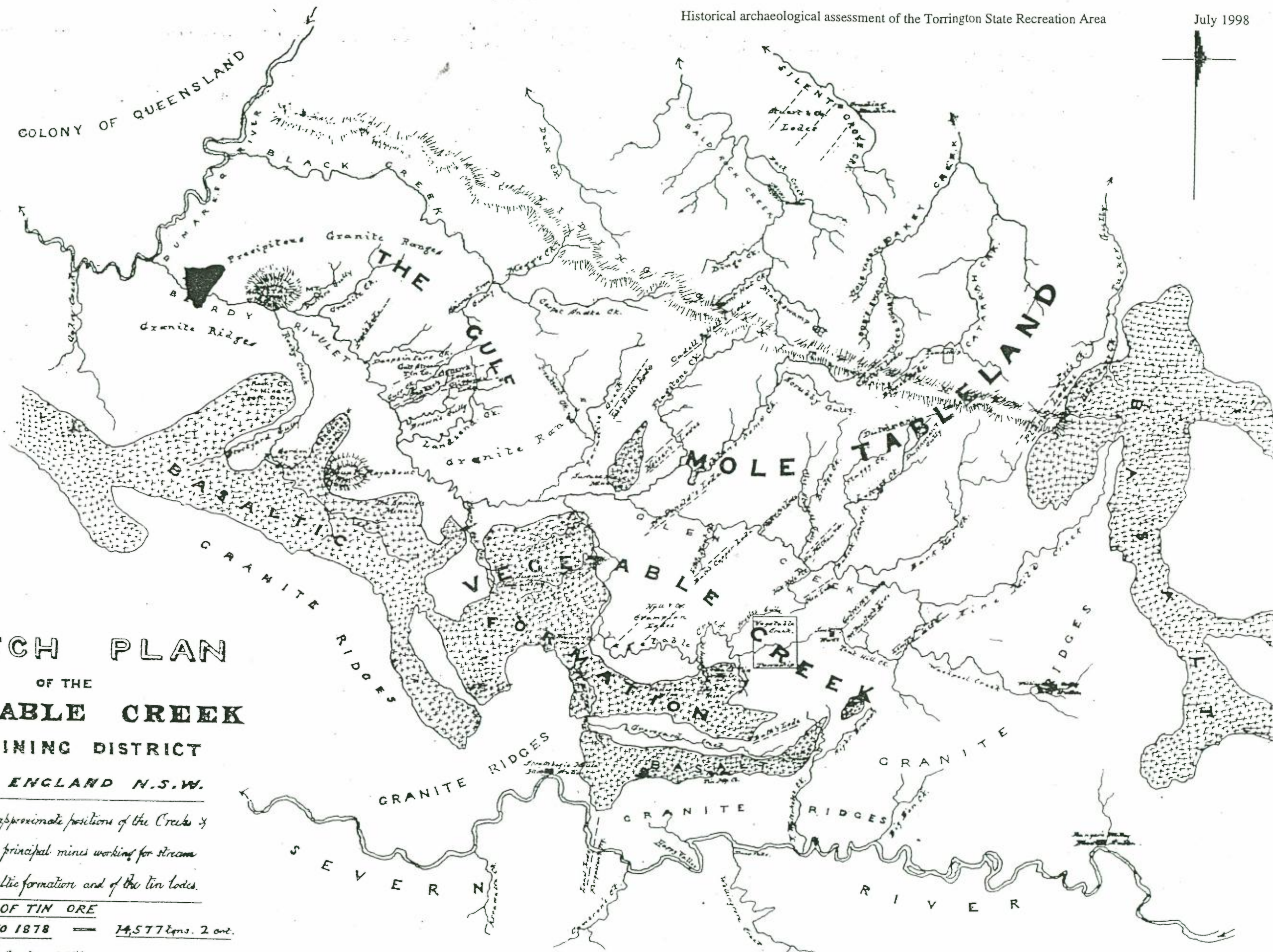


SKETCH PLAN
OF THE
VEGETABLE CREEK
TIN MINING DISTRICT
NEW ENGLAND N.S.W.

*Showing the approximate positions of the Creeks &
localities of the principal mines working for stream
tin under basaltic formation and of the tin lodes.*

TOTAL YIELD OF TIN ORE
FROM 1872 TO 1878 — **14,577 lbs. 2 oz.**

Scale of Miles



Not surprisingly, further tin lodes were discovered regularly: the Gulf, Flagstone Creek and Silent Grove by 1877; the Yankee lode by 1878; Carter's, Curnow's, Butler's and the Torrington tin-veins in 1881; and Lee's Gully, the Wallaroo and Hart's by 1882 (Department of Mines Annual Report 1878, 129; 1881, 101-102; 1882, 89-90; David 1887, 7-8). Joe Bates was the accidental discoverer of the Torrington tin lode in 1881, when his dray became bogged whilst carting hurdles for removable sheep fences. Bates was required to undertake extensive digging to extract his dray from the mud, and in doing so noticed some black stones, which upon later identification, turned out to be tin (*Glen Innes Examiner*, 6/1/1954).

Tin production in the district peaked in 1881, when there were over 900 Europeans and 2,000 Chinese miners engaged in mining on the Vegetable Creek tin field (Department of Mine Annual Report 1881, 103). By 1888 the number of miners had fallen to roughly half this, with only 544 Europeans and 950 Chinese (Department of Mines Annual Report 1888, 99). Between 1888 and the early 1900s there was a general decline in the prosperity of the field and many mines closed apart from some prospecting. The pattern of short term peaks followed by periods of depression was characteristic of the entire historical life of the tin field: in 1894, for example, Vegetable Creek supported only 174 European and 216 Chinese miners, which was described as a 'great reduction on the number employed in 1893 when there were nearly 900 men on the field' (Department of Mines Annual Report 1893, 51). By 1895, however, the Emmaville division, of which Torrington was a part, was described as the largest tin-producing mining division in NSW (Department of Mines Annual Report 1895, 59), although within two years the annual report (1897, 62) noted that '[n]umbers of Chinamen are leaving the field, which goes to show that the payable ground is worked out ...' In 1900 there was another rise in the price of tin and more large scale tin mining operations were established, lasting until 1920 (Department of Mines Annual Report 1900, 59). Tin production at Torrington was at its peak during the 1920s, however by the late 1930s and the beginning of World War II, mining activity again lessened. Although the Government had instituted a scheme to

subsidise the price of tin in an attempt to prop up the industry in the late 1930s, this was withdrawn shortly after the war and the price of tin fell well below viable levels. More exploratory work in the 1960s resulted in another short burst of interest, and the introduction of tax deductions for exploratory work in the 1980s, meant a further period of increased activity (Rosen 1998, 25-29).

One of the most important industrial uses of tin was in the manufacture of tin-plate, as a protective coating on stronger metals such as steel or copper. It was also employed as an alloy in solder, as an alloy with brass or bronze in bearing metal, gun metal, type metal or diecasting, as a salt in ceramic enamels and in organo-tin compounds in plastics, wood preservatives and pesticides (Ingram 1976, 1).

2.2.2 *Wolfram*

Wolfram is one of the most commercially important of the tungsten minerals, along with scheelite which only occurs in isolated instances on the Mole Tableland. Wolfram is a heavy, hard, dark-grey to black mineral composed of tungstate of iron and manganese; scheelite is calcium tungstate and is typically buff to white in colour. Both can be treated to release purified tungsten. Although classed as a rare metal, because of its extreme hardness tungsten is used for a wide variety of industrial purposes: as an alloy with various metals, particularly with iron in the steel industry; in the manufacture of tungsten carbide used for cutting edges; in electric lighting (eg. the filaments in light bulbs or the phosphors in fluorescent lights) and electronics; and in the manufacture of inks, paints, enamels and glass (Carne 1912, 17; Rasmus 1969, 8-9). During both the First and Second World Wars, great quantities of tungsten carbide were employed in the manufacture of war materials, such as armour piercing shells, armour plate and gun barrels (Rasmus 1969, 9).

Although recognised early by the Reverend W. B. Clarke, and described on the Mole Tableland by David in 1887, wolfram received no commercial attention in NSW until

1890 (Carne 1912, 5). There was slight activity prospecting for tungsten ore in 1896 and by 1899 wolfram was being mined at Scrubby Gully and the Gulf (Department of Mines Annual Report 1899, 76). Over the next decade the production of wolfram remained negligible and the first official mention of large scale mined deposits on the Mole Tableland was not until 1903/1904 (Department of Mines Annual Report 1904, 143). Near Torrington, the Wentworth Claim at Cow Flat, the Bismuth Claim, the 'Disputed' Claim, Smyth's Claim, The Kate Mine, and Uren's Claim were all mentioned, while at the Gulf, Flynn Brothers, Rumsby's Claim, Bradshaw's Claim, Clapham and Townsend's Claim, Brown's Claim and Bell's Claim were also described (Department of Mines Annual Report 1904, 143). The Torrington Ore Company produced the bulk of wolfram exported from NSW in 1906 (Department of Mines Annual Report 1906, 59), but by 1908 a serious depression resulting from the low ruling prices of metals had fallen over the industry, affecting the greater part of the Northern Mining District. Mining for antimony, wolfram, molybdenite and bismuth, which up to this time had contributed considerably towards the aggregate value of the returns for this district, was practically at a standstill (Department of Mines Annual Report 1908, 97).

Wolfram was mined most heavily in the lead up to the First World War, when it was in great demand on the world market. Torrington was known as the principal centre of the wolfram mining industry in the late 1910s, but by 1920 the value of plant and machinery erected on the field had fallen from £100,000 to £12,500 (Department of Mines Annual Report 1920, 34). By 1924 all of the mines in Torrington were abandoned, although some were re-worked during the 1930s, 40s and 50s. Approximately forty wolframite-bearing deposits have been recorded in the Torrington area, and three-quarters of these occur within the Torrington Pendant (Weber 1974, 364). No tin has been recorded in association with the larger wolfram deposits in the pendant, but there are many instances of wolframite contained within the tin deposits (Ingram 1976, 24).

2.2.3 *Bismuth*

Bismuth is another relatively rare metal which almost never occurs in its native form. Although a few samples of native bismuth have been found within New South Wales, it is more commonly found as a bismuth oxide, sulfide or carbonate in association with lead, zinc or tin deposits (anon 1998). The low toxicity of bismuth salts allows them to be used in the manufacture of makeup and medicines, although bismuth is also alloyed with other metals to produce a wide variety of end products, including punches and dies, lost wax castings, solders, acrylic fibres and various plastic goods (anon 1998).

Bismuth as a metal, oxide and sulfide is widespread throughout the margins of the Mole granite, where it is commonly found in association with wolframite. The earliest known production of bismuth around Torrington was in 1879 from the Duck Creek bismuth deposits, although the Kingsgate Mine at Glen Innes was producing as early as 1877. By the turn of the century only occasional parcels of bismuth were being produced from the Mole Tableland mines (Department of Mines Annual Report 1901, 63), until the Bismuth Mine at Torrington began producing in 1904 (Carne 1912, 71). Unfortunately, the average grade found here was low and total production only amounted to around 40 tonnes (anon 1998). The Bismuth Mine had ceased production by 1927, although it was revived briefly during the 1970s. The lease for the last company to work the Bismuth Mine, Pacific Copper, has only just expired, and has now been taken up by the Topalite Mining Company as part of their mineral exploration license to search for industrial topaz (silicite).

Small quantities of bismuth were noted or mined throughout the twentieth century in conjunction with deposits at Fielder's Hill, Cow Flat, Scrubby Gully, Mt Everard, Trewhella's Lode, Heffernan Brother's Wolfram Lode, Elliott and Hore's Lode, Paradise Lode, Saul and Staude's prospect on Duck Creek, the Marven Mine, and in

the wider region, at the Ottery Mine, Webb's Silver Mine and the Webb's Consols Mine (anon 1998).

2.2.4 Relative success of tin, wolfram and bismuth mining

Various remarks from the Annual Reports of the Department of Mines indicate that the relative success of many deposits depended upon a number of variables apart from merely knowledge of a deposit's existence, particularly rainfall and the financial state of the world market. With regards to tin, in 1876 for example, although several areas had already been worked on the Mole Tableland by this date, the Annual Report (1876, 113) remarked that '[a]t the Mole tableland ... the ground may be said to have been barely tested, although tons of stream tin have already rewarded the workers; ... the main discoveries have yet to be made.' By the following year (1877, 111), the mines on the Mole Tableland were described as having 'for some time' been deserted. This situation obviously improved somewhat, for by 1878 (Department of Mines Annual Report 1878, 128), the Report noted that '[t]he ... Mole Tableland ... alluvial mines have supported a population comparatively small, and mostly composed of scattered parties' and in 1879 (155) that '[s]ome of the leases at the Mole Tableland previously tested and abandoned as unpayable have recently been re-occupied.' By 1880, the Report remarked that '[s]everal miners have been working in the gullies at the Mole Tableland during the past wet season with good results, but the water is now becoming scarce and they are leaving pending further rains' (Department of Mines Annual Report 1880, 163). As a consequence there was a continual practice of re-working old deposits as rainfall or the market price improved. This has resulted in an overlay of new workings on old, which sometimes has serious consequences for the archaeological traces of mining. It not only means that virtually every site will have a sequence of operating periods, which may or may not be continuous, but that as technology changed, the methods of working at a single site also changed, sometimes to the point of later periods obliterating all traces of earlier workings.

3. MINING AND PROCESSING TECHNOLOGY: TIN, WOLFRAM AND BISMUTH

Technology refers to the entire process, from extracting the ore to dressing and preparing it for market. Hardesty refers to this as the 'total system', including the tools and labour for removing the ore body, taking it to the mill, crushing the ore, extracting the precious metals, and dumping the waste (Hardesty 1988, 18). Sometimes the system may be visible in contemporary technical documents, which describe how the technical process was planned, or how it was actually carried out at a place; mostly though it is only visible as a network of observable (archaeological) features and artefact assemblages (Hardesty 1988, 18). To complicate matters, more often than not, an archaeological site is not just reflective of a single technological process or system, rather it may be made up of several systems which reflect how the process changed over time.

The technology of tin, wolfram and bismuth mining is closely related to the geology of the ore deposit. I will deal jointly with the technology of mining for tin, wolfram and bismuth, mainly because the processes of extraction and dressing the ore were roughly similar for each. Most of the information in the following sections relates to the mining and processing of tin, as very little specific information exists relating to wolfram and bismuth. Unfortunately, data provided by the Department of Mines does not contain sufficient chronological information from which to compile a table for the relative frequencies of tin, wolfram and bismuth mines which have existed in the Torrington study area over time.

3.1 Mining Technology

There are four main technological processes which are relevant to the total system of mining:

- Extraction
- Haulage and winding
- Milling
- Concentration

3.1.1 Extraction

Tin can be extracted from either primary (*in situ* hard rock) deposits or from secondary (placer) deposits. Primary deposits are where tin occurs *in situ* in (in the case of Torrington and surrounds) granite and adjacent contact rocks. Tin usually occupies fissures, though frequently penetrating the walls of these fissures, and is often also disseminated through the host granite (Carne 1911, 26). The primary deposits on the Mole Tableland occur within the granite of the Mole Batholith (also referred to as the Mole Granite), which encloses the Torrington Pendant, a metamorphosed sedimentary inlier of Permo-Carboniferous age (Weber 1974, 363).

Secondary deposits on the other hand derive from primary deposits. There are three kinds of secondary (or placer) deposits: tin-bearing alluvium (wash) in present day rivers and streams; former drainage systems of Quaternary age which contain wash at the surface and/or buried under a few layers of barren alluvium; and former drainage systems of Tertiary age which have been covered by subsequent Tertiary flood basalt flows (Weber 1974, 376). Secondary placer deposits (generally present river and stream deposits or old river terraces) are essentially loose water-transported deposits which often occur close to the ground surface, although they may also be covered by one or more layers of basalt. Primary deposits, on the other hand, occur within the parent rock. Each required radically different extraction methods, which related to

both the geology of the ore body and the engineering problems of gaining access to and removing the ore body (cf. Hardesty 1988, 20).

Wolfram and bismuth both occur in primary deposits, usually in pipes of quartz developed in granite.

1. Alluvial tin mining

All the methods which were originally used for alluvial gold mining were automatically applied to alluvial tin mining when the first rushes to the alluvial tin fields took place in 1872. Altered conditions and greater experience did lead to subsequent modifications in techniques, but the main principles remained unchanged. Alluvial tin was relatively easy to extract and was mainly separated by hydraulic techniques such as panning, cradling, banjoing, sluicing or dredging (see glossary). With the exception of dredging, all relied on a gravity separation principle, and involved agitating the tin-bearing deposits with water so that the heavier tin precipitated out and was caught in the rims of a pan, in the riffle boards or slats on the bottom of a cradle, or at the apex of the banjo (Birmingham, Jack & Jeans 1979, 37; Ritchie 1981, 53; Walker 1964, 398).

The first systems of sluicing for tin were the same as those previously employed in sluicing for gold, however many miners found that the narrow sluice box and fork did not recover enough of the tin to render their leases profitable (*Town and Country Journal* 30/10/1875). In searching for more economical means of washing the dirt more quickly and cheaply, other sluicing techniques were introduced. One correspondent reported 'a great improvement in the sluicing boxes' employed at the Star, Garter, and Anchor Tin Mines at Vegetable Creek (*Town and Country Journal* 22/3/1873): 'The new idea consists of one large box from which projects two longer boxes—the ore is put into the former while a steady stream of water is admitted from the latter. By the means of one California pump a sufficient quantity of water can be

raised to satisfy all requirements.’ Other improvements were the hopper plate, large sluice box and square mouthed shovel, also introduced at Vegetable Creek:

These hopper plates are now in general use, and are 4 feet long by 2 feet wide, perforated with holes from 5/8 to 1 inch in diameter, and fitted at the head of the sluice box. This has proved to be a considerable improvement on the original manner of sluicing, for a larger quantity of puddled dirt can be washed per day, the principal reason being that the stones or pebbles are not allowed to drop into the sluice box; the fine stanniferous dirt is in consequence far more easily washed, a square mouthed shovel being used in place of the fork to keep the tin up to the head of the box. (Department of Mines Annual Report 1875, 65)

Further improvements were made by substituting horse power for manual labour in pumping water (*Town and Country Journal* 30/10/1875), and in driving the puddling machines, which were used to break up the tin-bearing ore before it could be passed through the sluice box (David 1887, 5). Puddling machines (sometimes referred to as ‘Australian’ puddling machines, see Foster 1901, 551) were circular pits into which the ore-bearing gravel was agitated with water, usually to rid the gravel of heavy clay. Puddlers were horse drawn, and used rakes or chains attached to radial arms carried round a vertical axis to stir the wash dirt (Foster 1901, 551; Ritchie and Hooker 1998, 7). The horse was attached to a pole in the centre of the puddler and walked endlessly around the perimeter of the trench (McGowan 1994, 5). Such alluvial technology dominated the Vegetable Creek tin field for much of its early history: in 1876, for example, the field held only one steam engine and one boring machine, but thirty puddling machines; seven whims and pulleys; thirty-six pumps and thirty-nine sluice boxes (Department of Mines Annual Report 1876, 35).

Sluicing was often larger in scale than panning or cradling and used either pressurised or unpressurised water to break down gold-bearing deposits. To achieve this, water races following natural contours were constructed across the landscape to divert water from permanent or abundant local water sources to the diggings.



Figure 3.1: Puddling machine in use on a Queensland goldfield (from Stone and Mackinnon 1976, 30).

In hydraulic sluicing, water from the race was directed over the face of the working terrace by means of a hose and nozzle, and in ground sluicing simply left to flow across the workings unaided, the face then being broken down manually and processed (Birmingham, Jack & Jeans 1979, 38; Ritchie 1981, 53). Even the sluicing techniques used on the Vegetable Creek tin field were described as 'different from what is found in mining generally' (Lyne 1882, 172). In particular, Lyne (1882, 183-184) noted a method of re-using water:

... where the dams are extensive and the machinery and box-fluming—or canvas piping, which is sometimes used—is more than ordinarily elaborate, the pumping apparatus lifts the water to a considerable height, and by an ingenious method of ground watercourses the water, after having been conveyed along a very lengthy extent of fluming, and after having done the work required of it ... runs back to the dams and is used again. The fluming is erected on wooden scaffolding or staging, at the height from the ground necessary to cause the water to flow where it is

wanted, and except in one or two instances in connection with mining for gold at the Turon ... this method of providing mines with water is, as far as I have seen, peculiar to tin-mining.

By the turn of the twentieth century sluicing had declined in popularity as a technique and was largely replaced by dredging, a procedure reportedly introduced into the Australian gold mining industry in the 1890s from New Zealand, where it had been used since 1863 (Ritchie 1981, 53, 64). Quickly transferred to the tin mining industry, the first tin dredge in use in the colonies was introduced at Cope's Creek, near Inverell in 1900 (Walker 1964, 405). Unlike in gold mining, where bucket dredges were most popular, in tin mining it was the suction or pump dredge which was most common (Carne 1911, 44). These used steam pressure forced through a powerful nozzle to break down alluvial deposits and revolutionised tin-mining in the principal tin centres. The greater efficiency of these kinds of dredges led to the recovery of a larger percentage of tin ore from dredged deposits (Carne 1911, 44).

2. Hardrock mining

Hardrock mining of tin, wolfram and bismuth differed significantly from alluvial mining in that it required the breaking, hauling and crushing of the surrounding granite rock in which the ore was present. Hardrock mining techniques could be either small-scale and relatively inexpensive in resources and labour, or large-scale and highly mechanised, depending on variables such as capital, the availability of sophisticated machinery or problems of isolation and difficult terrain (Birmingham, Jack & Jeans 1979, 41). Both open cut (above ground quarrying) and underground mining methods were used in the Torrington area to extract hardrock ore deposits. Open cut quarrying could be employed when the lode deposit outcropped near the surface and did not dip too sharply; but underground techniques were necessary when the ore body was narrow or dipped steeply (Hardesty 1988, 21).

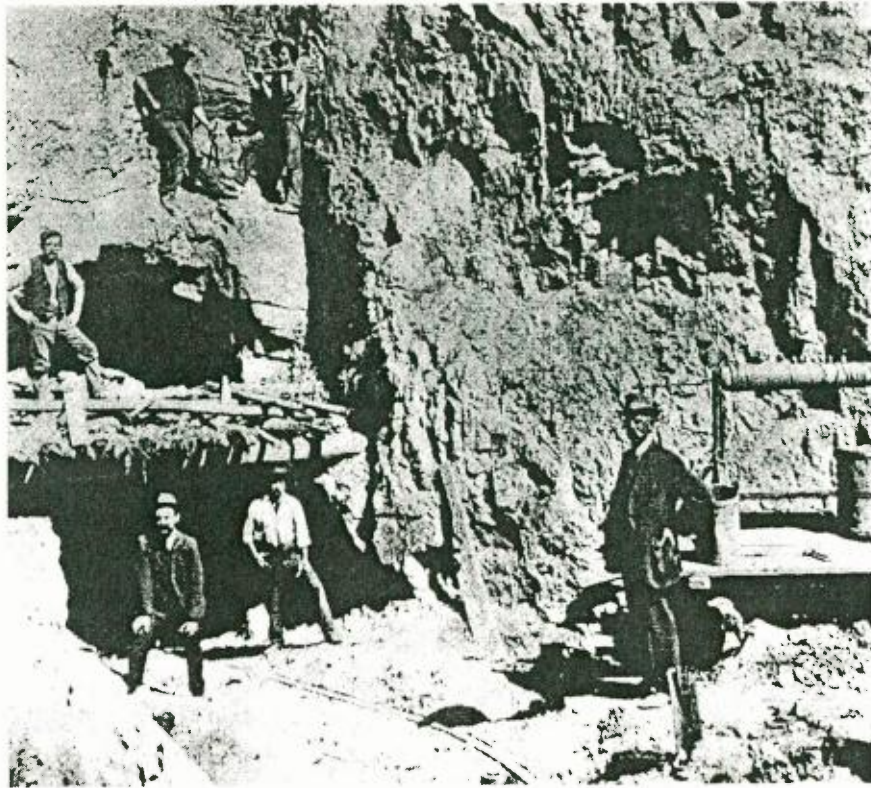


Figure 3.2: Rockvale Wolfram Company's quarry, Carter's section, 1910. Note the windlass and ore bucket to the right of the photograph.

Both open cut and underground miners used hammers and rock drills to make holes in the ore body, which could then be blasted using an explosive and mucked out with picks and shovels. Holes were drilled into the ore body, which were plugged with a charge and then ignited using a fuse. Prior to the introduction of dynamite, miners used gunpowder to blast the ore face, and by 1876, there were at least five 'black powder' manufacturers in Australia (Kolm 1988, 639). Dynamite was both safer and easier to control, however, and required smaller amounts to achieve the same effect (Terry Clifford pers. comm; Hardesty 1988, 21-22). The original Swedish patent for dynamite had been registered in 1867 by Alfred Nobel (Hardesty 1988, 21; Kolm 1988, 640), although it was not patented in Australia until 1872 (Kolm 1988, 640). By 1874, Frederick Krebs of Krebs Brothers and Company in Cologne, had begun exporting 'lithofracteur', a dynamite derivative, to Australia, and began manufacturing in Australia in 1874 (Kolm 1988, 640).

With the introduction of mechanical rock drills to Australia in the 1870s, miners were saved both considerable time and effort. The average distance which could be drilled by hand was between 4-6 feet per miner per shift, compared to an average of 30-60 feet when using a mechanical rock drill (Moor 1928, 43). Run by compressed air, mechanical rock drills required the installation of air compressors (usually steam driven) on the surface and revolutionised the labour requirements of mining (Hardesty 1988, 21).

The underground extraction of ore required the construction of shafts and adits, which generally followed the direction of the vein. Shafts are either vertical or inclined passages (also known as incline or underlay shafts), while adits (or tunnels) are horizontal passages. Both connect the mine to the surface. Shafts and adits had two functions within a mine—they were a route linking the working face with the surface for the access of both miners and materials, and they provided passages through which the mine could be adequately ventilated. Underground mines were established as a series of horizontal workings or levels which were numbered consecutively from the surface down (Ritchie and Hooker 1998, 13). The vertical distance between each level varied, although at mines like Curnow's, each new level was approximately 100 feet below the last. Levels were connected by raises, or rises (shafts excavated upwards) and winzes (shafts excavated downwards) (Hardesty 1988, 22; Ritchie and Hooker 1998, 14-15).

3.1.2 Haulage and winding

1. Kibbles and windlasses:

In mines worked by hand, the ore was raised to the surface in an ore bucket or kibble. Kibbles could either be made from timber staves, in the same way as a barrel, or from hammered iron plates rivetted together and closed at the base by a circular plate provided with a ring (Foster 1901, 408).



**Figure 3.3: The incline (underlay) shaft at the Torrington Ore Company's
Bismuth Mine, 1910**

Kibbles were characteristically barrel shaped to minimise the catching of the lip on the sides of the shaft (Ritchie and Hooker 1998, 13). The simplest method of winding used a pulley or sheave supported on a poppet head or headframe above the shaft, which carried a rope to which a kibble could be attached at one end, while the other was wound up onto a windlass. In some ventures the pulley was dispensed with and the rope was wound directly onto the windlass (see for example Figure 3.4 below). Many of the mines at the Gulf were operated using such small scale hand technology, and there was considerably less machinery used here than in Torrington (Terry Clifford pers. comm.; Rex Clifford Interview in Rosen 1998, 135). This would appear to be a distinct regional difference between the two areas.

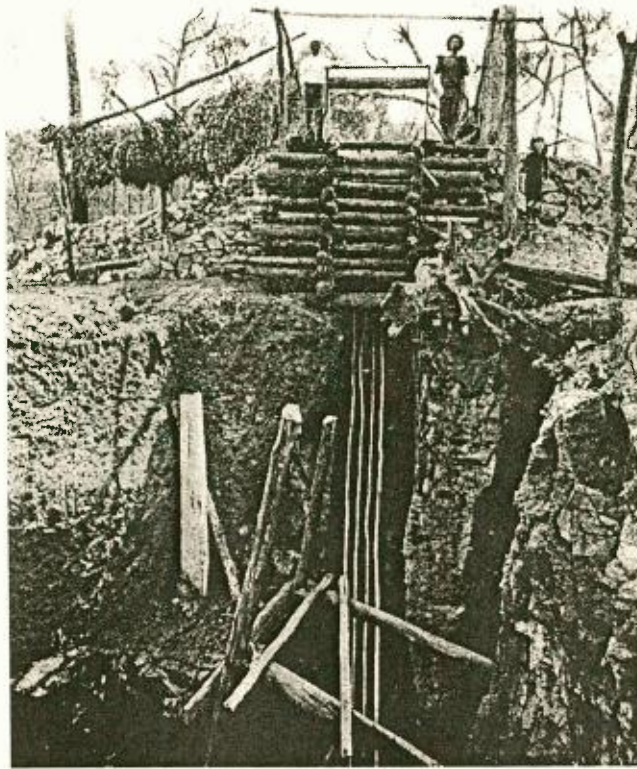


Figure 3.4: Windlass in use at the New Hope Mine, Cobalt, near Torrington, 1910. Note the standard method of timber collaring around the opening of the shaft.

In replacing horse power for manual labour in winding, a structure called a whip could be used. This consisted of a pulley suspended over the apex of the shaft, through which a rope ran which was attached at one end to a horse. When the horse was lead away from the shaft, it raised the kibble, and in reversing, it lowered it again. A whip pole such as this was used at the New Hope Mine (Bill Sherratt Interview in Rosen 1998, 139).

2. Whims

On Cornish mines a horse-whim was quite commonly used to raise the ore and consisted of an upright axle, usually timber, supported at the base by an iron pin. A horizontal beam was attached to the axle, and above it a hollow wooden cylinder or drum. As the horse walked around the axle, the rope was wound onto the drum, and one kibble raised while another was lowered (Foster 1901, 393). Horse whims were always used in conjunction with head frames.

3. *Skips*

On larger mines, ore carts or skips were used to transport the ore to the surface, and once there, to transport it to the milling plant or to the waste dump. Skips used as transport on the surface differed from the skips used to raise the ore from underground workings. Skips used in shafts were usually constructed to have a sloping bottom provided with a hinged door for discharging their contents on reaching the surface. Skips used on the surface were often designed to be filled and emptied from either side. Typical of these were the V-shaped side-tip skips which fitted into a steel frame base.



Figure 3.5: Torrington Wolfram Pty. Ltd. Number 2 quarry, ML 75, 1910. Note the V-shaped skips, one of which is being pushed by hand, and another which appears horse drawn.

4. *Winding engines and inclines*

Skips could be hauled using a variety of methods. In vertical shafts, the greater weight of skips as opposed to kibbles necessitated a better haulage solution than small scale hand or horse drawn techniques. As a consequence, steam or electric engines were

used to raise and lower cages containing both ore carts and miners. Steam winding and pumping engines were only introduced onto the Vegetable Creek tin field in 1878, and even then only in the largest mines (Department of Mines Annual Report 1878, 126). [The Department of Mines photographic archive in Sydney has a photograph of the first steam engine in the area used for haulage at a tin mine (Photograph No. 0212)]. Installed adjacent to the shaft, such winding engines often had two winding drums, so that one cage counterbalanced the other (Ritchie and Hooker 1998, 15). A single rope system was sometimes employed in conjunction with an incline shaft, using an engine-driven drum around which the rope was coiled. After the load had been brought up, the empty skips were run back down into the mine of their own accord, taking the rope with them (Foster 1901, 369). Self-acting inclines on the other hand, operated using two parallel tramways, one for the full skip going up and one for the empty skip going down (Ritchie and Hooker 1998, 13). The cable on a self-acting incline was either a single rope running around a bull wheel at the upper end of the incline, or two ropes wound in opposite directions on to a winch drum, so that one was paid out while the other was wound in (Ritchie and Hooker 1998, 13).



Figure 3.6: Rockvale Wolfram Company's hauling plant, Carter's section, 1910. Note the winding drums attached to the Robey winding engine.

3.1.3 *Milling*

Many of the larger concerns in the Torrington area erected milling equipment in association with their mines, some of which included complete milling, concentrating and power plants. The smaller mines usually operated either with small scale hand techniques only, or sent their ore to the larger plants for processing. The following section provides a brief overview of the range of milling techniques possibly used in Torrington, culled from a wide range of contemporary technical manuals. Specific details of processes at particular mines no doubt varied over time and between mines. Details of the precise processes employed at particular mines are only known for five of the largest concerns: Curnow's and the Butler tin mines, Wolfram Hill, Torrington Wolfram Pty. Ltd., and the Torrington Ore Company's Block 14 Wolfram Mine at Bismuth and Fielder's Hill (see section 3.2).

1. Hand techniques

Once again, the simplest techniques of milling were done by hand, traditionally employing women and children in Cornwall, although not in Australia. Hand milling, or dressing, techniques were extremely common in the Torrington area up until the 1920s and 30s. One of the simplest and most frequently used methods (used in the Gulf in the 1910s) was a bucking or spalling hammer struck on a flat rock surface, after preliminary roasting if the material was hard (Carne 1911, 42). Improvements on this method took the form of raised 'bucking tables,' which were built of roughly dressed stone capped by a single stone slab or iron plate (Carne 1911, 42). These, or similar, methods had been in use since the 1880s, at sites like Hart's reef: 'William Howes and Co. are working on this block as tributors with very good results. ... The stone is dug out of the top of the hill, and from thence carted to the creek, a distance of about a quarter of a mile, where they burn the stone in order to soften it, after which it is passed through very primitive processes for crushing and saving the tin.' (Department of Mines Annual Report 1882, 90).

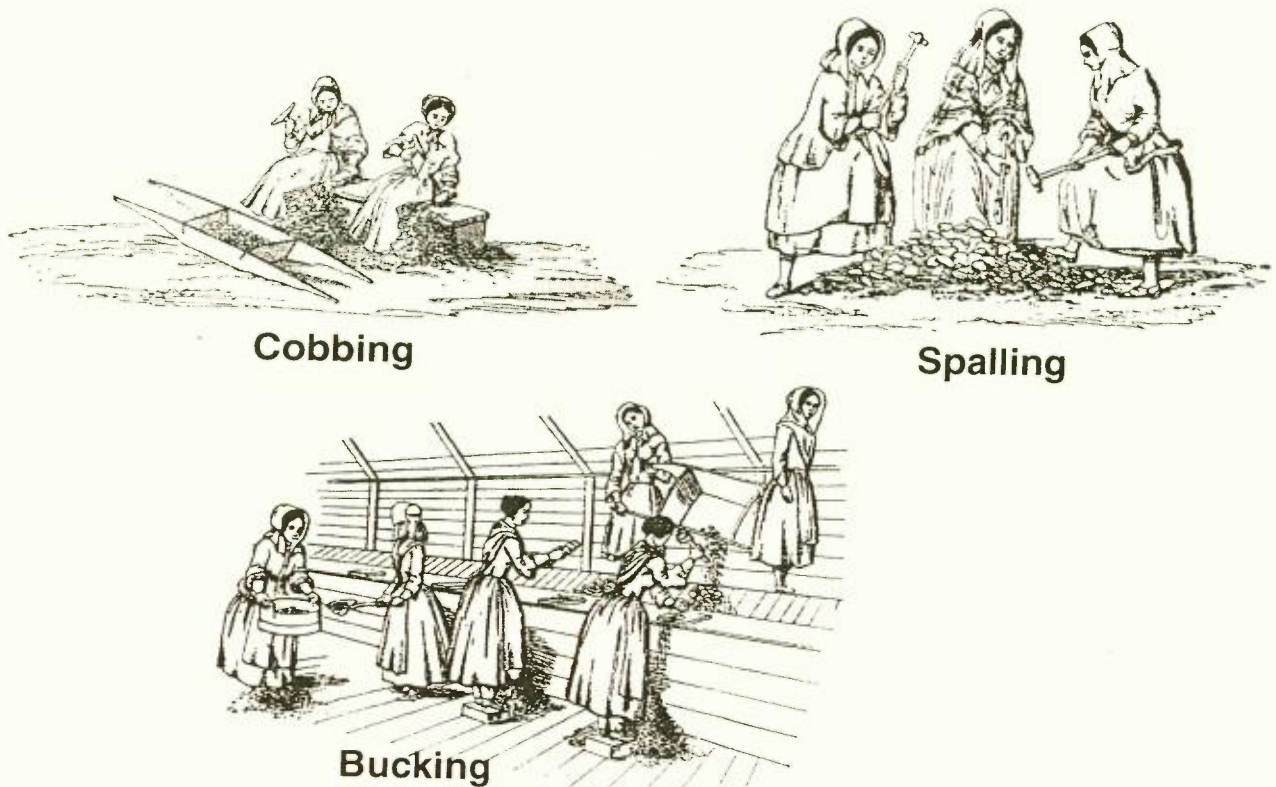


Figure 3.7: Hand cobbing, spalling and bucking (from Foster 1901, 556-557)

2. Dollying

One step up from a bucking table was a spring dolly, or dolly pot. A dolly consisted of an iron-shod wooden stamp worked by hand by means of a spring pole. Dollying was in use at the Gulf in the late nineteenth and early twentieth centuries: in 1890, the warden of the Glen Innes division noted that '... as there is not any machinery available in the locality, the whole of [the] output [at the Gulf] had to be dollied and hand dressed' (Department of Mines Annual Report 1890, 103). In 1906 at the Gulf and in the neighbourhood, '... numerous small and rich chutes of tin and wolfram have been worked by individual miners, who appear to do well, especially when their primitive methods of hand dollying the quartz is taken into consideration. Other men make a living in this locality along the creeks and gullies by cradling' (Department of Mines Annual Report 1906, 51). Dollying was still in use at the Dutchman in 1911 (Carne 1911, 43).

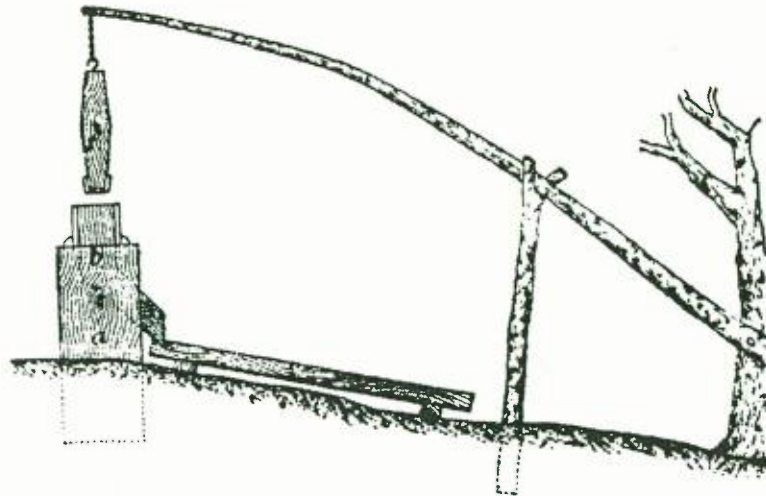


Figure 3.8: Dolly pot (from Lock 1890, 76)

3. *Rolls*

Rolls were introduced to replace bucking by hand. Usually they consisted of a pair of smooth, fluted or toothed cylinders, made of cast-iron or steel, which revolved in opposite directions and crushed any stones fed between them (Blake 1871, 182; Foster 1901, 565). Rolls could be either hand powered or driven by means of steam or water power. At the Gulf in the 1910s, a small hand-powered set of rollers were added for fine crushing: 'At Clifford's claim, Yankee Lode, The Gulf, Sims and Sons', small adjustable rolls with [a] fly-wheel, geared for hand power, is in use. The lode stuff is returned through closer adjustments, and finally is sieved.' (Carne 1911, 44).

4. *Mills*

Another form of horse drawn technology was employed in milling, where large grindstones were used to crush the ore. In a Chilean mill, a steel capped wheel was pulled by a horse around a circular trench into which the ore was placed to be crushed (Ritchie and Hooker 1998, 18). Later versions of the Chilean mill consisted of a revolving iron pan in which the ore was crushed by two vertically mounted wheels revolving against the base of the pan (Ritchie and Hooker 1998, 18). The Mining Inspector recorded the use of such a Chilean mill on the Gulf Lode in 1877

(Department of Mines Annual Report 1877, 150): ‘... a Chilean mill has been erected close to sluicing appliances, into which tin-stuff is thrown and crushed, and from thence taken in a wheel-barrow to the sluice box where it is ... streamed.’ This mill was still in use in 1885. The stone wheels made by John Trehwella (currently in the memorial park at Torrington) were described by Carne (1911, 44) as an ‘ingenious local adaptation of the Chilian (sic) mill principle, in which granite wheels, or grinders, take the place of steel, and a rock floor that of the pan.’ The wheels were cut with a chisel from local stone and were horse drawn across the surface of a large flat granite outcrop (Stephen Elliott pers. comm.).

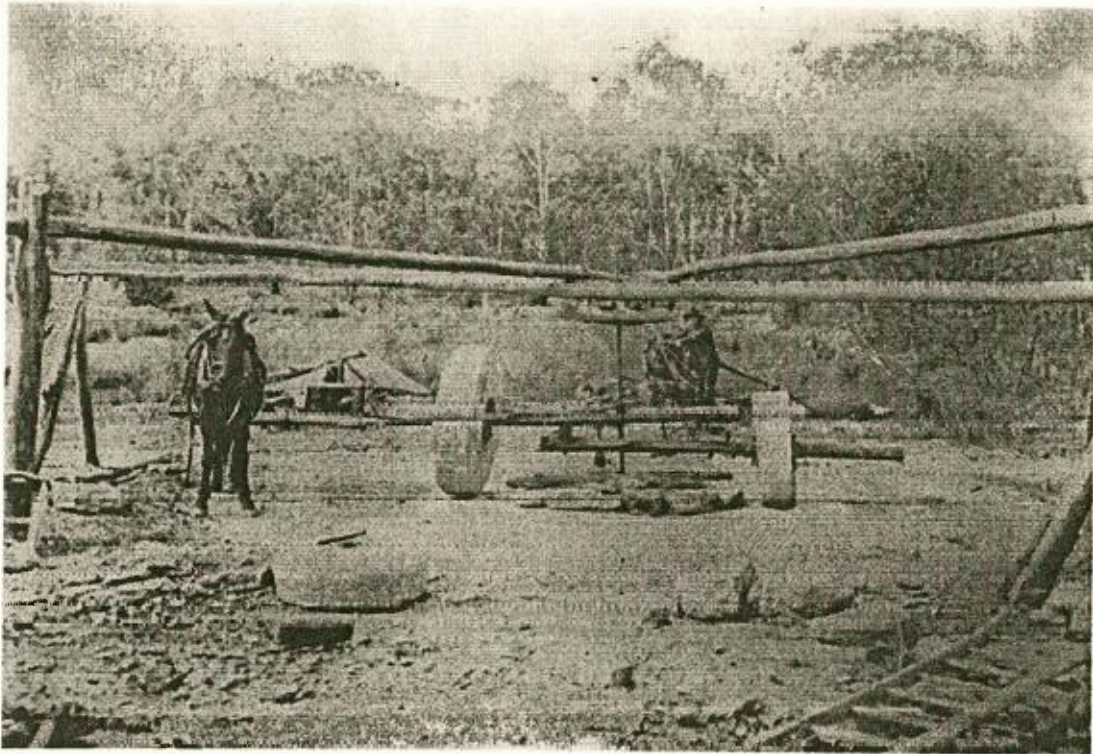


Figure 3.9: Trehwella's wheels c1911.

5. Rock breakers

On more high tech ventures, ore could be milled by a variety of mechanical means. Perhaps the most common of these were stamper batteries, which had been in use for several centuries for crushing ore. Before ore could be fed to the stamps however, it had to be of a suitable size and larger pieces needed preliminary crushing in a rock breaker or jaw crusher. These machines cracked stones by the action of two powerful

iron or steel jaws. The best-known of these machines was the Blake's rock breaker, invented by Eli Whitney Blake, and introduced to the mining industry in the 1860s (Blake 1871, 177; Foster 1901, 559). Other, similar, varieties were developed by Robeys, May Brothers and Krupps.

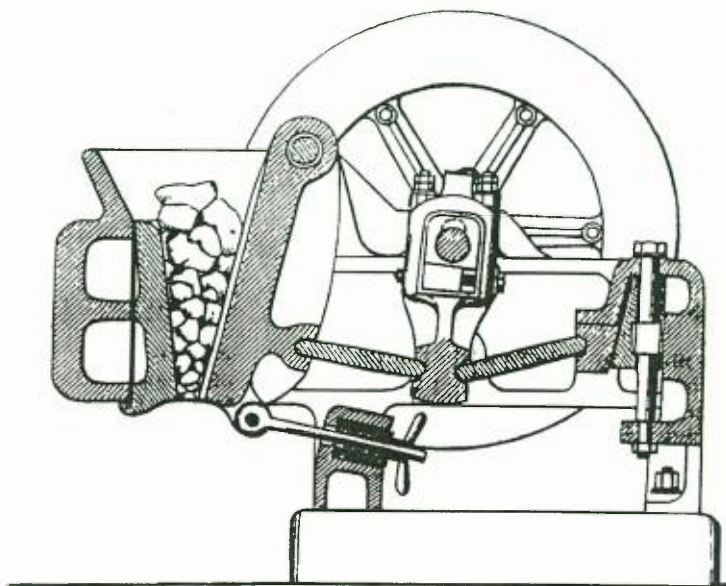


Figure 3.10: Blake's rock breaker (from André 1878)

6. Stamper batteries

Stamper batteries were basically pestles worked by machinery in large mortars. The battery was powered by either a portable or stationary steam engine and consisted of a series of large, heavy stamp 'heads' which were successively lifted and dropped onto the ore by a rotating overhead shaft fitted with cams. In the late nineteenth century, next to California and Nevada, Australia was the country in which the greatest number of stamp mills were erected (Blake 1871, 205). Ore could be fed to the stamps as part of either a dry or wet process: in dry crushing, the ore was roasted prior to being crushed, in wet crushing, water was piped continuously into the mortar boxes (Hardesty 1988, 40). In wet crushing, each battery of five heads required two water pipes, although the quantity of water varied depending upon the nature of the

ore being treated (Davies 1902, 266). The crushed ore from either process was discharged through an opening in the front of the mortar box, usually through screens designed to release only ore of the correct size (Hardesty 1988, 40-41). The screens could be manufactured of either finished or slotted sheet iron or copper (more common in dry crushing), or from wire gauze (more common in wet crushing) (Blake 1871, 192; Davies 1902, 265). Stamper batteries were in use at most of the mine sites in the Torrington area over the entire period of mining activity.

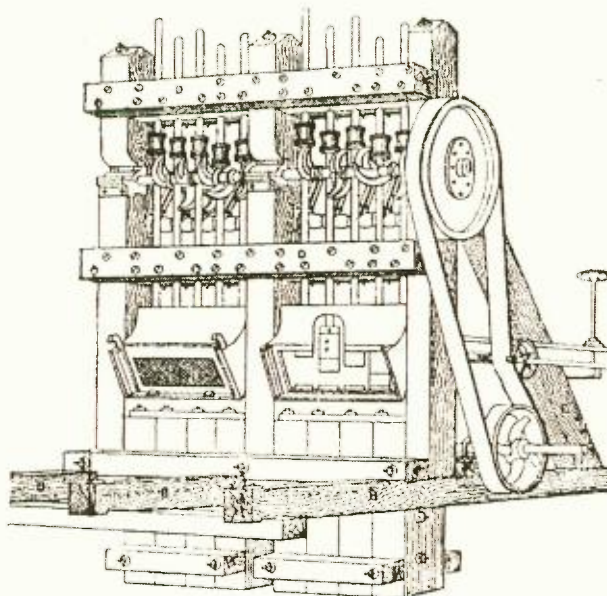


Figure 3.11: Typical stamp battery (from Foster 1901, 561)

7. Ball mills

The Krupps ball mill used by the Torrington Wolfram Pty. Ltd. in the 1910s consisted of a horizontal iron cylinder containing several curved plates which carried a number of steel balls. During each revolution of the cylinder, the balls would drop as they came to the edge of a plate, and the ore, which was fed into the cylinder via a hopper, was ground by their rubbing. The ground mineral passed through holes in the curved plates and into a second hopper beneath (Foster 1901, 569-570).

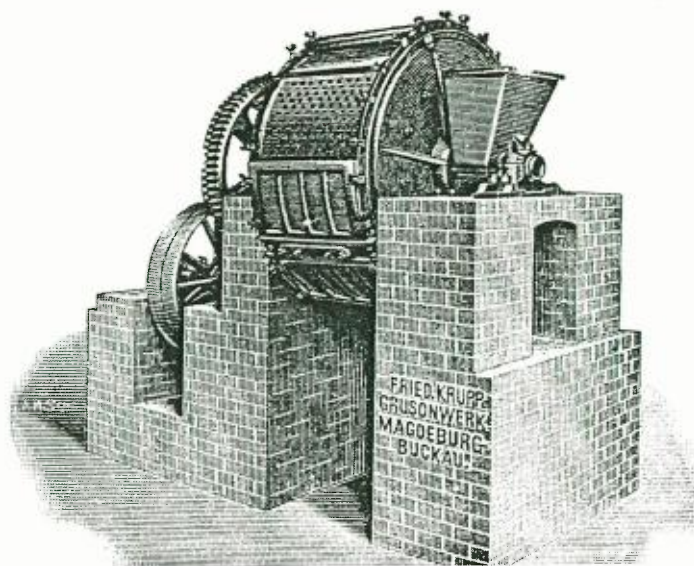


Figure 3.12: Krupps ball mill (from Clark 1904)

8. *Berdan pans:*

Berdan pans were a form of grinding pan which consisted of a revolving cast iron basin containing a heavy steel weight used as a muller. The mills at both Butler's and Curnow's tin mines used one of these devices (Bill Sherratt pers. comm), as, quite possibly, did the mill at Flagstone.



Figure 3.13: Berdan pan from the Butler mine, courtesy Bill Sherratt.

9. Centrifugal grinders

Huntington mills were especially adapted to dry crushing and consisted of a series of (usually four) vertically suspended rollers which whirled around the inside of a steel cylinder and crushed the ore by centrifugal force (Davies 1902, 255-257). The Rockvale Wolfram Mines and Garth's battery both used Huntington mills to crush their ore.

HUNTINGTON Centrifugal Roller Quartz Mill

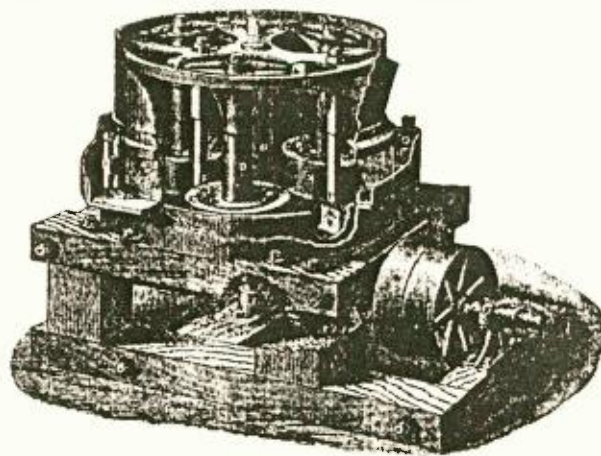


Figure 3.14: Huntington mill (from Gordon 1889, 8)

3.1.4 Concentration

Concentration refers to the process of separating the heavier portions of the pulverised ore from the lighter waste materials. In tin, wolfram and bismuth mining this was accomplished through the motion of the crushed concentrate in water.

1. Jigs

Jigs or jiggers were vibratory machines which separated by relying on the fall of particles through water. The simplest form of jig was essentially a sieve which was

charged with crushed ore and then moved up and down in a tub full of water. Each time the sieve was lowered sharply into the water the particles were free to drop a short distance and gradually form layers, with the heaviest at the bottom and the lightest at the top. On lifting out the sieve the light waste could be skimmed off and the heavy mineral rich layer at the bottom removed separately (Foster 1901, 583).

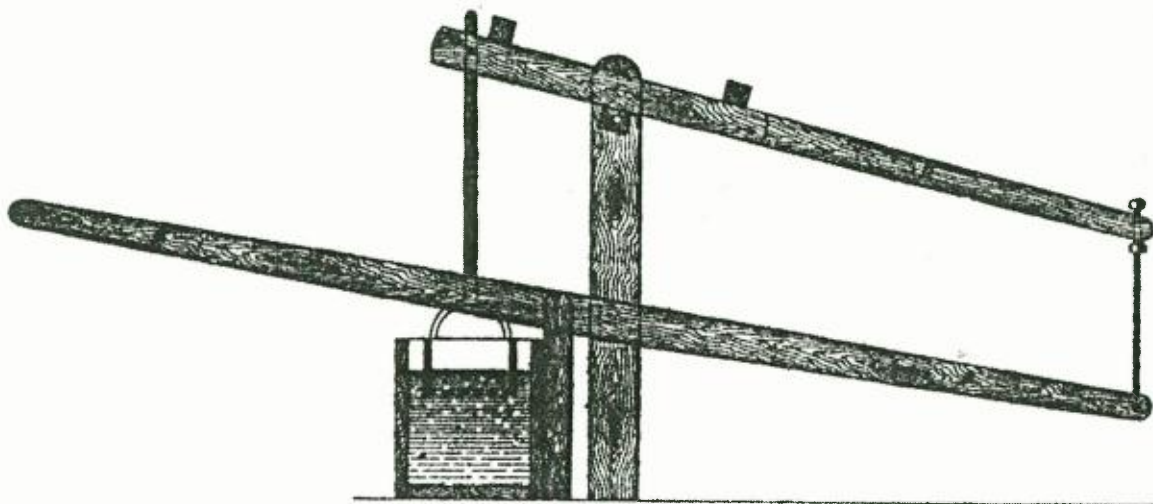


Figure 3.15: Hand jigger (from Davies 1902, 292)

Mechanical jiggers allowed a continuous feed of the ore and the discharge of the products without any stoppages. These continuous acting jigs came in a variety of forms, all basically consisting of a box or hutch which was divided by a partial partition into two compartments: in one was fixed a flat sieve which carried the ore, and in the other a plunger which moved rapidly up and down (Blake 1871, 231; Foster 1901, 584). The plunger forced water up through the sieve so that the gangue could be carried off by the water (Gordon 1894, 364).

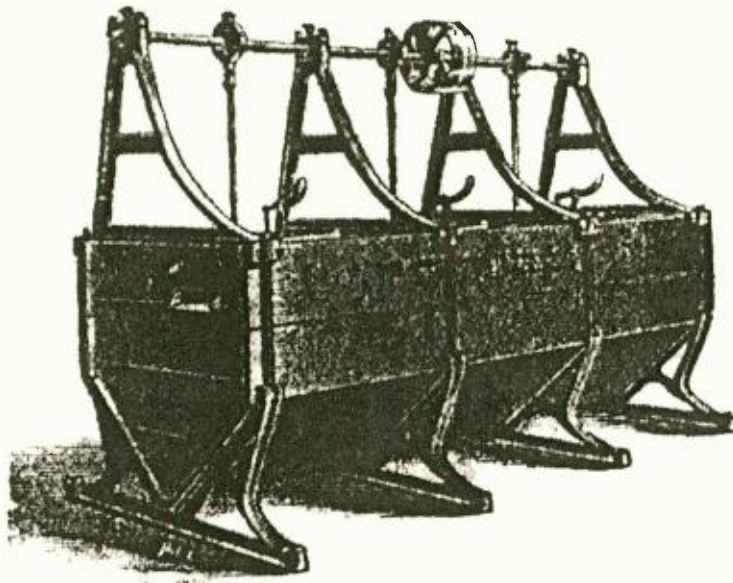
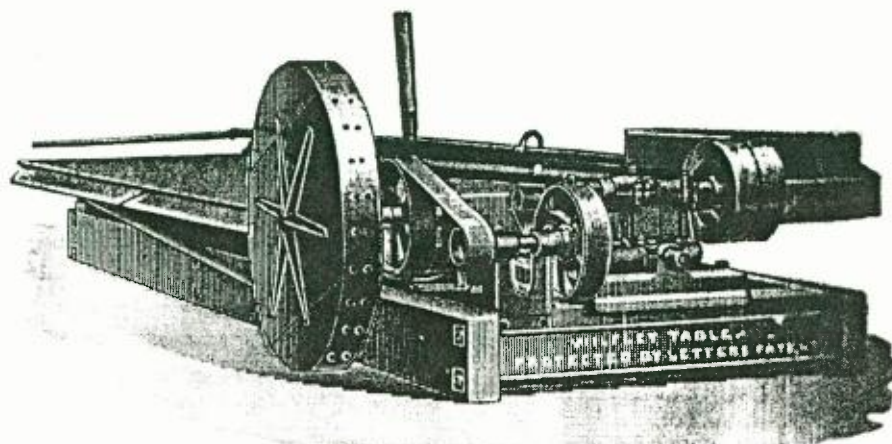


Figure 3.16: Mechanical jigger (from Lock 1890)

2. Percussion and shaking tables

Commonly designed to be bumped or shaken in a direction at right angles to the flow of the pulp. The Wilfley shaking table, designed in 1896, was one of the most common of these types of concentrator. Narrower at the base than at the top, concentrates were discharged at the wider top end, which was also slightly lower and could be tilted transversely at any angle. The working surface was covered with linoleum and over this were tacked a number of narrow wooden strips or riffles running lengthwise down the table about 3cm apart. The riffles gradually increased in length, from that closest to the discharge point which was the shortest, to the riffle on the farthest side which ran the entire length of the table. The riffles also increased in height as they extended further away from the discharge point (Foster 1901, 598). The pulp was fed onto the higher end of the table and washed toward the lower end by a thin film of water. The table was supported on rollers and was designed to shake lengthwise, the heavy particles of the pulp being jerked towards the narrower end of

the table and caught in the riffles, while the cross current washed the waste over the barriers so that it could be discharged as tailings at the lower end (Foster 1901, 598).



THE WILFLEY CONCENTRATING TABLE (DRIVING END)

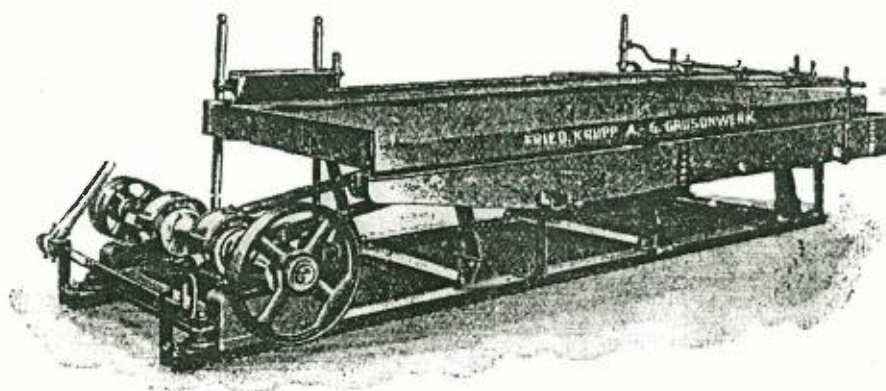


**Figure 3.17: Wilfley's and Krupp's shaking tables (from Clark 1904, xviii;
Davies 1902, 350-351)**

Other forms of percussion tables were Card tables, which differed from Wilfley tables only in that the riffles cut into the linoleum were triangular rather than rectangular in cross-section (Taggart 1927, 734). Krupp's and Ferrari tables were both made by the same manufacturer (Fried Krupp A. G. Grusonwerk) and were similar again to the Wilfley table. Percussion or shaking tables produced three grades of product: a concentrate, middlings and tailings, each of which were sent on to the next stage in the

process. Concentrates, for example, were finished products, which could be dried and bagged, while middlings and tailings required further processing.

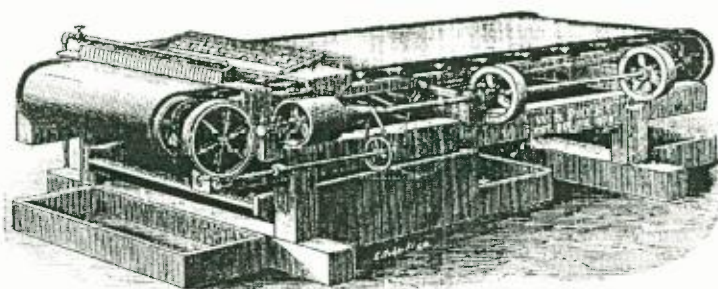
3. Travelling belts (vanners)

The most common form of this kind of concentrator was the Frue vanner, an endless band of cloth supported on a frame with a number of small rollers over which it could travel easily. The cloth was driven slowly and slightly upwards and the ore was fed with water onto the higher end of the belt using a spreader (to ensure that the spread was uniform) (Lock 1890, 75-76). The frame was given a slight sideways shaking movement (Gordon 1894, 361-364) to separate the lighter mineral from the heavier gangue. The natural path of the particles was down the inclined belt, but those which could resist the action of the stream of clean water were washed over the top end. The degree of concentration could be regulated by the slope and speed of the belt and the strength of the streams of ore and water (Foster 1901, 598-599).

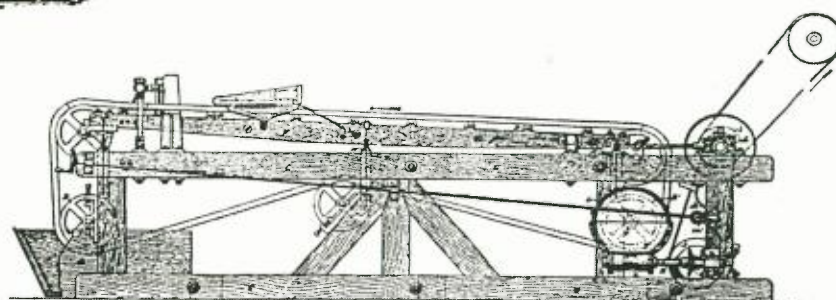
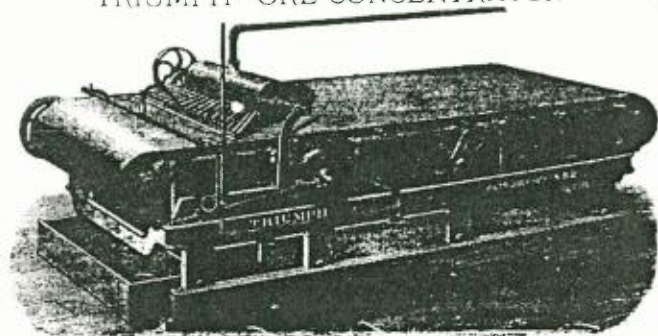
Embrey tables were extremely similar to Frue Vanners, only differing in that they shook from end to end rather than from side to side. The patents to both machines were held by the same company (Fraser and Chalmers Ltd., London and Chicago) and various experiments suggested that, to obtain similar results, the Embrey tables required a greater inclination to the belt, a greater quantity of water, or a more rapid shaking motion, in order to give equally clean concentrations (Davies 1902, 322).

The Woodbury ore concentrator was made up of several narrow belts, each with its own flanges, instead of one broad band. This was designed to prevent unevenness of flow (Foster 1901, 734). A Triumph vanner was a similar device, with a lateral shaking motion instead of a cross-wise one. Triumph vanners tended to cost less than Frue vanners and, as a consequence, were often preferred (Gordon 1889, 16).

THE FRUE ORE CONCENTRATOR.



"TRIUMPH" ORE CONCENTRATOR



Embrey vanner

**Figure 3.18: Frue, Triumph and Embrey vanners (from Davies 1902, 340;
Gordon 1889)**

4. Buddles

Buddles were very similar in principle to puddling machines and could be either revolving or stationary ('dead' buddles), the revolving form being a much greater improvement on the original stationary design. Revolving buddles could be either convex or concave. The convex round buddle was a circular pit with a truncated cone in the centre and a bottom sloping towards the circumference. The pulp was fed

gently over the cone in the centre, depositing the heaviest particles near the centre, and the lighter ones further down, while the lightest were washed away entirely. The surface was kept even by revolving brushes, which prevented gullies forming in the sediment (Davies 1902, 303; Foster 1901, 601-602). In a concave buddle the process was reversed: the base sloped towards the centre, rather than towards the circumference and the ore was fed in at the circumference rather than in the centre. Stationary buddles had no revolving arms, no central head and no sweeps to keep the surface of the ore dirt even (Moor 1928, 63).

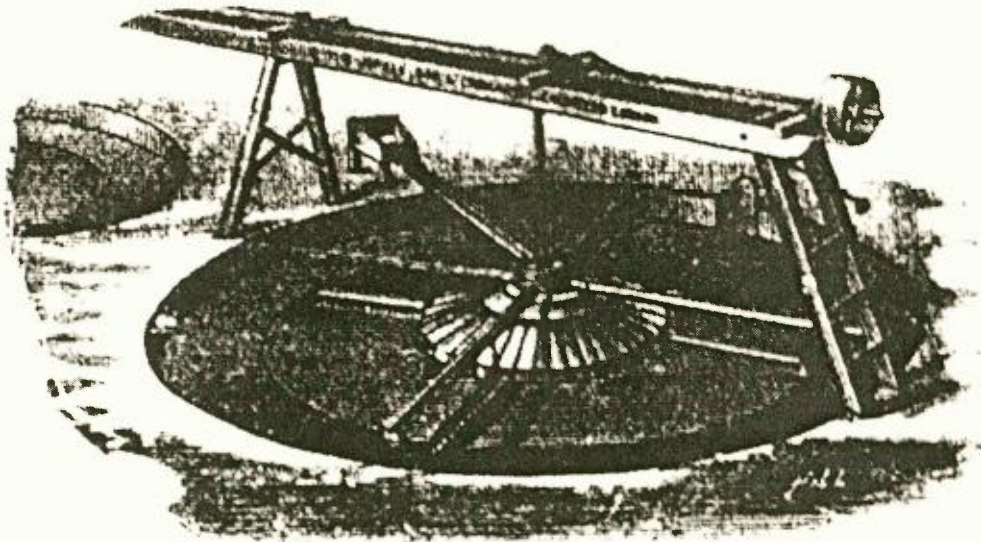


Figure 3.19: Round convex buddle (from Davies 1902, 303)

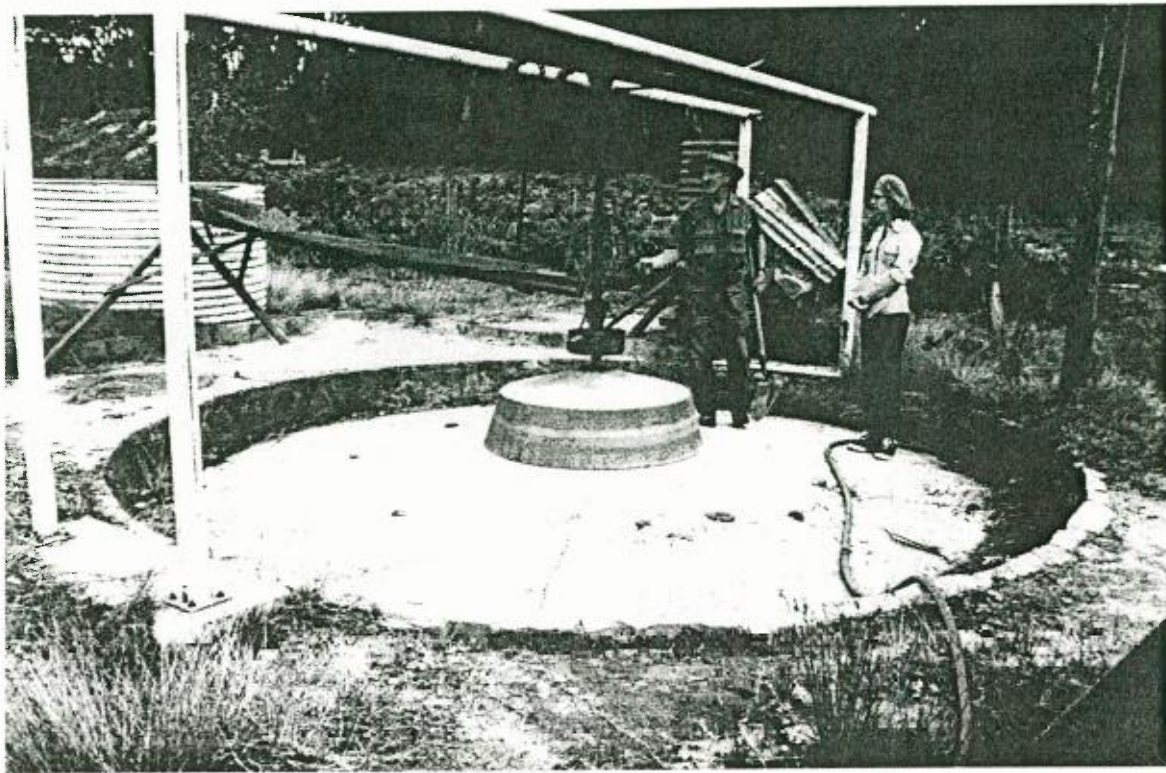


Figure 3.20: Convex buddle still operated by Bill and Fred Sherratt

5. Kieve (keeve) or dolly-tub

A kieve was simply a vat or tub (often just a 44 gallon drum) in which the finely divided ore was stirred and then allowed to settle. It was specifically used for the final treatment of fine tin and lead ore. The stirring was done with a set of blades attached to a vertical axle (similar in principle to a washing machine agitator). When enough ore had been added, the stirring was stopped and the agitator removed. The water was then kept in a state of vibration by tapping on the outside, either manually or mechanically. The process of settling was also called packing and as soon as it was completed the deposit was scraped off layer by layer (Foster 1901, 582).

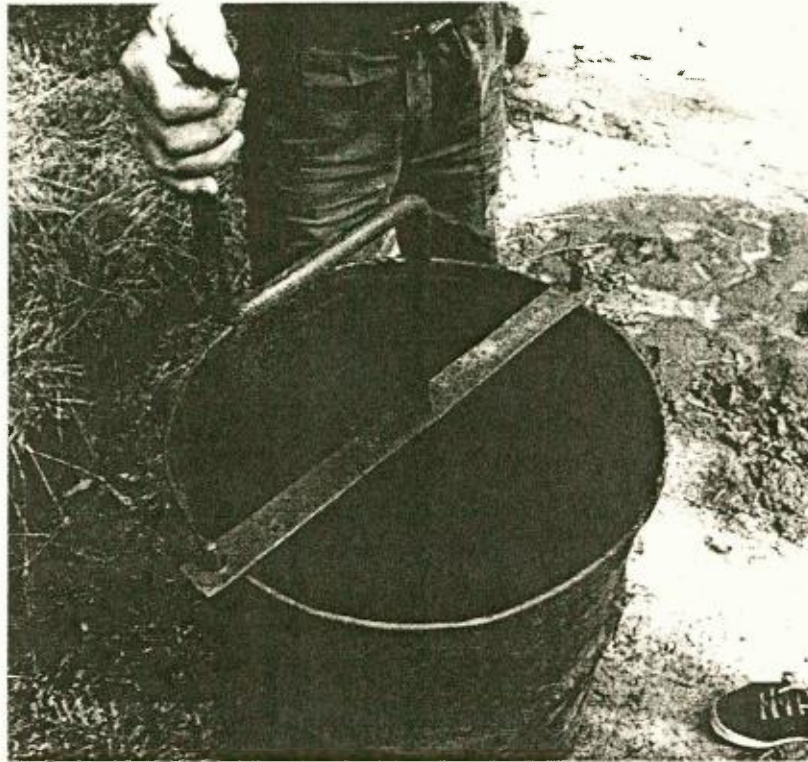


Figure 3.21: Kieve owned by Bill Sherratt

6. Blanket tables

Like kieves, blanket tables were one of the final stages in the concentration process. Mineral particles were carried down an incline by a steady stream of water and flowed over a surface that was covered with carpet or sacking blankets. An even flow of water over the whole width of the table was ensured by passing the stream through a separator which divided it into a number of little rills (Geoff Finnigan pers. comm.). The heavier metal content of the stream settled and was trapped in the weave of the blankets, which could be periodically removed and washed to recover the concentrated product. Blanket tables were often referred to as strakes tables.

[Over Figure 3.22: Machinery in use across the study area]

Figure 3.22: Machinery in use across the study area

Mine	Date	Engines	Winding gear	Crushing machines	Stamp heads	Concentrating machinery	Other
<i>Planet</i>	1875-1876?				8-head		
<i>Gulf stream lodes</i>	1877-1885			Chilean Mill			
<i>Silent Grove</i>	1877-1905?				10-head	Wilfley tables; buddles	
<i>Baldrock Creek</i>	????-1881	5 horse power steam engine					
<i>Torrington lode (tin)</i>	1882-1886?	12-horse power steam engine	windlass		5-head	4 circular buddles; 'improved dressing appliances'	dam
<i>Harts</i>	1912			Rock breaker	5-head	2 classifiers; 2 Wilfley tables; 1 Ferrares slime table; 1 Frue vanner; 1 Callow tank	Knowles duplex pump (water supply)
<i>Dutchman</i>	1883-1912?	12-horse power steam engine Babcock and Wilcox boiler	'Winding engine'		5-head	6 jiggers; Wilfley tables; vanners; 4 round buddles; 1 dead buddle	Blake's steam pump; weighbridge; 6 drill air compressor
	1889						
	by 1936	Colonial boiler (air compressor); tandem compound engine (rock breaker); Colonial boiler (Dutchman shaft); 'small' engine (sawmill)	Single drum winch (Dutchman shaft)	Rock breaker	5-head		Sawmill
<i>Butler</i>	1885-1892 1907	12-horse power steam engine 'one small winding plant and colonial boiler'			10-head	4 buddles	
	1912-1922					2 Frue vanners; 1 Triumph vanner; 1 round buddle; strakes	

Figure 3.22 [cont.]: Machinery in use across the study area

<i>Butler [cont.]</i>	1916-1922	2 Babcock and Wilcox boilers (battery and winches); 1 engine (battery); 22-horse power motor (belt conveyor); 7-horse power D.C. motor (pump)	winding engine	Blake's rock-breaker, Berdan pan	10-head	8 Wilfley tables; 2 jigs; classifiers, kieve, Frue vanners, Callow tanks, bag strakes, Triumph vanner, mineral separation flotation unit; magnetic separator	Hillman cages, air compressor; 23-kilowatt generator; centrifugal pump
<i>Yankee lode (Clifford's)</i>	1888-?		windlass	Sims and Sons hand rolls			
<i>New Hope</i>	1903-?				10-head	1 Wilfley table; 1 Woodbury table; 4 Frue vanners; 1 sweeper buddle	
<i>Bismuth (Torrington Ore Company/ Block 14 Torrington)</i>	1904?-1913 1913/14	Kynoch suction gas engine (power plant) suction gas producers; 1 Cornish boiler by Thompson and Company (winding engine); Portable boiler and bench (sawmill)		Middleton-Cobbe pans (same as the 2 Mathieson grinding pans?); Rockbreaker	10-head 20-head	1 Card table; 2 Wilfley tables; blanket-lined launders; 2 dead buddles; 1 'sweeper' buddle Callow screens, 6 Callow tanks, 10 Phoenix-Weir tables; 2 Canvas tables; 1 Bartch mechanical buddle; 2 tilting buddles	2 Brisbane charcoal retorts (gas producers); Rand drill air compressor
<i>Elliott's lodes (Torrington)</i>	1906-1907				10-head		
<i>Elliott's lode (Cow Flat)</i>	1907-?				5-head		
<i>Stannum lode (Battery Mt)</i>	1909-				5-head	Wilfley tables, frue vanners	

Figure 3.22 [cont.]: Machinery in use across the study area

<i>Mt Everard</i> (wolfram)	1909-1911 1911-????	9-hp vertical Hoskins boiler (pump); 6-hp horizontal boiler (crushing and conc) 12.5-hp Shanks' Caledonian engine (battery); 8-horse power vertical Tangye boiler (conc); 6-horse power engine (conc)			10-head 10-head	1 Wilfley table, 2 Frue vanners 2 Wilfley tables; 2 Frue vanners; 2 dead buddles; blanket tables	
<i>Rockvale</i> <i>Wolfram</i> (<i>Carter's cut,</i> <i>Hawkin's cut</i>)	1910-1912?	35-horse power Morts Dock boilers x 2 (battery); 1 50-horse power horizontal engine (battery); 1 vertical engine (battery); 14-horse power Robey engine (conc plant); 1 6-horse power Tangye engine	18-horse power Robey winding engine & cable	Huntington mill; May Bros breaker; Robey breaker	10-head x 2	1 May Bros jig; 3 Wilfley tables; 6 Frue vanners; 1 Card table; 2 Phoenix-Weir tables; 5 sweeper buddles; blanket lined launders	Challenge self-feeder; dams; 1 Worthington pump; link-belt elevator; hoppers; storage bin; battery bin; 'trucks'; chain bucket elevator
<i>Torrington</i> <i>Wolfram Pty</i> <i>Ltd (Lock's cut)</i>	????-1912?	15-Kilowatt generator (conc and lighting)		Krupp's ball mill; Krupp's rock breaker		2 Krupp's tables; 2 Ferrari's tables; 1 Frue vanner	
<i>Garth's</i>	1913 1919 1937?				'Small battery' 10-head 15-head	3 concentrating tables (curvilinear and Wilfley)	
<i>Flagstone</i>	1925-1929			Rock breaker; grinding pan	10-head	5 concentrating tables	Ore bins; pumps, pipe lines; electric generator plant
<i>Curnows</i>	1927-?? By 1936	Twin cylinder steam engine	Double drum hoist	Grinding pan	5-head 10-head	5 Wilfley tables; Frue vanners; buddles Strakes	Six drill straight line air compressor
<i>Wallaroo</i>	1936-1937	Unspecified	Winch		10-head	3 Wilfley tables; 2 Frue vanners; 1 buddle	Ore bins; overhead tramline

3.2 The processing system

At many sites the entire process of refining ore, from initial breaking, through to milling and concentration, was often housed within the one covered structure. Typically the various parts of the process were arranged on a gravity feed system, which allowed the end results of each stage to be fed easily onto the next stage of the process:

... a site for a mill should ... be chosen where there is sufficient space and fall for the various operations to be conducted in such a manner that the ore passes by gravitation through all the processes down to the final stacking of the tails and has not to be lifted or returned during any stage of the treatment. (Moor 1928, 55)

Figure 3.23, a rare interior view of the battery at Mt. Everard at Torrington, illustrates the arrangement of the various sections of the process. The stamper battery is visible at the rear of the plant, on the highest level. Below this are two Wilfley tables, with launders which feed down onto two Frue vanners. Launderers from the base of the vanners led to buddles (not shown), and from there the concentrate was fed onto blanket strips as a final treatment.

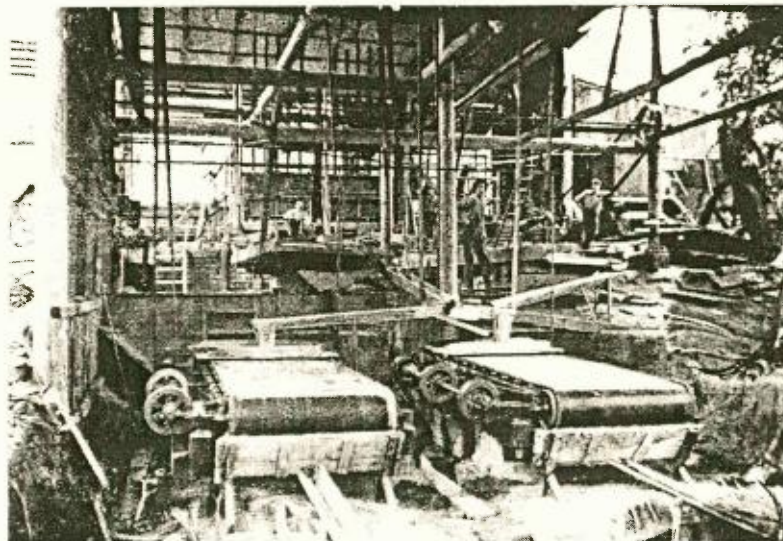


Figure 3.23: Mount Everard battery and concentration plant, 1910.

Similar spatial arrangements are evident in the flow charts for the processing plants at other major mines, regardless of whether they were intended to concentrate tin or wolfram. The dates for these treatment plants range across a period of twenty-five years: the earliest is from 1911 (Torrington Wolfram Pty. Ltd.), then 1913 (Block 14, Torrington Ore Company), 1918 (Butler), and 1936 (Curnows). What is obvious is that little changed over two and a half decades. Percussion tables, vanners, blanket strips and kieves continued to be used as the main concentrating devices, with similar arrangements between various parts of the process. The Torrington Wolfram Pty. Ltd.'s process was the only one not to employ a buddle and the Block 14 mine was the only mill not using vanners (see figure 3.24 and 3.25).

The Department of Mines Annual Report (1913, 89) recorded the milling process at the Block 14 Bismuth and Fielder's Hill mines as follows (see figure 3.25):

The ore [from the open cut] is carried up an incline of 45 degrees and by self-acting skips is tipped into bins from which it passes to a Hadfield's ore (jaw) breaker. From this, by means of a Jeffries steel elevator, it is taken to a shaking conveyor to other bins from which it passes into Challenge feeders of the suspended type. These feed 20-head of stampers (each 1,150 lb). The ore then passes into Frenier pumps and is elevated 24 feet to a launder connected with a revolving screen. The revolving and battery screens are of the same mesh, viz., 64 holes to the square inch; both screens are of steel, but they are being exchanged for brass ... From the revolving screen it passes into a V-shaped box on the principle of the spitzkasten, where it was expected the slimes would be removed and worked by Callow tanks; experience, however, has shown that it is better to pass the material direct to the concentrating tables, of which there are six of the Phoenix-Weir and Wilfley types. From these tables, wolfram fit for the dressing-room is recovered ... this is reconcentrated by means of a hand buddler and hydraulicizing ... A mechanical buddler is now on order for this work. The tailings from the tables are passed on to other Wilfley tables and a further quantity of concentrates ... is recovered; this also goes to the dressing-room ... The retreated tailings from the Wilfley tables go to the waste heap, while the seconds pass to further Wilfley tables, where they are concentrated without further treatment. All residues before going to the waste heap pass through Cornish tyers, and the sands are classified out, the slimes passing over canvas tables. The latter are washed by a hydraulic spray every three hours to remove the mineral; this gives a product of upwards of 25 percent [wolfram] and some bismuth which will be treated on the mechanical buddle to be installed. The finished concentrates assay about 68 percent [wolfram] and from 2½ to 3 percent bismuth. ... The

power is supplied by a Kynock's 220 B. H. P. tandem engine, fitted with the necessary starting compressor and suction gas plant.

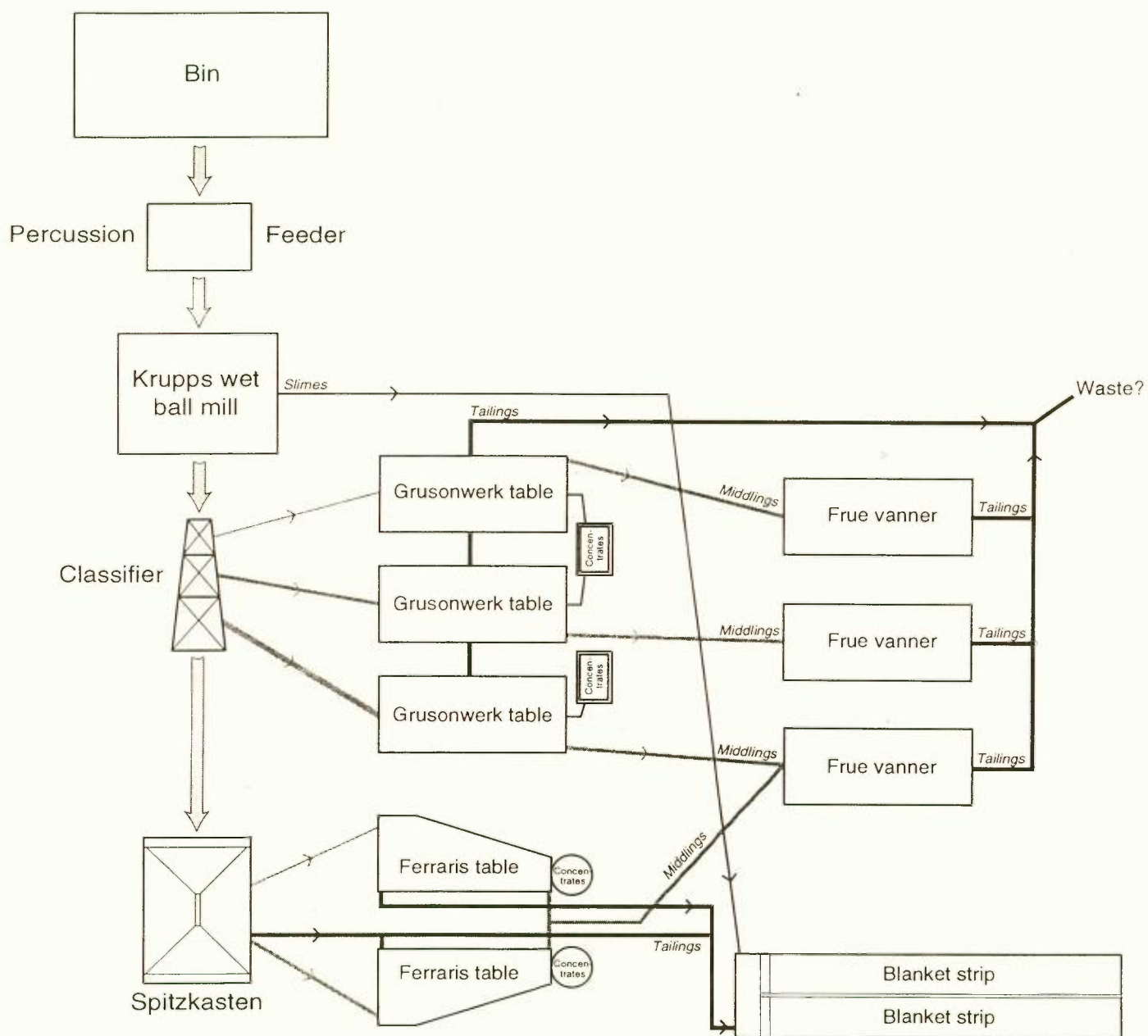


Figure 3.24: Simplified flow chart of the process used by the Torrington Wolfram Pty. Ltd, 1911

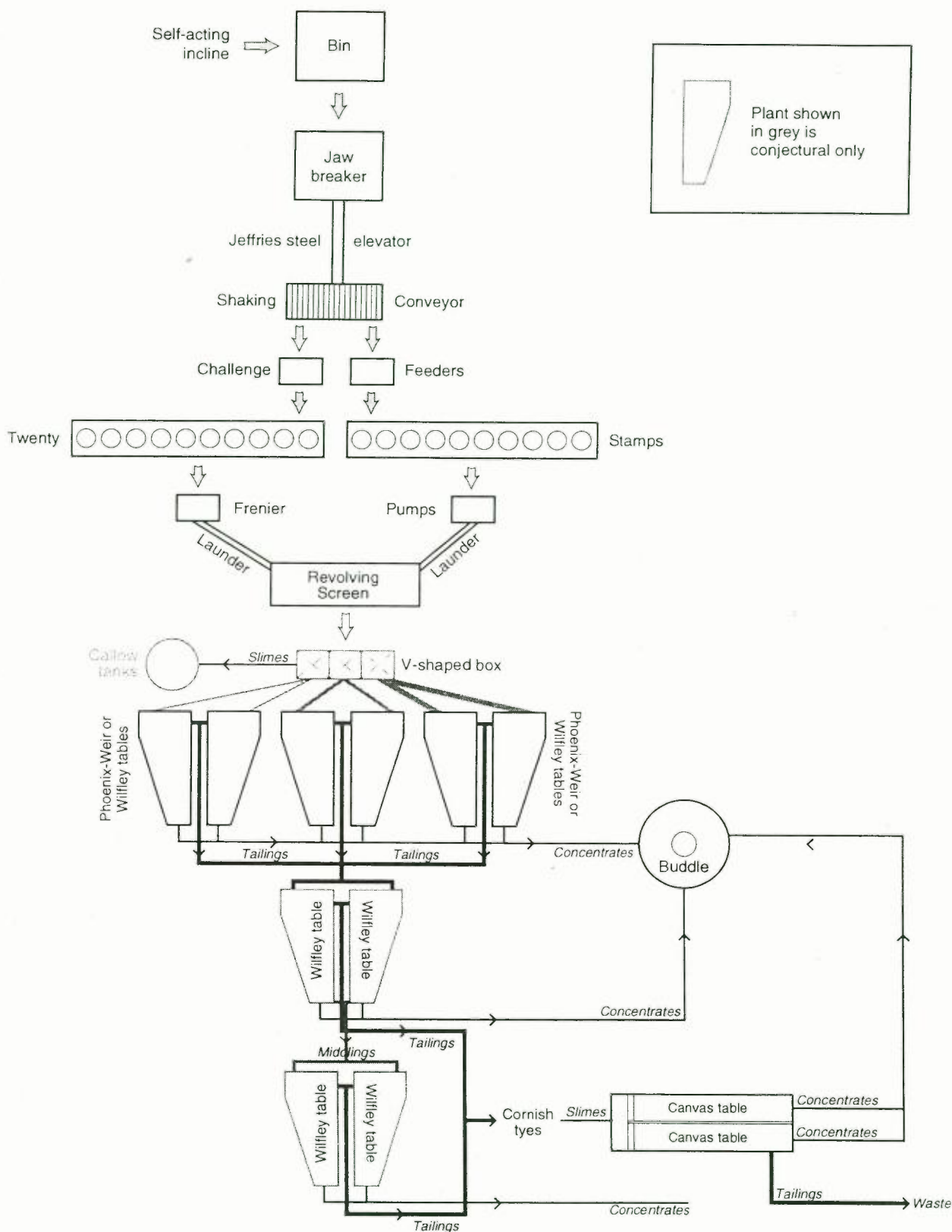


Figure 3.25: Flow chart for the process used by the Block 14, Torrington Ore Company's plant at Bismuth, 1913

At the Butler mine in 1918, ore was crushed by ten heads of stamps and passed to a three compartment classifier. Typically each stage was successively refined until as much tin as possible was recovered from the ore (see figure 3.26). The classifier gave three products: a fine fraction, a coarse fraction and an overflow. The fines from the classifier were more or less 'straight' concentrates. They were passed across Wilfley tables, and the firsts went straight to hydraulic cleaners. The seconds from this stage, along with the seconds from the coarse classifier product (also initially passed across Wilfleys) were retreated on more Wilfley tables. The firsts from the coarse fraction of the classifier were kieved. The overflow from the classifiers went into two tanks, from which the thickened product was fed to yet more Wilfley tables. The fines from this stage were sent to kieves, the seconds went to a vanner and the tailings to a race. The tailings from the race were fed across bag strakes, the fine material from which was re-treated in a Triumph vanner. This was the primary stage of treatment. Following this the concentrates were sent to a mineral separation flotation unit to remove the lead, and the remaining tin-wolfram dried and treated by magnetic separator to remove the wolfram and give a marketable tin product (*Chemical Engineering and Mining Review* 5/6/1918).

The process of milling at Curnow's was recorded in 1936 by M. R. McKeown for the *Chemical Engineering and Mining Review* (8/9/1936, 429-430) (figure 3.27). Ore was trucked from the main shaft, crushed in a jaw type rock breaker, and delivered into the battery bin. The crushed ore was fed into the 10-head stamper battery and the pulp was classified into two products: coarse underflow and fine overflow. Each of these were fed to separate Wilfley tables which produced concentrates (which were dried and bagged), middlings (which from the coarse tables were sent to another Wilfley, and from the fines table to a Frue vanner), and combined tailings (sent to canvas strakes or blanket tables). The concentrates from the second stage Wilfley tables were collected and passed through a streaming box, while the concentrates from the strakes tables were collected by hand and, together with the Frue concentrate, were buddles. The

firsts from this buddling stage were kieved and bagged, the seconds, together with the seconds from the streaming box, were fed to a grinding pan and returned to the buddle.

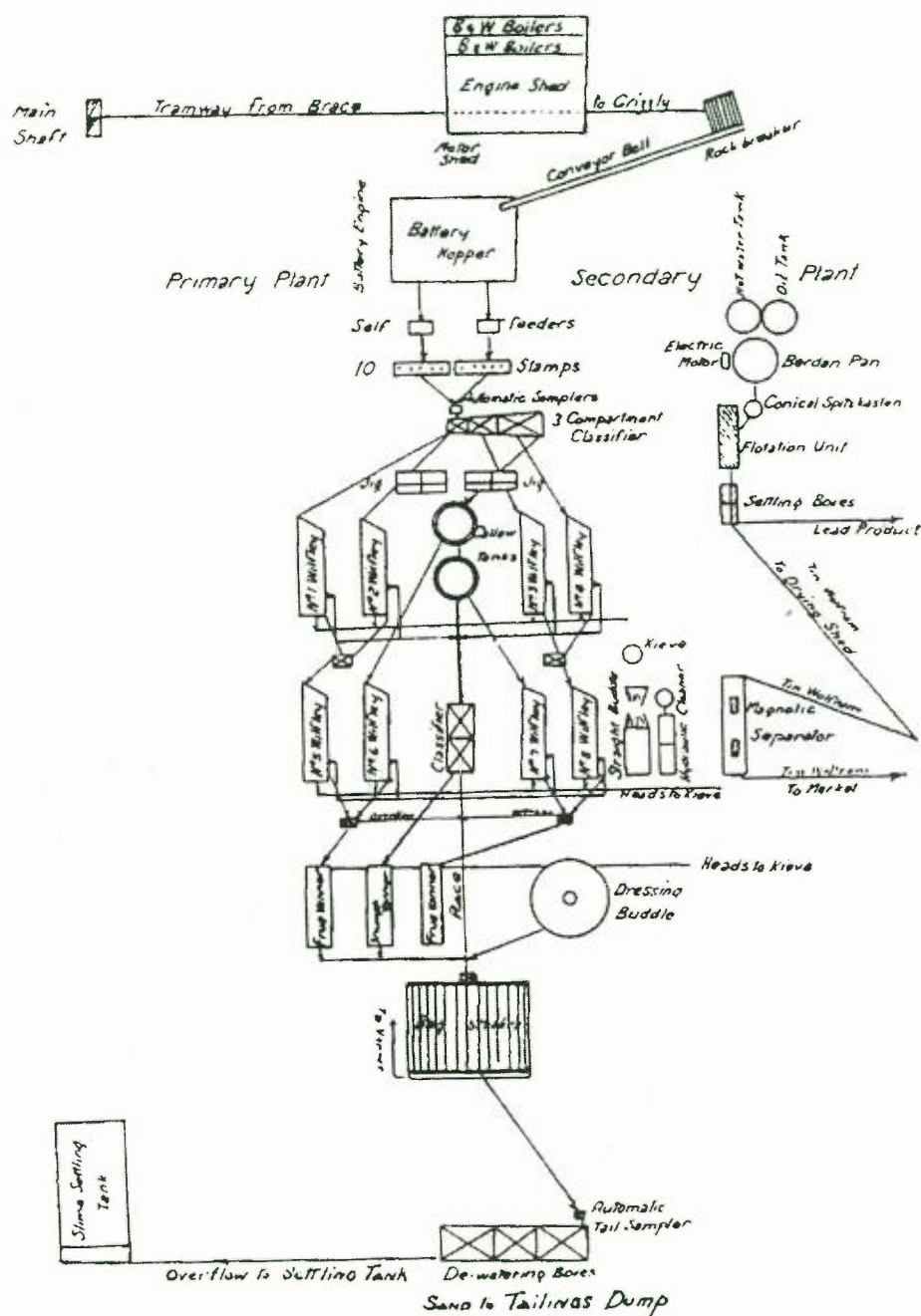


Figure 3.26: Flow chart for milling at the Butler Mine, 1918.

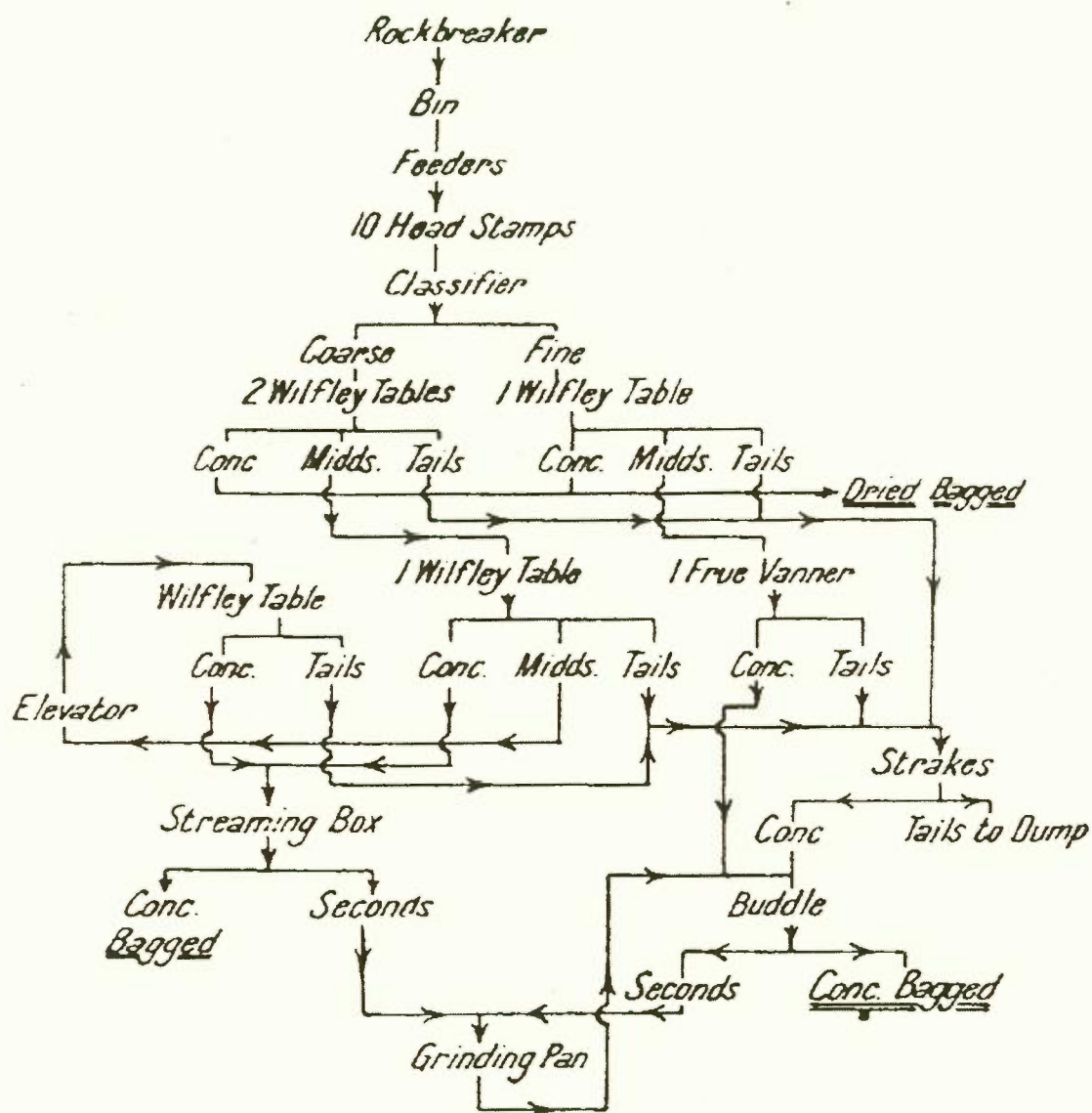


Figure 3.27: Flow chart for the Curnow's mine, 1936

3.3 The material traces of mining

There are essentially two kinds of 'site' which are formed as a result of past mining behaviour: the technological features of the mine workings and the residential features of the associated habitation sites. The technology of mining undoubtedly covers the most visible category of remains: the waste dumps, shafts, adits, mill foundations, engine pads, tramways, etc. of the actual extraction and concentration process. The mine will obviously provide evidence of the scale of the operations at the site, the methods of extraction employed and perhaps the available technology. The waste dumps, (called tailings on alluvial sites, and mullock on hardrock sites), are the waste materials (sand, gravel, cobbles, boulders) which result from the extraction process. Because many shafts and tunnels are either destroyed or infilled for safety reasons, mullock and tailings are often the most obvious features to remain on mining sites. Ritchie (1981, 51) notes that the chief value of tailings sites lies in their ability to show how a particular area of ground was worked in the past. Features associated with mine workings will include water-races, dams, milling and processing sites and in some cases rail networks for the transportation of ore.

Settlement sites are the residential mining camps or domestic settlements associated with life on the mine. A domestic/habitation site may range from the remains of an isolated single hut, to the interrelated remains of larger concentrations of people, either in a township, or in a mining camp or boarding house. Settlement sites are a focal point for social information about the mining frontier (Hardesty 1988, 13) and such sites can, for example, provide information on living conditions, diet, acculturation or population size. Miners often lived in close proximity to the areas in which they worked. When the Mining Act of 1874 was introduced, a prospector could mark a claim, occupy it and begin to work ten acres (six acres of stream tin), providing that within thirty days they had applied for a minimal lease of twenty acres (Rosen 1998, 19). In 1882, Lyne, describing the Vegetable Creek area, remarked in rather glowing terms that a miner's '... hut is erected on the land which he occupies under the easy

conditions which the law imposes, and he may, by going to very little trouble, surround it with all the elevating ... influences which make cottage life agreeable.' Often these huts were little more than tents or lean-to's, which could be easily removed when the miner moved on to a new area of ground.

Miners also constructed tents and huts near the larger mines, either because this minimised the travel distance to and from work, or for security reasons, to prevent theft from or damage to the site. From the 1880s onwards, accommodation was constructed by and for the miners at sites such as the Butler mine (Department of Mines Annual Report 1883, 1884, 99), the Dutchman mine and the Torrington mine, although at the Butler there was also a boarding house at the top of the hill (Isobel Finch interview in Rosen 1998, 143). In a 1911 lease plan for the Rockvale Wolfram Mines Ltd., several camps and huts are shown scattered across the mining lease, typifying the random and opportunistic settlement pattern of much of the mining industry (figure 3.28).

Many small settlements also grew up around the main mining areas on the Mole Tableland. Bismuth, Tungsten, Cobalt, Cow Flat, the Gulf, and of course Torrington, all developed settlements servicing the nearby mines. Although these lacked many of the formal qualities of actual townships (such as formed or named roads), they contained such services as schools, stores and hotels. The close proximity of many of these settlements meant that their inhabitants interacted and formed parts of wider social and economic networks (Rosen 1998, 23). Houses at these settlements were not necessarily more durable than the huts erected on mining leases, although some were occupied for much longer periods of time. Many miners preferred to live in the townships and walk to work at the mines each day (Harold and Kegger McCowan Interview, in Rosen 1998, 121; Geoff Finnigan pers. comm.).

There were other secondary industries which grew up around the mines, particularly sawmilling to provide better quality timber for industrial and domestic use. One early

saw mill was located at Black Swamp: 'On the way to the Black Swamp I may remark that a sawmill has been put up and is in full working, which will supply a want that has been much felt in this district, not directly in mining matters (although by supplying smooth battens and for timbering the works, much time would be saved), but for building the miners' houses and necessary work-shops and sheds etc, will prove of very great advantage to the miners generally.' (Department of Mines Annual Report 1883, 103). Other sawmills were located on Lottery Creek, beside the dam feeding the Wallaroo tin mine; and at the Butler's, the Dutchman and the Bismuth mines.

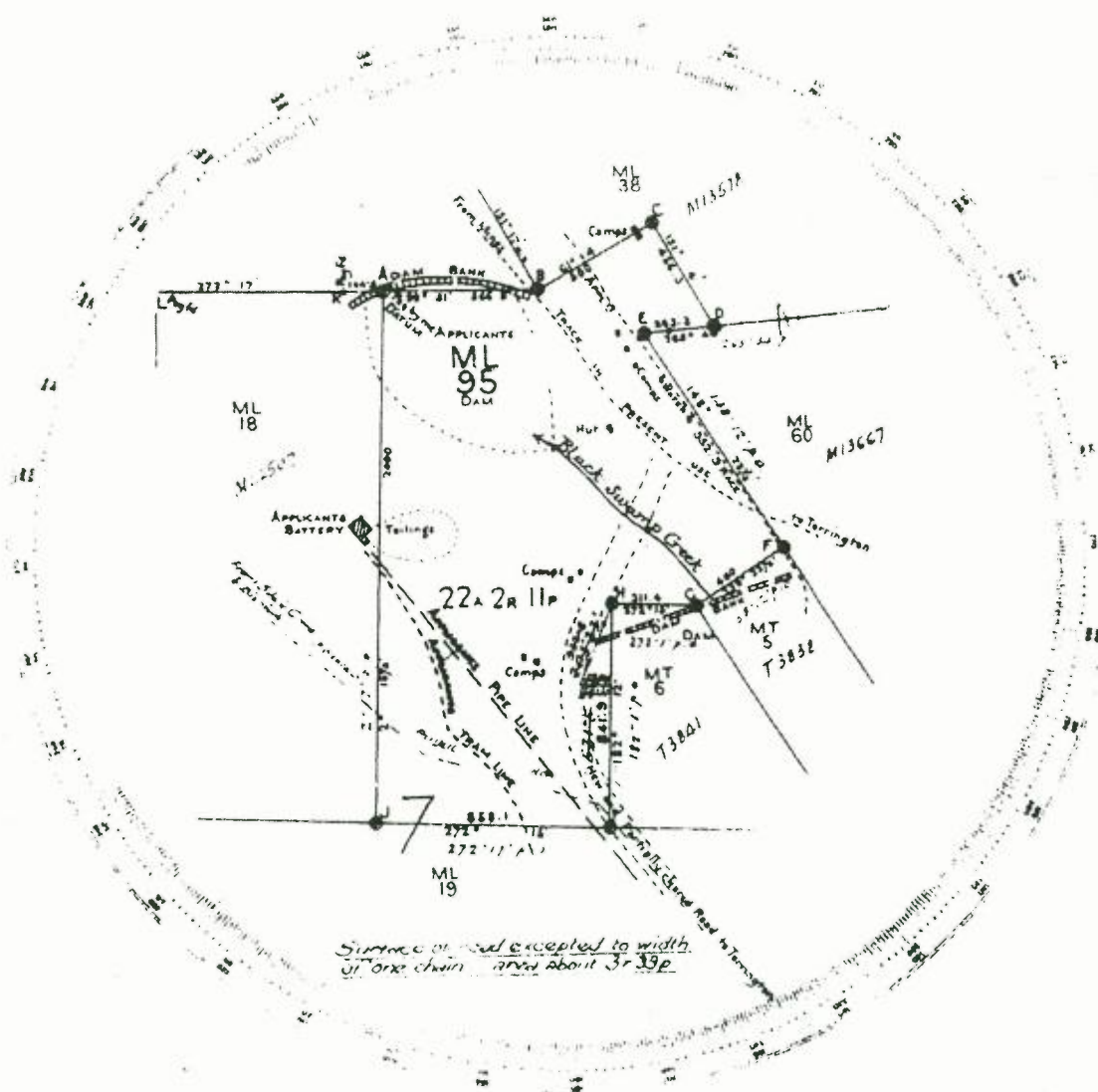


Figure 3.28: Rockvale Wolfram Ltd. lease plan, 1911. Note camps and hut.

4. THE ARCHAEOLOGICAL SURVEY

4.1 Design and survey method

Given that there are some 1300 identified mineral deposits within the SRA, it was impossible to record all of the known mine sites given the time frame of this report. Instead, the survey strategy focussed on five prioritised areas:

- Areas identified by Glen Innes district as infrastructure development zones, or areas which are subject to visitor pressure (Blatherarm Creek);
- Evidence of rare or representative mining activity;
- Large or unusual operations as opposed to small or undifferentiated sources;
- Areas where mining occurred over a longer period; and
- Extension along geological settings (along the line of lode).

The remains of pastoral and agricultural land use were also made a priority of the survey, given that so little of these landuses are now archaeologically visible. 'Rare or representative' mining activity was interpreted to include a range of sites and site types covering the main themes identified in the contextual history. This, in part, allowed statements of significance to be formulated for the area and the sites, and also directed the recommendations for future recording (see section 4.3.9). The final survey incorporated a representative sample of mining:

- On different mineral deposits, including the alluvial and hardrock mining of tin, wolfram, and bismuth;
- On different scales, from small scale alluvial and small scale hardrock to large scale companies;
- During different time periods, from at least the 1890s to the 1950s;

- Using different technologies, from manual labour and horse power to more highly mechanised ventures.

A total of 41 sites were recorded during the survey, including tin, wolfram and bismuth mine sites, sites worked on by Chinese and European miners, and alluvial and lode mines, as well as associated settlement sites. Dredging was the only form of mining employed in the study area which was not recorded within the time frame of this report, although several creeks in the area are known to have been dredged in the past (e.g. Catarrh Creek, Bridge Creek, Lottery Creek, Black Swamp [Bald Rock] Creek and Flagstone Creek).

For the smaller and more contained sites a scale drawing was prepared showing the spatial arrangement of features at each site. On the larger sites (Dutchman's, Butler's, Curnow's) however, both the extreme slope of the sites and their sheer size made it impractical to prepare scale drawings, and sketch maps only (not to scale) were prepared. These sketch maps still preserved the spatial relationship of features at the site, but cut down considerably on the time required to record these sites.

Given that one of the priorities for the historical archaeological survey was the coverage of a representative sample of sites, not all sites recorded during the survey were contained within the boundaries of the SRA (23 within; 18 without).

Inside SRA	Outside SRA
<i>TCH1. Roaring Meggs Creek Stockyards</i>	<i>TCH2. Maidenhead Outstation stockyards</i>
<i>TCH4. Wallaroo Lode (EA 28)</i>	<i>TCH3. Turner's house and farm, Bismuth</i>
<i>TCH7. Hill Flat Deposit (EA 621)</i>	<i>TCH5. Curnows Tin Mine (EA 260)</i>
<i>TCH8. Flaggy Creek alluvials</i>	<i>TCH6. Dutchman Tin Mine (EA 27)</i>
<i>TCH11. Bismuth town</i>	<i>TCH9. ML31, Tungsten (EA 160)</i>
<i>TCH12. Wall Creek alluvials and gravesite</i>	<i>TCH10. Cemetery, Tungsten</i>
<i>TCH13. Back and Wall Creek lode (MR171)</i>	<i>TCH15. Back Creek huts (Binghi)</i>
<i>TCH14. Back/Wall Creek alluvials</i>	<i>TCH18. Kathida/Yankee lodes (IN 0110-0113)</i>
<i>TCH16. Blatherarm alluvials</i>	<i>TCH19. Cemetery, the Gulf</i>
<i>TCH17. Blatherarm stone bases</i>	<i>TCH20. Company's Hill (IN0094)</i>

<i>TCH21b. Chinese sites, Raines Gully (dam & trench)</i>	<i>TCH21a. Chinese sites, Raines Gully (well & oven)</i>
<i>TCH23. Carpet Snake Creek alluvials</i>	<i>TCH22. Garth's battery (EA22)</i>
<i>TCH25. Flagstone and Cartwheel lodes (EA306)</i>	<i>TCH24. Specimen Hill (EA337)</i>
<i>TCH26. Hut sites, Corduroy Creek</i>	<i>TCH27. Butler Mine (EA 25)</i>
<i>TCH28. Cunliffe lode (EA262)</i>	<i>TCH30. Lee's Gully and Chapman's lode</i>
<i>TCH29. Nash's (EA261)</i>	<i>TCH31. Camp Gully alluvials</i>
<i>TCH32. Bismuth Dam</i>	<i>TCH37. Donaghue's lode</i>
<i>TCH33. Bismuth Mine (EA874)</i>	<i>TCH39. Mica Hill Wolfram (MR079)</i>
<i>TCH34. Elliott's wolfram (MR053)</i>	<i>TCH41. Rockvale Wolfram Pty. Ltd.</i>
<i>TCH35. Duck Creek Bismuth (MR052)</i>	
<i>TCH36. Oppenhiemer's (MR167)</i>	
<i>TCH38. McDonald's (EA0097)</i>	
<i>TCH40. Steven's Wolfram (MR080)</i>	
TOTAL 23	TOTAL 18

It was impossible to consider the sites within the SRA without also considering the context of the wider region, consequently the development of sensible statements of significance often required the comparison entailed in recording sites outside of the SRA boundaries. In the case of the Turner's farm at Bismuth, for example, this site was included in the survey because it represented the only remaining standing structures associated with the settlement of Bismuth. As such, although outside the boundaries of the SRA, the buildings of Turner's farm are the only above-ground material indicators of the kinds of structures and ways of life within such settlements.

The issue of defining site limits was often problematical, particularly on the larger, more complex sites, which covered extensive areas of ground and often incorporated several smaller ventures or producers (eg. Curnow's, Wallaroo, Butler, Dutchman and Kathida). In the end, no attempt was made to separate smaller production episodes or sites within the larger complexes, except as separate features within the overall site designation. At the Butler mine, for example, many different producers worked the various leases simultaneously (see Volume 2, figure 2.146), but because of the difficulty of locating these lease boundaries on the ground, all associated archaeological

features were grouped together as part of the total Butler site. This is perhaps somewhat misleading, as what was referred to historically as the 'Butler Mine' in the Department of Mines Annual Reports only covered certain leases, although oral and local histories seem to be much broader in their definition, and probably approximate the coverage of the archaeological survey. As a result, the grouping of features into complexes is an artefact of the close proximity of mined deposits: at the Butler, for example, different leases were covering extensions along the same line of lode; at Kathida, different producers were working parallel deposits within the same relatively small area. Rather than trying to separate these closely related deposits and material traces archaeologically, they were grouped together as complexes.

A further problem arose in determining boundaries for sites. Although areas around each discrete site were surveyed to determine the limits of archaeological material, given the density of vegetation overgrowth and ground cover, this is largely an artificial boundary, reflecting viewing conditions rather than the absolute extent of the site. This cannot be remedied without further detailed survey following dry seasons or major bushfires.

4.2 Limitations

There were numerous limitations on the extent and effectiveness of the survey coverage for this report. Most areas were subject to extensive vegetation regrowth and dense ground cover, which not only made it difficult to determine the boundaries for some sites, but also prevented locating some sites in the field. In addition, many of the areas subjected to mining activity, particularly in the western part of the SRA, are located in areas inaccessible to 4WD vehicles and could not be visited during the present survey period. The sheer number of possible sites which could exist within and around the SRA was another limiting factor—given the relatively short time frame for this report, it was not possible to visit the location of all 1300 known mineral deposits. All of these limitations, along with the time constraints of this project

meant that only a small percentage of the total historical archaeological resource within the SRA was able to be surveyed. In total, three sites associated with pastoral or agricultural landuses, 28 related to tin mining, and ten sites relating to wolfram, bismuth or tungsten mining were located during the present survey (figure 4.1).

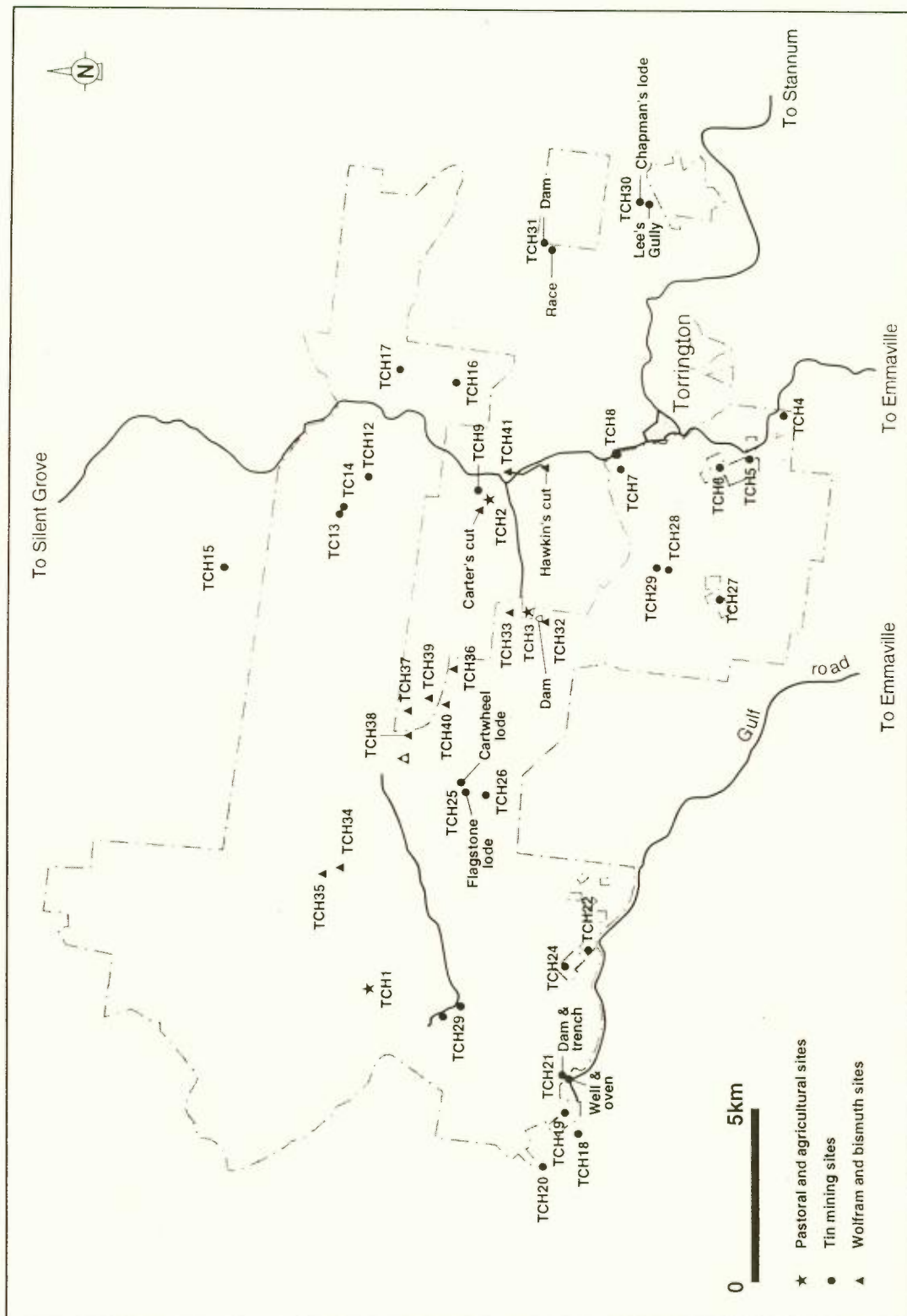


Figure 4.1: Pastoral, agricultural and mining sites recorded during the project

Figure 4.2: Table of dates, major physical features and moveable artefacts at each site

Site (Deposit)	Major periods of use	Mining methods	Associated plant	Known instances of intervention in site fabric	Remaining major physical features	Remaining items of equipment	Condition*	Possible threats# (see also sections 6.1.1 & 6.2.1)
TCH1: Roaring Meggs Creek stockyards	1840s-1920	N/A	N/A	Fire	Upright timber posts and rails, postholes	N/A	Poor	Fire Mechanical failure
TCH2: Maidenhead stockyards, Tungsten	1840s-1920	N/A	N/A	Fire	Upright posts, postholes	N/A	Poor	Fire, Mechanical failure
TCH3: Turner's farm, Bismuth	c1880s, ?-1975	N/A	N/A	Removal of floorboards in kitchen and main house	Three standing structures, yards, fencelines	N/A	Excellent	Theft, Visitation, Mechanical failure, Fire, unmonitored grazing, Continued mining
TCH4: Wallaroo Lode (Tin)	1881-1941	Shafts, pits	Stamper battery and concentration plant	1946 plant moved to Butler's	Shafts, pits, mullock heaps, concrete machinery bases, buddle, floor slabs, reservoir, dam	None	Level of the complex: good Level of ind. features: poor	Mechanical failure (reservoir)
TCH5: Curnow's mine (Tin)	1881-1947	Shafts, pits, trenches, adit	Stamper battery and concentration plant	1953 machinery sold, shafts capped and fenced	Shafts, pits, adit, concrete floor slabs, machinery bases, buddle, tramway mound, mullock heaps	Three multitubular boiler shells; Ingersoll Rand air compressor base; drying pan	Level of the complex: good Level of ind. features: poor	Fire, Mechanical failure

Figure 4.2 [cont.]: Table of dates, major physical features and moveable artefacts at each site

TCH6: Dutchman mine (Tin)	1875-1890; 1906-1923; 1937-1945	Shafts, pits, trenches, adit	Stamper battery and concentration plant	Shafts fenced, mill site buried under mullock	Shafts, pits, trenches, adit, machinery bases, reservoir, two magazines, tramway mound, mullock heaps	Three boiler shells; winding gear sheaves	Level of the complex: good Level of ind. features: poor	Mechanical failure
TCH7: Hill Flat deposit (Tin)	1936	Alluvial, shafts, pits, trenches	None	Unknown	Shafts, pits, trenches, stone base, domestic artefact scatters	None	Level of the complex: good Level of ind. features: good	Theft
TCH8: Flaggy Ck alluvials (Tin)	Unknown	Alluvial	None	Unknown	Pits, tailings	None	Level of individual features: good	No immediate threats
TCH9: ML31, Tungsten (Tin)	pre-1907; 1907-1930s?	Alluvial, dredging	None	Unknown	Pits, tailings, races, dams, domestic artefact scatter	None	Level of individual features: good	Theft
TCH10: Cemetery, Tungsten	c1924-1977	N/A	N/A	None	Graves, headstones, fence	N/A	Excellent	Fire
TCH11: Bismuth town	c1904- 1950s?	N/A	N/A	Unknown	Earth mounds, stone bases, fencelines, domestic artefact scatters, 1 pathway, 1 standing timber structure	N/A	Poor	Theft, Visitation
TCH12: Wall Ck alluvials and gravesite (Tin)	Unknown but by 1920	Alluvial	None	Unknown	Pits, tailings, graves, domestic artefact scatter	None	Poor	No immediate threats

Figure 4.2 [cont.]: Table of dates, major physical features and moveable artefacts at each site

TCH13: Back and Wall Ck lode (Tin)	1915-1920; 1967-1978	Shafts, pits	Stamper battery and concentration plant	Removal of second (c1960s) stamper battery 1997	Shafts, pits, mullock heaps, concrete machinery bases, floor slabs, haul road	Wolseley pump	Level of the complex: good Level of ind features: poor	Mechanical failure (haul road), Theft
TCH14: Back/Wall Ck alluvials (Tin)	Unknown but by 1920s?	Alluvial	None	Unknown	Concrete dam wall, hut site	None	Poor	Floods, Mechanical failure (dam wall)
TCH15: Back Ck huts (Binghi)	?-1970s	N/A	N/A	Unknown	Concrete floor slabs, stone fireplace, domestic artefact scatters	N/A	Poor	Fire, Theft
TCH16: Blatherarm alluvials (Tin)	1875-?	Alluvial	None	Unknown	Pits, tailings, stone bases	None	Poor	Visitation
TCH17: Blatherarm stone bases (Tin?)	Unknown	Alluvial	None	Unknown	Stone bases, trench	None	Average	No immediate threats
TCH18: Kathida/Yankee lodes (Tin)	1878-1886, 1937-c1940s	Shafts, pits	Air compressor, pump, engine, boiler	Unknown	Shafts, pits, trenches, mullock heaps, machinery	Babcock and Wilcox boiler, Taylor Horsfield air compressor, Tangye pump, Colonial engine	Level of complex: excellent Level of ind features: excellent	Mechanical failure, Theft
TCH19: Cemetery, the Gulf		N/A	N/A	None	Graves, headstones, fence	N/A	Excellent	Fire
TCH20: Company's Hill (Tin)	1872-1910s	Shafts, adit	Unknown	Unknown	Shafts, trenches, pits, adit	None	Good	No immediate threats

Figure 4.2 [cont.]: Table of dates, major physical features and moveable artefacts at each site

TCH21: Raines Gully (Tin)	?-WW2	Alluvial	None	Unknown	Well, stone oven, shaft, trench, stone dam wall	None	Excellent	Mechanical failure (dam wall)
TCH22: Garth's battery (Tin)	1911-c1960	N/A	Stamper battery and concentration plant	Unknown	Concrete machinery bases, timber retaining walls, earth mound, concrete floor slab, stone bases	Davey Paxman and Co. Boiler, shaking table?	Level of complex: good Level of individual features: poor	Mechanical failure (standing timbers), Theft, fire
TCH23: Carpet Snake Ck alluvials (Tin)	Unknown (pre-1920?)	Alluvial	None	Unknown	Stone bases, race, pits, tailings, domestic artefact scatter	None	Poor	No immediate threats
TCH24: Specimen Hill (Tin)	1909-1938, 1960s-1970s	Shafts, pits, trenches	Battery? Flying fox	Unknown	Shafts, pits, mullock heaps, machinery bases, haul road	None	Level of complex: poor Level of ind. features: poor	Mechanical failure (haul road), Fire, Continued mining
TCH25: Flagstone and Cartwheel lodes (Tin)	1896-1906, 1924-1927	Shafts, adits	Battery and concentration plant	Unknown	Shafts, adits, mullock heaps, concrete machinery bases, road, tramlines, dam	Centrifugal mill?, pump, ore skips, pulley from haulage gear	Level of complex: good Level of ind. features: poor	Mechanical failure (stone retaining walls, tramways), Fire, Theft
TCH26: Huts Corduroy Ck	Unknown	N/A	N/A	Unknown	Stone bases, standing timber, winding drum?	N/A	Poor	No immediate threats

Figure 4.2 [cont.]: Table of dates, major physical features and moveable artefacts at each site

TCH27: Butler Mine (Tin, wolfram)	1881-1892, 1907-1921, 1937-1951	Shafts, pits, trenches	Stamper battery and concentration plant, winding gear	Plant removed to Flagstone 1925; Shafts fenced and capped	Shafts, pits, trenches, mullock heaps, concrete machinery bases, buddle, floor slabs, tramway, hut sites, race, magazine, dam	Ingersoll Rand air compressor, Tangye pump, mine skips	Level of complex: good Level of individual features: poor	Mechanical failure (reservoir, magazine), Continued mining, Fire
TCH28: Cunliffe's (Tin)	1928-1933, 1937-1940, 1960s	Shafts, pits	Boiler?	Unknown	Shafts, pits, trenches, mullock heaps, concrete machinery bases, floor slabs, dams	Knowles patent casing	Level of complex: good Level of ind. features: poor	No immediate threats
TCH29: Nash's (Tin)	1891-1896, 1908-1910	Shafts, alluvial?	None	Unknown	Shafts, pits, mullock heaps	None	Good	No immediate threats
TCH30: Lee's Gully and Chapman's lode (Tin)	1875-1911, 1927-1934	Alluvial, shafts, pits, trenches, adit	Air compressor	Unknown	Shafts, trenches, pits, mullock heaps, drives, adit, tramway	None	Good	Mechanical failure (stone loading bay), Fire
TCH31: Camp gully alluvials (Tin)	Unknown	Alluvial	None	Unknown	Rock cut race, earth race, tailings, concrete dam wall, pits	None	Poor	No immediate threats
TCH32: Bismuth Dam (Wolfram, bismuth?)	1943-c1953	N/A	Concentrating plant	Unknown	Blanket tables, buddle, tin drying tables, pits, machinery bases	Vat from coke burners at Fielder's Hill	Excellent	Fire, Mechanical failure (standing timbers), visitation

Figure 4.2 [cont.]: Table of dates, major physical features and moveable artefacts at each site

TCH33: Bismuth Mine (Bismuth, wolfram, cobalt, arsenide of nickel)	1904-1926, 1942, 1949, 1960s	Open cuts, shafts	Battery and concentration plant	Unknown	Shafts, pits, mullock heaps, open cut	Riveted iron drum, ore skip, windlass	Good	Mechanical failure (standing timbers), Fire
TCH34: Elliotts wolfram (Wolfram)	1910, 1927- 1931, 1979- 1980	Shafts	None	Unknown	Shafts, drive, mullock heaps, poppets head, standing timber	None	Good	Mechanical failure (standing timbers), Fire
TCH35: Duck Ck Bismuth (Bismuth)	1879, 1973- 1975, 1981- 1983	Shafts	Battery	Rehabilitation 10 years ago	1 possible capped shaft, machinery bases, dam, mullock heaps	None	Poor	No immediate threats
TCH36: Oppenhiemer's (Wolfram)	1899, ??	Shafts, open cut	None	Unknown	Shafts, drive?, pits, mullock heaps, open cut, stone base	None	Good	No immediate threats
TCH37: Donahue's (Wolfram)	1911-1920, 1951?	Shafts	Puddler	Unknown	Shafts, mullock heaps, puddler	Puddler	Good	No immediate threats
TCH38: McDonald's (Wolfram)	??, 1970s	Shafts	None	Unknown	Shafts, mullock heaps, poppet head, stone bases, standing timber	None	Good	Mechanical failure (standing timbers), Fire
TCH39: Mica Hill (Wolfram)	1911-1915, 1942-1943, 1955-1957	Shafts, pits	None	Unknown	Shafts, pits, poppet head, trenches, mullock heaps	None	Good	Mechanical failure (standing timbers), Fire

Figure 4.2 [cont.]: Table of dates, major physical features and moveable artefacts at each site

TCH40: Steven's (Wolfram)	1904-1909	Pits, trenches	None	Unknown	Pits, trenches, mullock heaps	None	Good	No immediate threats
TCH41: Rockvale Wolfram Mines (Wolfram)	1907-1919, ??1970s?	Open cuts, shafts	Battery and concentration plant	Unknown	Open cuts, shafts, pits, tramways, battery bed, buddle, engine bed	Grinding pan (1970s?)	Good	Fire, Mechanical failure (standing timber)

* Condition: Level of the complex = in terms of the whole operation, e.g. are all parts of the industrial process represented by clearly visible physical evidence? Level of individual features = e.g. what is the state of preservation of the milling plant? The level of integrity for sites relates to the nature of the original physical features present at the site—those sites which were only ever mining and not also milling and processing sites, are considered to be better preserved (i.e. there are fewer alterations to the physical fabric of the site) than those which once had batteries or mills which have since been removed.

Possible threats: Although there are no urgent measures which need to be taken to conserve any sites, there are longer term possible threats to their significance. For management prescriptions following on from these possible threats, see section 6.2.1.

4.4 Discussion

Although only a small proportion of the known mineral deposits were recorded during the present survey, it is evident that virtually every area across the entire study area has been worked for both alluvial and lode minerals for at least the last 126 years. All the creeks draining the Mole granite contain tin, in particular, in varying degrees of richness and old lease plans and primary accounts suggest that very few sections of creek bed remained untested even by the end of the last century (Weber 1974, 376). Coverage of the area by mining leases and tenements shows particularly dense areas of prospecting and workings in the Torrington pendant and in the Gulf, but also indicates that most areas, at one period or another, have been affected by some form of mining activity (figure 4.3 and 4.4).



Figure 4.3: Density of mining lease coverage across the study area



Within this larger picture there are a number of more specific trends which contribute to the overall picture of mining in Torrington. One of the most obvious is the regional variations which are evident between the Gulf and Torrington, in both the amount of machinery and the type of technology which were used for mining and processing in each area. Compared to Torrington, the Gulf always seems to have operated with less equipment, relying more upon small scale hand techniques, rather than extensive and expensive machinery installations. Both Terry and Rex Clifford (pers. comm.) assert that mining techniques in the Gulf were not as sophisticated as those in use in Torrington. In 1890, for example, the Department of Mines Annual Report (1890, 103) noted that ‘... 26 European miners resident at the Gulf, obtained 21¼ tons of ore

... and as there is not any machinery available in the locality, the whole of that output had to be dallied and hand dressed'. This situation was not limited to the late 1800s, and in 1906 (51), the Annual Report recorded that '[a]t the Gulf and in the neighbourhood, numerous small and rich chutes of tin and wolfram have been worked by individual miners, who appear to do well, especially when their primitive methods of hand dollying the quartz is taken into consideration'. This reliance upon less sophisticated technology was still the case even up until the 1930s and 1940s: prior to the erection of the boiler at Kathida, hand steel was still used to drill into the ore body, rather than the more efficient compressed air rock drills (Terry Clifford Interview 28/4/98). This affected the material remains of mining in each area: batteries and processing plants for the treatment of lode ore were much more common in Torrington than in the Gulf, so much so in fact, that according to Rex Clifford, there was only ever one battery erected at the Gulf (Interview in Rosen 1998, 135).

The Gulf had always supported a large population of itinerant miners searching for alluvial tin. Many of these had been previously employed building the great northern railroad, but once this had been complete, had turned to mining to make a living (Terry Clifford Interview 28/4/98). Numerous asides in the Annual Report refer to parties or individuals fossicking along the creeks and using cradles to extract the tin from the gullies. The methods of treatment for alluvial tin, in fact, were a second major difference between the Gulf and Torrington, in part due to the different quality of the alluvial tin deposits and consequent upon this, the methods required to work them: because the tin was finer and higher in quality at the Gulf, cradles were the preferred method to extract it, but at Torrington banjos and buddles were more heavily relied upon (Bill Sherratt pers. comm, Rex Clifford Interview in Rosen 1998, 135; Terry Clifford Interview 28/4/1998).

**Banjo****Cradle**

Figure 4.5: Regional differences in the treatment of alluvial tin: a Banjo owned by Bill Sherratt used to wash tin in the Torrington area, and a cradle owned by Terry Clifford used to wash tin at the Gulf.

Also noticeable over the entire mining period is the fact that these small scale mining techniques didn't change much over a century and a quarter. The same or similar methods (cradles, banjos, manually wound windlasses, drilling by hand steel, sieving through riddles, timber bush pole shaft collaring, simple but effective bush pole poppet heads) continued to be used in the smaller scale operations through to the 1940s and 1950s. Partly this is a result of the scale of operations employed at a site and the level of capital input which was available—the smaller operations continued to use reliable and relatively inexpensive techniques, compared to the larger companies which were often able to purchase up-to-date items of plant.

4.4.2 Cultural differences

The Cornish

Many of the early miners at Torrington were Cornish, as were aspects of their technology. Equipment such as riddles, buddles and kieves, and processes such as bucking, were all part of the traditional Cornish mining repertoire, as were early forms of stamper battery (known as Cornish stampers), crushing rolls (similarly called Cornish rolls) and boilers (Cornish boilers). Some families presently living at Torrington are descended from Cornish ancestors, implying that a continuing Cornish influence on sites in Torrington is a strong possibility, although this is easiest seen in the processing technology. Unfortunately, whether the continuation of various aspects of Cornish technology is a reflection of a stable Cornish presence, or the adoption of these proven techniques by others, remains unknown at present.

The Chinese

While there were certainly differences between different scales of mining venture, variation in the material traces of mining could also be a result of the cultural backgrounds of different groups of miners. The relationship between European and Chinese miners is one of the most enduring aspects of the Torrington mines and their surrounding area, in both the material remains and the oral history. While general stories of Chinese involvement on the tin fields occur in many secondary accounts, there are very few specifics concerning how the Chinese miners actually worked and what kinds of material traces they may have left behind them.

The first Chinese to arrive in New England in the 1840s and 1850s came as indentured labourers—shepherds or farm workers—who were brought in to work the larger pastoral stations (Swanson 1968; Wilton 1989). The declaration of gold and tin fields at places such as Rocky River, Timbarra, and Vegetable Creek, brought new influxes of Chinese immigrants, many of whom eventually migrated back to China, but some of whom became permanent members of colonial society. The first Chinese in the

Torrington area would have arrived in the early 1870s and by 1877 Chinese labour was described as 'rapidly increasing' in the Mole Tableland district (Department of Mines Annual Report 1877, 111). By 1879 there were about 670 Europeans and 360 Chinese miners, but over a twelve month period the number had increased to about 950 Europeans and 1,200 Chinese miners (Department of Mines Annual Report 1879, 155; 1880, 163). The proportion of Chinese to European miners continued to increase and by 1881 there were only 900 Europeans, but 2,000 Chinese engaged in mining on the Vegetable Creek tin field (Department of Mines Annual Report 1881, 103). This appears to have been the most vibrant period on the field, and in later years the numbers of Chinese declined, until by 1910 the report noted that only '[a] few Chinese may still be found fossicking along the various gullies and watercourses, but they eke out a bare existence' (Department of Mines Annual Report 1910, 51). The last such official reference to Chinese in the study area was in 1923 when the report recorded that 'there were about 180 fossickers working on old alluvial leads in the [Emmaville] division, twenty of whom were Chinese' (Department of Mines Annual Report 1923, 25).

This sudden and rapid mixing of cultural groups created the society and conditions around which many of the stereotypes and myths about the Chinese people in Australia were created. While first hand accounts of the Chinese miners *were* literal descriptions of the practices Europeans were seeing, the interpretation of these practices was often coloured by the unavoidably ethnocentric, and sometimes racist, viewpoints of the observers (Wilton 1989). There was often a good deal of open hostility in this relationship and the community of Vegetable Creek was no exception. An early report by the Vegetable Creek correspondent to the *Glen Innes Examiner* (20/3/1878) in 1878 was particularly vitriolic and resentful in its depiction of the Chinese community:

When a Chinese population swarms on a European community, it soon becomes apparent that one of the two of these distinct races must inevitably give place to the other. Their social difference does not so much depend upon race as by that incurable enmity engendered by social

intercourse. The habits and customs of life of heathens are naturally enough at direct variance with all other sections of the human family, and this fact not infrequently culminates in a mutual hatred and avowed contempt for each other. Less than a year ago, Vegetable Creek was peopled by Europeans; now it is rapidly becoming an exclusively Chinese community, both as regards labour and commerce also. But apart from minor considerations, the moral tone of any community is principally actuated by a due sense and equal regard for such laws as are deemed inseparable as between God and man ... For instance a Chinaman cannot be expected to understand the ritual obligations surrounding our Sunday observances; nor will he ever abstain from actual labour unless compelled to do so by law. The Mongolian fraternity here generally devote the Sabbath to gambling and carrying out the ordinary labour of the week. On Sunday last, as the long funeral procession of the late Mrs. Thompson was passing one of these Chinese camps, its progress was obstructed by a number of these workmen. The annoyance certainly was but trifling, as they were speedily dispersed by Mr. J. P. Stuart in a manner which 'John' will remember.

The Vegetable Creek correspondent indicates one extreme in the spectrum of the relationship between the two cultural groups, one which fails to exhibit any sympathy for, or understanding of, the cultural context of the Chinese, most particularly their alternative religious beliefs. The ethnocentric bias in this account is obvious and dominant, and not all descriptions of the Chinese were so negative or dismissive. Typical of these references are various asides in the Department of Mines Annual Reports, referring to the 'very patient way' in which the Chinese worked (1881, 101) and the fact that 'Europeans alone are employed in those mines where the leads are deep; but Chinese appear to succeed best where heavy work is done in open excavations' (1878, 89). In 1880 (162) the annual report noted in more detail that:

The whole of the mines situated in the bed of Vegetable Creek are in the hands of Chinese tributers, of whom about 500 find profitable employment in washing continuously the tailings and patches of unworked ground. ... It would, in fact, be difficult for many of the tin mines to be worked with any prospect of profit if the Chinese were not employed. Even the European miners admit this, for the Chinese can make mining profitable when Europeans cannot; and here there is a large extent of ground where tin is obtained which would probably be untouched if Chinamen were not employed to work it. The real reason why the Chinese seem able to succeed in mining upon ground that yields a little over £1 per week per man to any other labour employed is to be seen in the long hours they work (from sunrise to sunset) and their constant and persevering industry. ... Sometimes the Chinese purchase land for mining purposes from Europeans. Many of the European miners do nothing but prospect new ground, and if they find

a payable spot, they either endeavour to get Chinese to work the ground on tribute, or sell it to them. Among the numerous instances that came under my notice, one occurred on Catarrah Creek, Mole Tableland, where a European sold a 4-acre mineral area to a party of Chinamen for £200 cash.

This contains all of the most enduring facets of classic stories about Chinese miners: emphasising their thrift, industry, hard work ethic, and efficiency. It also refers implicitly to the notion that Chinese miners focussed upon alluvial deposits, without actually stating this point explicitly. While most of the locales in which the Department of Mines records Chinese labour as operating were undoubtedly alluvial (e.g. Catarrah Creek, Moleyard, Blatherarm, Black Swamp, Scrubby Gully), in 1885, the Mining Inspector also made the point that '[d]uring the past year a considerable falling off in the Chinese population has taken place, and numbers of those remaining have been compelled to devote their attention to the deep basaltic country, which, as shown by the increased output from this source, has well recouped them for their labour' (Department of Mines Annual Report 1885, 93-94). This alludes to a willingness, at least, by the Chinese miners to work deposits other than alluvial flows, a fact which is seldom referred to in this context. Oral history accounts strengthen this observation, and often refer to known instances of Chinese miners working underground (Ginger Burton Interview 29/4/1998; Terry Clifford Interview 28/4/1998; Alvena Gibbs pers. comm.). Moreover, some of these mines and sites are still identified explicitly with Chinese miners.

Although the transience of Chinese miners, most of whom returned to China eventually, may have in part contributed to the narrow stereotypes which were perpetuated, they were probably no more transient than many of the European miners who worked the various fields and moved on. Furthermore, many Chinese became permanent and important members of the community, even in Torrington. Jan Hin was one well remembered figure, who was also highly regarded as a skilled doctor and herbalist. He earned at least part of his living through tin mining and at various times lived in cottages in both Tungsten and Torrington, and possibly also Deepwater, from

which he dispensed remedies and cures which many residents of Torrington swore by (Alt 1981, 82-83; Beryl Elliott pers. comm.). When, as an old man, he suffered a stroke, he was cared for by his neighbours until his death (Alt 1981, 83).

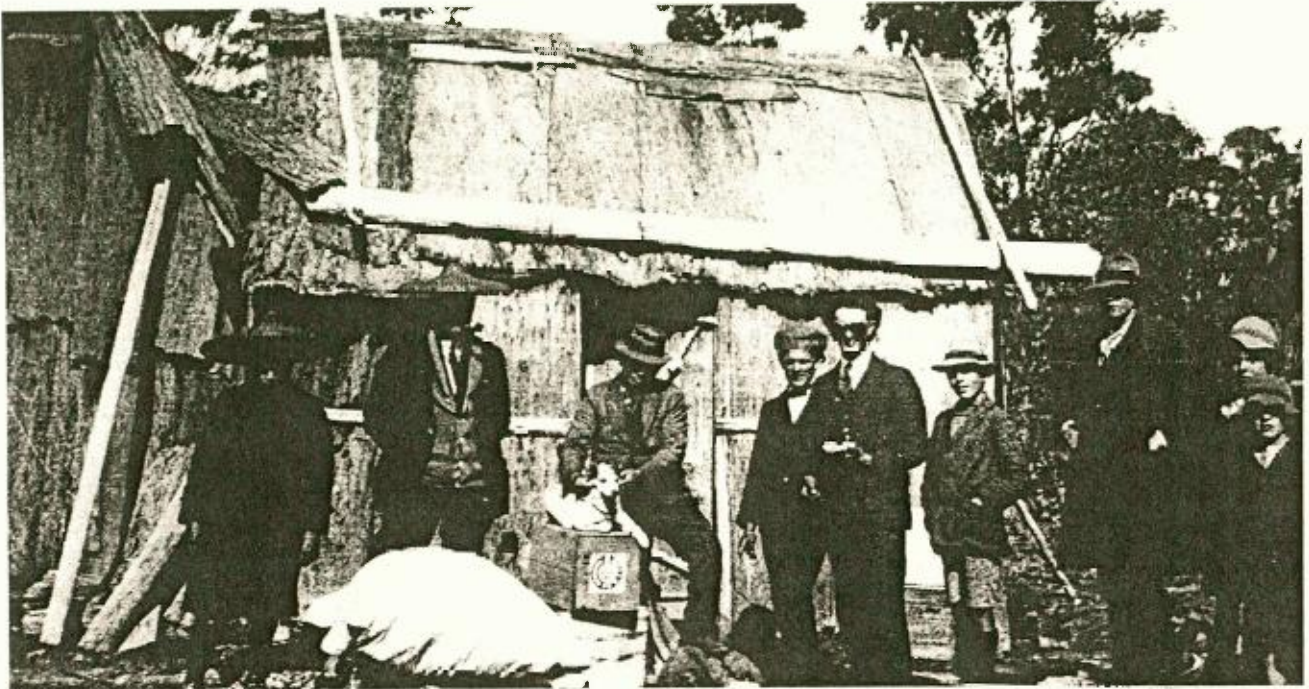


Figure 4.6: Jan Hin outside his hut at Deepwater (from Gilbert 1980, 32)

Unfortunately, detailed knowledge of Jan Hin's past is virtually absent, and nothing is known of where he came from in China, why he came to Torrington or why he stayed. The material remains at the site of Jan Hin's hut in Tungsten illustrates one of the behaviours which undoubtedly helped to set many Chinese apart from their European counterparts: their reliance upon traditional networks for the supply of goods, including the many domestic facets of their lives. Even though he was living in remote Tungsten during the first few decades of the twentieth century, Jan Hin sent to China for many of the ingredients for his medicines (Alt 1981, 83) and for his medicine bottles as well, he obviously purchased many of his foodstuffs (including soy sauce and wine) through familiar sources of supply, and continued to use traditional forms

of Chinese tableware. At the same time he was also tapping into European supply networks and purchasing European foods and beverages.

4.4.3 Removal

One of the most lasting practices to have an effect on the archaeology of tin, bismuth and wolfram mining in the Torrington area is the removal of above ground artefacts and traces of mining once sites have been abandoned. This is absolutely typical practice and is by no means limited to Torrington, but it has had a particularly devastating effect on the Torrington sites. There are a wide range of reasons for the removal of material remains, some larger in scale and repercussions than others. Furthermore, the process of removal began almost as soon as the site ceased production, but has continued up to the present in a multitude of forms, and it is perfectly possible for a site to have had various artefacts removed over a sixty, seventy or eighty year period. The sale or removal of machinery for re-use on other properties would have occurred relatively quickly after the mine ceased production, and would have affected a wide variety of plant. Modification for safety reasons is a relatively recent, but devastating phenomenon, which at its least intrusive has resulted in the capping of, or the erection of fences around, the deeper shaft systems (eg. Curnow's, Dutchman's, Butler's), and at its most intrusive in the wholesale levelling of sites (e.g. Duck Creek). The institution of safety measures is dictated by the issue of the legal liability of landholders and has resulted in the dismantling of many potentially dangerous features, particularly the larger poppet heads above many of the main shafts (Bill Sherratt pers. comm.). Given that so many potentially dangerous shafts exist in the Torrington area and that many of them are located on private property, safety issues are probably one of the most pertinent problems in dealing with the continued long term existence of archaeological features.

Removal on a smaller scale has also been effected by collectors and dealers. Many of the larger items of plant which remained on sites were recycled for scrap or parts. At

least some of this was undertaken by gunmetal dealers both during and after World War Two, who simply exploded the machinery to retrieve the internal 'white metal' bearings, leaving only the torn casings (Mal Bowers Interview in Rosen 1998, 123). Bill Sherratt remembers that machinery started to be removed from sites in the 1950s (Interview in Rosen 1998, 140), although this has accelerated over the last forty years, particularly within the last 15 years (Manuel Bringas Interview in Rosen 1998, 132).

Souveniring is a long term practice which has affected the archaeological content of sites, particularly in terms of 'collectable' items, such as the maker's plates and brass fittings from items of equipment, and of course domestic artefacts such as discarded bottles and ceramics. This last practice destroys both the above ground and the subsurface remains of archaeological sites and is particularly evident in the larger scale illegal household dump excavations in and around the settlement of Bismuth. When artefacts are collected, the context of the artefact is destroyed and so, too, is the archaeological information which is retrievable from it. This in turn affects the significance of the artefact, and of the site from which it came. Removing artefacts from the public arena through souveniring also takes away their potential for interpretation and general enjoyment.

It is not just artefacts *per se* which are removed through later human intervention in sites, but also the material traces of past mining practices in terms of the ground surface itself. Fossicking by tourists may have been going on for 50 years (Mal Bowers Interview in Rosen 1998, 122), but fossicking in terms of reworking old sites in times of changing fortunes or technology has been occurring since the beginning of the tin field.

4.4.4 Reworking of deposits

As early as 1879 (155) the Department of Mines Annual Report noted that '[s]ome of the leases at the Mole Tableland previously tested and abandoned as unpayable have recently been re-occupied' and in 1881, that:

Since the latter part of 1881, when the price of tin increased considerably, there has been quite a revival in tin-mining. Land that previously would scarcely be looked at has been taken up and worked, and old workings which had already yielded a considerable quantity of ore, but had been almost abandoned because the rate at which tin was selling made profits in these places too small ... have again been taken in hand and mined thoroughly. (Department of Mines Annual Report 1881, 96)

This is one of the most dominant patterns in the tin, wolfram and bismuth mining industry, which has not only affected, but created the archaeological landscapes that result: old areas being reworked periodically, when the market again became profitable, when labour conditions or technology changed, or when extraction and processing methods improved. The dependence of the mining industry on fluctuations in external factors, particularly market demand and rainfall, led to many alternative ways of deriving a living from the mineral fields. Both were often wildly unpredictable and both led to distinct cycles in working the mineral fields. Market demand was the one factor which was absolutely beyond the control of miners and some commentators went so far as to maintain that the vagaries of the tin market, in particular, were due to the control by syndicates in Paris and London, 'who raise and lower the prices at pleasure, regardless of the quantity on hand or the demand. The price of tin has been known to decline suddenly in London, without any apparent cause, at a time when the stocks were the lightest and the most satisfactory accounts were being received from the market elsewhere.' (Griffin 1888, 134). While market demand could not be remedied at the local level, the pattern of rainfall, in contrast, led to numerous innovations in water management technology, creating a variety of complementary archaeological features in association with mine workings. Dams, races and flumes

were all constructed in attempts to manage the supply of water to the diggings and to improve their productivity in times of drought.

The original introduction of the tribute system to Vegetable Creek in 1877/1878, was another example of a device to improve the productivity of mines at a time when the price of tin was dropping, by employing cheaper Chinese labour (Department of Mines Annual Report 1878, 126). The change from alluvial to lode mining was also, in part, a response to the decreasing profits obtainable from placer deposits, and with improvements in mining and processing technology, lode mines were able to be exploited with ever greater efficiency. The substitution of horse power for manual labour, and steam power for horse power, the introduction of the compressed air rock drill, the invention of dynamite, and the implementation of blanket tables, were all developments in technology which resulted in new incentives to expand the scale of workings and to rework old deposits.

Even changing knowledge of the nature of the ore deposits has affected the way in which the ground was worked. In 1887 David (149) noted that '[m]any miners appeared to me to be under the impression that the veins had been formed in fissures at the present surface of the granite. In consequence, after sinking to a depth of about 100 feet, which is as far as most individual shoots extend vertically, and finding that the ore became nipped, they have abandoned the work in the belief that the ore could not have penetrated from the surface below this level. Hence the number of old shafts in the district in which sinking has been discontinued at depths generally not exceeding 100 feet.' Obviously this situation changed as knowledge about the true nature of the deposits increased.

This kind of conceptual shift is still the case at present, when new uses are found for minerals which previously had no market such as silicite. This has serious repercussions for any attempts at long term conservation within the study area. Because the Torrington district is one of the richest mineral areas in the world, interest

in developing this area will continue, as new deposits, new uses for known deposits, or new technology changes the balance between supply and demand and profit and loss.

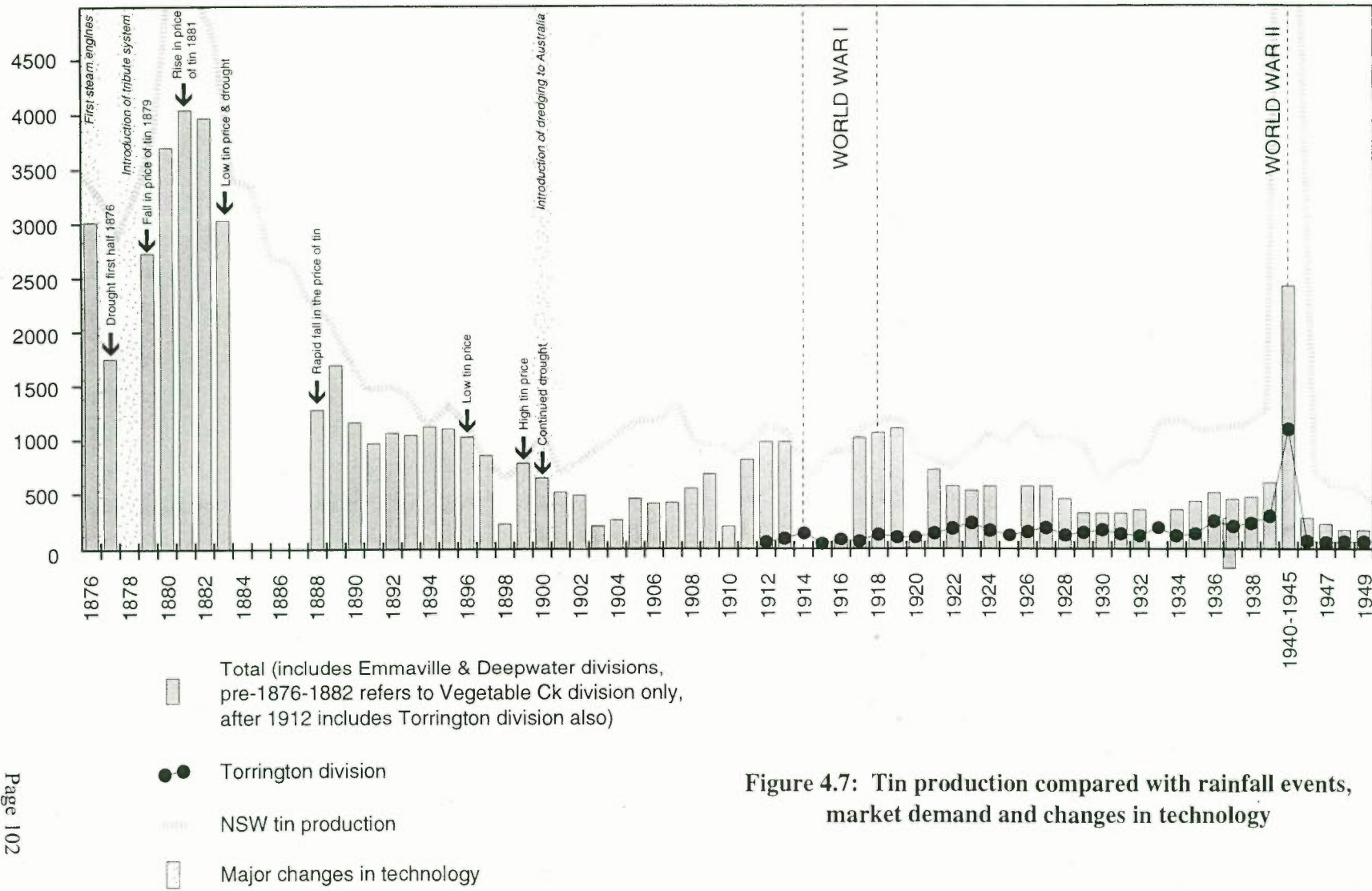


Figure 4.7: Tin production compared with rainfall events, market demand and changes in technology

4.4.5 Integrity and condition

Integrity refers to the intactness of the physical evidence on the site. It includes the structures, landscapes and subsurface archaeological remains which are able to provide information about activities that took place on the site. The higher the degree of integrity at a place, the more detail is able to be uncovered and communicated about the site and increases the potential for more secure intervention in the fabric.

The souveniring, recycling and re-use of materials has already destroyed much of the context and interpretive potential of many sites. As a result, most above ground physical remains consist of ground level foundations or floor slabs only. While integrity at the level of the complex may be reasonably well represented at the larger sites (Curnow's, Wallaroo, Dutchman, Butler, Back and Wall Creeks), i.e. all parts of the industrial process which were carried on at the site are still represented by clearly visible physical evidence and the spatial arrangement of that evidence allows the process to be reconstructed quite clearly, integrity at the level of specific features is universally poor. Very little machinery survives on sites and what does remain is mostly partial (i.e. just the casings or bases). The only exceptions to this are the site of the Flagstone and Cartwheel lodes (with a possible centrifugal mill, skips and sections of the haulage system), the site of Kathida and the Yankee lodes (with a substantially intact Babcock and Wilcox boiler) and the site of Garth's battery (with a substantially intact multi-tubular boiler). Given that Kathida and Garth's are not located within the SRA boundaries, the condition of the structures on site here are not directly relevant to the issue of integrity.

4.4.6 Threats

The main threats to all of the sites are fire, visitor impact, structural instability, and continued mining activity. To some extent, vegetation overgrowth is also a factor, although this is more in terms of obscuring sites rather than destroying them.

Bushfires are undoubtedly the cause of the destruction of most of the combustible or organic material of sites. Structural timbers in buildings, poppet heads, mine collaring or tramways are noticeably absent from most sites, and the two sets of stockyards are in particular danger of disappearing entirely, although there is also an element of natural decay at work here. The larger corner post from the Tungsten stockyards, for example, was claimed to have been six feet (1.82m) tall when it was first installed (it is now 1.6m high) (John Griffey pers. comm.).

Visitor impact can include both intentional and unintentional damage. While unintentional damage is difficult to pinpoint, the fact that many people enjoy camping and fossicking throughout the SRA, implies that there are ample opportunities for unintentional damage to sites. Creating new four wheel drive tracks to sites, building campfires from stone and brick rubble remains, and leaving paper, metal and plastic rubbish behind, are all real possibilities which influence the integrity and condition of sites. Intentional damage is much easier to pinpoint, but just as difficult to control, given that visitation to sites within the SRA cannot be closely monitored or controlled. Although visitation has limited potential to effect structural damage (because there is little that is 'structural' left), it is the most important contributor to the loss of material items from sites. The souveniring and re-use of materials has already destroyed much of the context and interpretive potential of many sites, although removal still continues. The numerous excavations by bottle collectors are merely one example, another is the relatively recent (within the last five months) removal of sawn timber floorboards from the Turner's house and kitchen at Bismuth. At present there is no good solution to the problem of unmonitored visitation.

Structural instability or mechanical failure, from weathering, erosion or water damage, are not major contributors to the deterioration of sites, as most sites are essentially reduced to ground level foundations only. The only exceptions to this would be the standing structures at the Turner's farm at Bismuth, the few standing timbers from the Roaring Meggs Creek and Tungsten stockyards, and from structures at the Bismuth

Dam, the Bismuth Mine, the Butler mine and Curnow's mine, the reservoir at Wallaroo, the larger magazine at the Dutchman mine, the stone loading bay at Lee's gully, and the more recent poppet heads at the Elliott's wolfram, McDonald's wolfram and Mica Hill wolfram mines (see Volume 1, section 6.2.1).

The impact of continued mining is almost impossible to evaluate, given that it is largely an unknown quantity (i.e. it is impossible to predict the future market or demand) and has very few restrictions on its development. Almost all of the residents of Torrington and Emmaville interviewed during this study stressed the importance of the mining industry to their continued livelihoods and reiterated their belief that they should be allowed to maintain this continuity with their past. Some of these people are part of families who have been mining here for four generations, and who have links with a number of sites and events. That one of the main threats to sites at Torrington is the potential for their continued working in the future is highly ironic, in that it is this more or less continual process of reworking sites in the past which makes them so complex and so interesting archaeologically. This continuity of activity across generations is also one of the main factors in the social significance of sites, and in many locales is what has caused the retention of invaluable oral histories about sites, miners and events. Rex and Terry Clifford's personal experiences across two generations at the Gulf, and the stories handed down to them by preceding generations, for example, provide a wealth of site specific information which is unparalleled in scope and detail. Other residents of Torrington, notably Bill and Fred Sherratt, can probably contribute the same quality and quantity of information for sites which they and their families have been connected to. It is therefore neither a simple nor easy matter to recommend that archaeological sites within the SRA be preserved from future intervention or mining, although it is relatively easy to identify this as an issue which urgently needs more detailed and direct attention.

5. STATEMENTS OF SIGNIFICANCE

Cultural significance is a concept used to identify and assess attributes which make a place of value to society (Kerr 1985, 3) and is assessed in terms of four categories: historic significance, scientific/research (archaeological) significance, aesthetic significance, and social significance. None of these categories are mutually exclusive of course: a site which has historic significance can also possess aesthetic significance as part of its locale and scientific/archaeological significance if it can contribute to historical archaeological studies. In addition it is also possible for the one historical site to possess significance for both Aboriginal and European people.

Assessing the significance of a place requires more than merely determining what categories of cultural significance are appropriate. Each category must also be assessed in terms of the nature and degree of its significance. Both of these are essentially assessments of comparative significance, or of the relationship between the place and other places which are either like or unlike it. The nature of the significance of a place relates to its relative significance on a **local**, **regional**, **state** or **national** scale. The degree of significance assesses each relevant category against two further criteria: representativeness and rarity. **Representativeness** is used to indicate that an item or place is a good example of an important class of significant items or environments, illustrating clearly the attributes of significance; **Rarity** is used to indicate that an item represents a rare, endangered or unusual aspect of our history or cultural environment and has few parallels elsewhere. Thus a place which has historical significance might be representative of the historical development of a region, but might not be rare, in that other similar places might also exist in the region. It could, however, be rare locally, if no other similar examples exist in the immediate vicinity. An outstanding place might be both representative and rare on a national scale.

In terms of the study area significance has been assessed both as a general statement for the suite of 41 mining and other sites (i.e. as the significance of the study area as a whole), and in terms of individual locations. This provides a basis from which to assess the range of conservation policies appropriate for the place and to identify the conservation and management issues which arise from these policies.

5.1 Aspects of significance

The sites within the Torrington SRA are of state significance, constituting some of the earliest tin mining sites in New South Wales. Many of the creeks in Torrington were worked from as early as 1872, making their workings as old as the first declaration of the tin fields and the more well known Vegetable Creek sites further south. In addition, at least one site in the SRA (Battery Mountain) was the first excavated lode tin deposit in the state and contained the first tin crushing equipment erected in the colony. The Torrington area was also a major contributor to the tin and wolfram industries in NSW in the late nineteenth and early twentieth centuries: its mines were situated within the largest tin-producing mining division in NSW, and Torrington later went on to become the major producer of wolfram in NSW in the 1910s. There is a staggering range and variety of mineral deposits within the Torrington area, encompassing over 24 kinds of minerals and over 1300 individual deposits, including the world's largest known silicite deposit.

Some sites within the Torrington SRA are significant for their rarity. The stockyards on Roaring Meggs Creek and at Tungsten are evidence of a rare past land use, and could date from the mid to late nineteenth century. The Chinese constructed rock cut races at Tungsten, and the stone dam wall in Raines Gully are also significant, as are the few located instances of Chinese domestic sites at Torrington and the Gulf. Although there are undoubtedly other Chinese sites within the local area, very few have been recorded, and on other major regional fields, such as Timbarra or the Sara River, few comparative archaeological examples are known.

The Turner's house and outbuildings at Bismuth are the only known standing structures to be associated with a domestic mining settlement. Although they were not strictly part of Bismuth town, the Turner's were still part of the Bismuth community and their structures are in many ways reminiscent of the range and kinds of housing erected elsewhere. Although their integrity has been affected in detrimental ways (through the removal of floorboards, the construction of recent shelving and carport and the introduction of recent rubbish), their significance as a set of domestic structures is enhanced by their continued use over time and by the continual alteration of their fabric while they were inhabited.

Some sites, while not rare in themselves, contain rare items, which contribute to their significance. The puddler from Donaghue's is the only known recorded example in the local area, as is the timber stamper bed from the Rockvale Wolfram Mine. Both of these demonstrate the continuity in technological forms across the field across time: the puddler is an example of an earlier form of technology initially applied on the alluvial gold fields, which was later adapted for use in the tin and wolfram industry; and the stamper bed is representative of one of the mainstays of the tin and wolfram industry for the last 120 years—the milling unit. The centrifugal mill, ore carts and skipways still located at the Flagstone lode sites, the boiler at Garth's and the Wolseley pump at Back Creek, are also rare, as little comparable equipment survives on other sites in the area. The Babcock and Wilcox boiler and the associated Colonial engine, Tangye pump and Taylor Horsfield air compressor at the Kathida and Yankee lodes, are also extremely rare, as the only known examples in the study area. They are also highly intact and their integrity is enhanced by their association with each other. These pieces of machinery together form a unit, typical of the steam driven pumping and compressing units in use on the other large mine sites. In their size and function, they form a contrast to the smaller scale hand techniques prevalent throughout the study area and illustrate many of the technological advances which revolutionised the mining industry.

Because there was so much reworking of deposits and areas right up until the present, there are very few known nineteenth century sites which have not been substantially altered since they were first established. Within this context, the site of Oppenhiemer's assumes greater significance given that it *may* be dateable to 1899, without serious or extensive re-working since. Likewise the site of Nash's may be a late nineteenth and early twentieth site which is still substantially intact.

Integrity is a large contributor to significance, and in this sense, the Bismuth Dam site, although relatively recent, is important as one site with a high level of integrity in terms of its remaining features. This integrity makes it highly demonstrative of the process used to concentrate wolfram. The techniques used at this site (blanket tables, buddles and kieves) had been in use since the earliest development of the tin and wolfram fields and demonstrate the continuity of technology across time.

The Torrington study area is also highly significant socially as a place which has been inhabited by members of the same families for at least two, and sometimes up to three and four generations. As a consequence, there is a strong sense of community identity and association with the place in general, as well as with particular sites.

Indicative list of most significant sites within and around the Torrington SRA:

Designation	Name	Basis for significance	Location
	Battery Mountain	First excavated lode tin deposit in the state, first tin crushing equipment erected in the colony	Inside SRA
TCH1	Roaring Meggs Creek stockyards	Rare past landuse	Inside SRA
TCH2	Maidenhead outstation stockyards	Rare past landuse	Outside SRA
TCH3	Turner's house and farm	Rare past landuse, rare evidence of a way of life (standing structures)	Outside SRA
TCH9	ML31, Tungsten (rock cut races and	Rare evidence of particular cultural group (Chinese)	Outside SRA

	domestic sites)		
TCH21	Stone dam wall, Raines Gully	Rare evidence of particular cultural group (Chinese)	Inside SRA?
TCH21	Chinese oven, Raines Gully	Rare evidence of particular cultural group (Chinese)	Outside SRA
TCH37	Donaghue's	Rare evidence of particular technology (puddling)	Outside SRA
TCH41	Rockvale Wolfram Mine	Rare evidence of particular technology (timber stamper bed)	Outside SRA
TCH25	Flagstone and Cartwheel lodes	Rare evidence of particular technology (centrifugal mill, skips, tramways)	Inside SRA
TCH22	Garth's battery	Rare evidence of particular technology (boiler)	Outside SRA
TCH13	Back and Wall Creek lode	Rare evidence of particular technology (pump)	Inside SRA
TCH18	Kathida/Yankee lodes	Rare evidence of particular technology (boiler, pump, compressor)	Outside SRA
TCH36	Oppenhiemer's	Rare evidence of nineteenth century mining activity	Inside SRA
TCH29	Nash's	Rare evidence of nineteenth century mining activity	Inside SRA
TCH32	Bismuth Dam	Intact example of the spatial relationships between technological processes	Inside SRA

5.1.1 Historic themes

The historical significance of the study area can be assessed in terms of both national and state heritage criteria. National historical significance is based upon the Draft Principal Australian Themes developed by the Australian Heritage Commission. These identify the major processes of land settlement and occupation which are represented at diverse sites around Australia and which created the modern form of Australia. The following principal themes are relevant to understanding the particular development of the Torrington study area. State historical significance is based upon a range of themes developed in the NSW State Heritage Manual.

5.1.1.1 Principal Australian themes

Note: the numbers refer to the principal Australian historic themes trial framework.

1.4 Appreciating the natural wonders of Australia

The environment of the Torrington SRA varies widely and includes a variety of landform types and features. The steeply inclined valleys and high ridges, combined with spectacular granite outcrops, waterfalls and diverse vegetation and faunal communities, evoke strong visual and emotive responses, and provide an opportunity to observe the often extreme contrast between natural and humanly created landscape features. Its rugged and often inaccessible surroundings enforce a sense of isolation and wilderness, which is enhanced by the many abandoned mine sites scattered across the landscape.

3.3 Exploiting natural resources

The mine sites scattered across the SRA landscape are illustrative of the process of exploiting natural ore deposits, through both their placement within the landscape in relation to the location of different deposits and the richness of deposits, and their individual physical traces. This process, and the effects which it has had upon the local landscape, is also relevant to an exploration of theme *3.10 Altering the environment for economic development* and *3.14 Developing economic links outside Australia*. This latter is important in terms of world ore markets and the effects which rises and falls in the demand for and price of ore had upon the local mining industry.

3.15 Struggling with remoteness, hardship and failure

The isolation of many sites in particular and the remoteness of the Torrington area from other centres in general, is reflected in the fortunes of various mining ventures. In the material traces of these ventures, and in their present status as abandoned mine sites which are often situated in difficult to access locations, they reflect the difficulties associated with working, winning and transporting ore and the hardships which accompanied the uncertain and often transient life of a miner.

The ultimate failure of many mine sites associated with the SRA, both individually, in relation to the nature and character of various ore deposits, and collectively, in response to the changing world market, reflects wider political and economic climates beyond the boundaries of the local mining industry, but which nevertheless closely affected the lives and lifestyles of ordinary miners and townspeople. These include changes in the regulation of the mining industry, downturns in other industries which forced people to turn to mining to make a living, and the increased demand for various metals in association with preparations for both world wars.

5.1.1.2. State themes

Note: the numbers refer to the state theme codes.

2. Agriculture

The Turner's farm at Bismuth, relatively typical of small scale, independent, isolated farms, provides a contrast to the dominant mining landuse surrounding it. The range of structures (main house, detached kitchen, barn, yards) indicates the variety of tasks necessary to successfully operate a small farm, and the way these structures were built and maintained (e.g. the use of newspaper and brown paper as internal wall paper, the re-use of hessian flour sacks as internal walling and ceiling materials), demonstrates the continual process of accommodation and improvisation in the maintenance and manufacture of structures and implements necessary for every day farm life. **Local Representative**

7. Death

The cemeteries at Tungsten and the Gulf, as well as the isolated burials on Back Creek and at the Gulf, indicate the harshness and loneliness of life associated with such an isolated area (Torrington/Emmaville) and occupation (mining). At the same time, inscriptions on the headstones indicate the continuity of family and the importance of maintaining familial networks as a mechanism for coping in such an environment.

Local Representative

9. Education

The site of the Bismuth school indicates the importance attached to education and the necessity to provide educational facilities for children close to hand. The fact that many miners obviously lived and worked in such settlements along with their families, indicates an alternative perspective on the 'typical' miner, all too often regarded as an isolated individual without family ties. Many of the people who sent their children to school in Bismuth worked some shifts at the mines, but also ran other businesses in the town (e.g. William Toy) (Alt 1981, 75). **Local Representative**

10. Environment

One of the most notable features of the environment within the SRA is the extent to which it has been modified by historical mining practices. Given that virtually every creekline would have at least been prospected, it is unlikely that many areas were left untouched, although the majority of activity did take place in the northern, eastern and southern portions of the SRA. To this extent then, the environment of the study area has been shaped by the patterns of behaviour resulting from over 120 years of more or less continual mining activity. The landscape in Torrington is an extension of the landscape further south on Vegetable Creek, which, because of the distinctive hummocking effect of alluvial pitting and tailings mounds, appears in places stark and barren. The characteristic landscape features created by the practice of pitting and trenching to follow the line of lode along the surface, is another distinctive feature of the modified landscape around Torrington. **Regional Representative**

11. Ethnic influences

Many of the early tin miners who came to Torrington were Cornish, as were various distinctive aspects of the technology they employed. Bucking tables, buddles, riddles, kieves, were all typical of traditional Cornish tin mining and the Cornish influence on mining practices cannot be underestimated in the successful working of the Torrington tin and wolfram deposits. The Chinese were also essential to the successful operation of the tin field, a fact which was often admitted by their European contemporaries.

That sites still exist which can be linked with Chinese miners demonstrates a facet of the mineral fields which is underexplored: namely the interrelationships between different cultural groups living in and exploiting the same environment.

Regional Representative

17. Housing

Although very little of actual domestic structures survives archaeologically, this in itself, is indicative of the kinds of housing built by miners in the area. Typically these were constructed of non-durable, easily obtainable and highly portable materials, such as bush poles, bark sheets, corrugated iron, local stone and flattened kerosene tins. Being highly impermanent, these structures leave few traces above ground, although many stone bases possibly mark the locations for huts. Furthermore, oral history indicates that there was a range of housing available for the different 'grades' of miners: from the company built manager's house or boarding house, to neat sawmilled worker's cottages, through to bark lean-to's and canvas tents.

Local Representative

18. Industry

The various cycles of working the tin and wolfram fields at Torrington relate to the cycles of supply and demand for these products on a world scale. These minerals were particularly in demand during the lead-ups to the First and Second World Wars, demonstrating the connection between a local industry and larger world-scale events. As the need for armaments, for example, passed, so too did the peak production periods at Torrington, although other mineral deposits have also influenced these cycles. **State Rare**

19. Land tenure

Two possible portion marks (one at TCH3 and TCH14) indicate the practice of subdividing land portions, presumably to mark the boundaries of mining leases. Given that so many mining leases have existed across the Torrington landscape, and that so

few boundary markers were located during the present survey, demonstrates the continually changing nature of the mining landscape, which continually removes vegetation and re-negotiates boundaries. **Local Representative**

23. Mining

Sites within Torrington SRA are early sites in the context of Australia's tin fields, containing the first excavated lode tin deposit in the state and the first tin crushing equipment in the colony. The sites demonstrate the application of technology previously used on the gold fields, but eventually adapted specifically to cope with local tin deposits and conditions. That alluvial sites still survive side by side with lode deposit sites indicates the change in emphasis from the more easily worked placer deposits to more difficult to extract, but productive deep leads. They also illustrate the contrast between the kinds of technology needed to work these different deposits and the different levels of labour and capital input required of each.

State Representative

25. Pastoralism

The two sets of stockyards illustrate an alternative landuse to the dominant mining industry, but also an earlier form of landuse, one which was replaced, and in a sense erased, by the more destructive alteration of the landscape through mining. Maidenhead station, typical of many of the larger pastoral concerns, had folded by the 1920s, and its employees turned to mining to make a living. The form of the stockyards, made from readily available bush timbers and constructed as post and rail fence lines, demonstrates the practice of expedient construction for sets of yard which were infrequently used and located far from the station homestead or any of its outstations. Furthermore, the location of the two sets of stockyards demonstrates the practice of running large mobs of cattle across a wide area and only mustering and moving them infrequently. **Local Representative**

31. Technology

Many facets of the technology used on the mineral fields demonstrate distinctive solutions to the problems encountered in working and processing tin and wolfram deposits. The construction of dams and water races to wash alluvial deposits is one widespread example of a technique developed to cope with the vagaries of rainfall and water supply. That Chinese miners built many of these water races and dams indicates a distinct cultural preference in technology, although this was not the sum total of Chinese mining practices, given that they also worked lode deposits.

The adaptation of traditional mining techniques to other kinds of deposits and situations demonstrates the twin processes of technology transfer between countries (from Cornwall to Australia) and industries (initially between the gold and tin industries, and subsequently between the tin and wolfram industries), as well as technological progression over time. The first systems of sluicing for tin were the same as those previously employed in sluicing for gold, although altered conditions and greater experience did lead to subsequent modifications in techniques. Over time the design and size of sluice boxes were altered, hopper plates were added and the square mouthed shovel was introduced to replace the traditional fork. Further improvements were made by substituting horse power for manual labour and in re-using water from the sluicing system (Lyne 1882, 172).

The application of alluvial methods, particularly puddling, to the processing of hard rock wolfram deposits at Donoghue's lode, indicates the cross fertilisation of techniques between the closely related industries of tin and wolfram mining. The application of traditional Cornish mining practices to Australian tin and wolfram deposits demonstrates the retention of distinctive cultural traits, while at the same time illustrating the process by which these practices were adapted for use in distinctive conditions. The progression from the use of dead or stationary buddles to revolving mechanical buddles illustrates another facet of these processes, whereby a technology is improved over time in response to the inadequacy of former methods.

The design and layout of the larger milling and processing complexes demonstrates the technology used to reduce mined ore to a manageable size and concentrate it through a variety of systems to produce a marketable end product.

Regional Representative

32. Townships

The townships of Bismuth, Tungsten, Torrington and the Gulf are representative of the kinds of small scale communities typical of mining towns. Their location demonstrates the practice of founding communities for goods and services in close proximity to major mines, and their proximity to each other illustrates the close social networks and interconnections maintained between the residents of each community.

Local Representative

5.3 Statements of significance

5.3.1 Aesthetic significance

The environment of the Torrington SRA varies widely and includes a variety of landform types and features. The steeply inclined valleys and high ridges, combined with spectacular granite outcrops, waterfalls and diverse vegetation and faunal communities, evoke strong visual and emotive responses, and provide an opportunity to observe the often extreme contrast between natural and humanly created landscape features. The close conjunction of natural and humanly modified landscape elements within the SRA is both visually stimulating and strongly evocative, reflecting changing attitudes and experiences of landscape. The rugged and often inaccessible surroundings enforce a sense of isolation and wilderness, which is enhanced by the many abandoned mine sites and other remnants of European cultural heritage scattered across the landscape. These sites contribute positively to the visual and sensory appeal of the place, through their composition as a landscape of past human activity.

Local Representative.

5.3.2 Historical significance

The Torrington SRA, and the various sites and landuses which it contains, represents wider regional and state historical processes. Patterns of exploration and settlement across the study area demonstrate the complementary processes of opening up the landscape, initially for large scale pastoral use, but subsequently for smaller scale alternative uses, and attracting larger and more permanent populations through the exploitation of various resources within that landscape. These patterns demonstrate the fluidity of population movement in response to opportunities for success, and a tendency for people to occupy even the most inhospitable and remote areas in their search for a livelihood.

The isolation of many sites in particular, and the remoteness of the Torrington area from other centres in general, is reflected in the fortunes of various mining ventures across the study area. In the material traces of these ventures, and in their present status as abandoned mine sites which are often situated in difficult to access locations, they reflect the difficulties associated with working, winning and transporting ore, and the hardships which accompanied the uncertain and often transient life of a miner. The ultimate failure of many mine sites, both individually, in relation to the nature and character of various ore deposits, and collectively, in response to the changing world market, reflects wider political and economic climates beyond the boundaries of the local mining industry, but which nevertheless closely affected the lives and lifestyles of ordinary miners and townspeople. These include changes in the regulation of the mining industry, the behaviour of overseas tin syndicates, downturns in other industries which forced people to turn to mining to make a living, and the increased demand for various metals associated with preparations for both world wars.

The historic mine sites associated with the Torrington SRA are early sites in the context of Australia's tin fields, containing the first excavated lode tin deposit in the state and the first tin crushing equipment in the colony. The sites demonstrate the

application of technology previously used on the gold fields, but eventually adapted specifically to cope with local tin deposits and conditions. That alluvial sites still survive side by side with lode deposit sites indicates the changes in emphasis from the more easily worked placer deposits to more difficult to extract, but more productive deep leads. This conjunction also illustrates the contrast between the kinds of technology needed to work these different deposits and the different levels of labour and capital input required of each.

Many facets of the technology used at these sites demonstrate distinctive solutions to the problems encountered in working and processing tin and wolfram deposits. In part this reflects the wider processes of adapting technology to suit specific local conditions, although many solutions indicate distinct cultural preferences in technology, which also illustrate the interrelationships between the various cultural groups who lived in and worked the same environment. The application of traditional Cornish mining practices to Australian tin and wolfram deposits, for example, demonstrates the retention of distinctive cultural traits, while at the same time illustrating the process by which these practices were adapted for use in distinctive conditions.

The townships of Bismuth, Tungsten, Torrington and the Gulf are representative of the kinds of small scale, but largely self sufficient communities typical of isolated mining towns. Their location demonstrates the practice of founding communities for goods and services in association with major mines, while at the same time their proximity to each other illustrates the close familial and social networks which were maintained between the residents of each community as a mechanism for coping in such an environment. The fact that many miners obviously lived and worked in such settlements along with their families, indicates an alternative perspective on the 'typical' miner, all too often regarded as an isolated individual without family ties.

More recently, the various debates over the status of the study area and its eventual declaration as an SRA, demonstrate important changes in the history of the conservation movement in NSW, and represent changing community attitudes to conservation issues and an increase in public opinion over the handling of these issues. In contrast, the ability of the local community to successfully challenge proposals advocating the elevation of environmental values over economic and utilitarian values, illustrates the power inherent in community unity to successfully defy government decisions. The increasing importance of the SRA as a recreational focus for a variety of different social groups, represents changing attitudes to the environment and the increased recognition of the landscape as a recreational facility.

Regional Representative

5.3.3 Scientific/research significance

A standard method of identifying the archaeological aspect of scientific/research significance of a place rests on answering three questions (Bickford and Sullivan 1977, 23-24): Can it provide information not available from other sources?; Can it provide information not available on other sites?; Can it answer pertinent research questions?

Ability to provide information not available from other sources

One of the major archaeological features of the Torrington study area is the regional differences in investment and levels of technology which are apparent—information which is only recoverable from a detailed survey of the range and kinds of sites existing across the study area. Likewise, through analysing a range of domestic sites (from ephemeral canvas or bark hut sites, to the more durable sawn timber worker's cottages and still more impressive manager's houses) historical archaeology has the ability to comment on the lifestyles enjoyed by miners, an aspect which is seldom referred to in collected written or oral histories.

A similar disjunction occurs in reference to the interaction between European and Chinese miners. Although Chinese miners are often referred to, the issues of cultural contact between the two groups are seldom explored, except in stereotypical and often racist forms. Little is known about either the degree or kinds of interaction which went on between Europeans and Chinese, other than superficially in terms of various goods and services (eg. through the Chinese supplying foodstuffs to the Europeans and vice versa, or through Jan Hin's provision of medical services). Historical archaeology has the ability to address this issue, through analysing the material remains of both groups. In a similar vein, archaeology has the potential to provide information about the closely related issue of the maintenance of traditional lifeways and consumption patterns, which has not yet been addressed through written or oral histories.

There are many other instances of information which is broadly available from historic sources, but which is not dealt with in terms of specific details. Precise methods of constructing water races (at least one in the study area has been constructed with stacked stone walls inside the inner wall of the race), mining trenches (one at Lee's gully also has stacked stone walls inside its inner walls), or constructing blanket tables (there are three different kinds at Bismuth Dam), are all examples of techniques which are referred to in the historical literature, but without detailing specific methods or forms. There are thus gaps in contemporary knowledge, which can only be filled by detailed investigation of the archaeology. **Regional** **Rare**

Ability to provide information not found on other sites

This applies more to particular sites rather than to the suite of mining sites as a whole. Some of the better preserved sites, such as Bismuth Dam, Flagstone and Cartwheel, can provide information on technical and mechanical processes which is not available on other sites, because so few other sites contain machinery or items of plant.

Local **Rare**

Pertinent research questions

The sites in the Torrington SRA can answer several pertinent research questions relating to ways of life, and methods of working deposits. The location of domestic habitation sites could provide information on such important themes as living conditions, diet and acculturation; the location and identification of Aboriginal contact sites, which could possibly exist within the study area, could answer questions about Aboriginal presence in the historic period, and the application of Cornish or other milling and processing technology to Australia and to different mineral deposits could shed light on the adaptation of technology to particular, and in some ways peculiar, conditions. **Regional** **Rare**

5.3.4 Social significance

The Torrington SRA is held in high esteem as place which is widely known across the local communities of Torrington, Emmaville, Glen Innes, Deepwater, Tenterfield and surrounding rural areas, and which is highly valued for its long and continuing associations with local families, as well as for its important role as a recreational focus. Particular sites within the SRA are closely associated with the contemporary identity of the local Torrington and Gulf communities and with people's continued residence in those places. Many of the residents of Torrington and the Gulf have long term links with the area in general, and with particular mining and other sites within it, not just within their own lifetimes, but also within the lifetimes of their parents and grandparents. Many families have three or even four generations of association with the place, and some people, while leaving Torrington temporarily, have returned there to live in later years. Social significance is also associated with less long term members of the community, including those who have chosen to reside in Torrington or the local area because of its remote and natural beauty. Many people hold the landscape setting of Torrington in high esteem as a special natural place and choose to live here on the basis of its outstanding floral and faunal values.

Department of Mineral Resources, but it is unreasonable to assume that the NPWS could institute a similar program, given the sheer number of shafts within the SRA.

The interpretation potential of sites also raises particular conservation and management issues. The most suitable sites for interpretation are the Bismuth Dam tailings retreatment site, and the existing area around the Blatherarm creek fossicking area. The Wallaroo Mine might also provide an opportunity for interpretation, particularly as it is easy to access and could be used to demonstrate the devastating process of the removal of material from sites and the effects this has on the archaeological remains left behind. The processing complex is a good illustration of the spatial layout of the milling process on the larger sites and could be reconstructed in photographs and cross sections to provide an idea of the size and scale of workings which once existed here. This would provide a contrast to the bareness of the site as it appears today.

6.1.2 Control of intervention in the fabric and the design of new works and activities

Physical intervention in the significant fabric will be necessary for safety and possibly structural reasons, particularly maintenance and stabilisation work. The place is also an archaeological resource and there is a need to both protect the archaeological potential of the place by controlling unrecorded excavation and demolition, and a need, if it arises, to allow properly conducted archaeological excavations. Deleterious forms of intervention need to be controlled.

One issue which is relevant here is the relatively recent removal of a 5-head stamper battery from the Back and Wall Creek lode site. This was done by local residents for a variety of reasons, with the primary one of re-erecting it in the memorial park at Torrington as part of an interpretive display for visitors. Unfortunately, in removing the battery, both the site and the battery were damaged, and the integrity of the site

affected, through the removal of what constituted its only remaining piece of major equipment. Mitigating against this, however, is the fact that the Back and Wall Creek site is fairly isolated, and therefore will not be part of general public visitation, and had a low level of integrity even before the battery had been removed, as well as the fact that the battery was a relatively recent addition to the site. From this perspective it does not seem worth reinstating the battery purely from a significance point of view.

One possible solution might be for the Service to collaborate at some level with the local community in setting up an interpretive display in the park at Torrington. This could include many of the findings from the Aboriginal, historical and archaeological components of the present cultural heritage assessment, as well as outlining the Service's responsibility to care for and maintain the Torrington SRA and its sites. As part of this, however, the Service would need to make clear that it does not condone the removal of archaeological material from sites, and does not condone the actions which led to the removal of the battery.

6.1.3 Interpretation and reconstruction work

Because of their cultural significance, sites within the Torrington SRA should be interpreted to the public and to specialists and access should be provided. Interpretation is best presented through interpretive devices such as pamphlets and signs, which detail the significance of the places and any subsequent restoration and/or reconstruction work. The interpretation need not attempt to present a place in any particular configuration which it possessed at any particular past time. It could present parts of a site as they have evolved over time and been incorporated into later phases or periods. Any restoration or reconstruction works are dependent on knowledge about the former configuration of the landscape and mining structures. At present, because little is known about the precise structure of the landscape and the placement of various elements within it, no conjectural reconstruction should take

place. Instead, a wider investigation of unrecorded sites within the SRA should be made a priority of any further research.

6.2 Conservation policies

As the place possesses cultural significance, activities should be guided by recognised conservation philosophy, such as the Burra Charter. It is critical that the place be managed in a way that permits the maximum number of appropriate conservation policies to be implemented and followed. Works at the place should be planned, directed and implemented by people skilled in conservation practice at a professional level. Appropriate efforts should be made during works, to document and record elements before, during and after work takes place. This may most appropriately take the form of photographing elements before work begins, during work and after the work has taken place. All such photographs should be fully documented.

On consideration of the above discussion and the statement of significance, the conservation policies will deal with:

- the treatment of the fabric of the place and its setting,
- physical intervention in the fabric of the place and its setting,
- the interpretation of the place,
- the use of the place and
- the conservation procedures for the place.

6.2.1 Conservation policy statement

Recognition of significance

CP1 Recognise the surviving historic places within the Torrington State Recreation Area as part of a significant cultural landscape. Recognise the site of Battery Mountain as being of state significance and all other sites within the Torrington SRA as being of regional significance

The Historical Archaeological assessment for Torrington SRA has identified that the surviving sites within the reserve are of cultural significance, both individually and as a collection, reflecting an historically and socially important regional industry. Recognition of the significance of the collection of sites within the SRA as a whole, as well as of individual places, requires that the Service manages these sites with regard to potential impacts upon their significance.

Strategies and actions

- CP1.1** Ensure that the location of the significant first mining episode at the site of Battery Mountain is established and the place recorded and assessed in further detail.
- CP1.2** Ensure that places of significance are entered into appropriate registers and lists including NPWS s. 170 Register, NSW State Heritage Inventory and Register of the National Estate.
- CP1.3** Ensure that the significance of the landscape as a unit and places within their landscape and environmental contexts are incorporated into park management instruments, such as the Plan of Management Fire Management Plan and identified during environmental impact assessments.

General conservation policy

CP2 The overall policy for the conservation of historic heritage within Torrington will be preservation through maintenance and monitoring. The introduction of new fabric will be limited to specific locations where it will ensure retention of significant fabric by stabilisation, public safety, or where it will benefit interpretation and understanding.

Generally all historic heritage will be retained in its current state, with monitoring of its condition to ensure there is no loss of significant fabric or values. Where loss is occurring, maintenance and stabilisation work only will be undertaken. The introduction of new material into sites to return them to a closer semblance of their original form constitutes reconstruction (as defined in the Burra Charter, 1.8). This will be limited to places which are actively interpreted, or where this will aid understanding of significance, or where it is essential for safety and stability.

Monitoring: Monitoring includes observing the condition of features, noting any changes to the condition of features and following a general policy on mechanisms and consequences if monitoring detects change.

Appropriate precautions: Appropriate fire prevention measures would include reducing the amount of fuel at sites, particularly by reducing fuel against and around any features using a hand tool (rake hoe) line, and incorporating archaeological sites within the Reserve's fire management plan.

Strategies and actions

CP2.1 The following places will be stabilised:

- The standing timber posts at Roaring Meggs Creek stockyards
- Standing timber structure near open cut mine, Bismuth Mine

- Standing timber structure of the lunch shed and office, Bismuth Dam site
- Standing timber poppet head, Elliott's wolfram mine
- Standing timber structure and shaft timbering, McDonald's wolfram mine

Bismuth Dam should be stabilised and maintained to enhance its interpretive potential, but not through anything more extensive than:

- Clearing leaf litter and accumulated soil off the two concrete sets of blanket tables, partly to reveal them for interpretive purposes, but also to ensure that people do not trip over the raised bolts covering one set of tables. A warning to be careful around these should also be included as part of any interpretive information.
- Stabilising the stone chimneys and walls to ensure they are not liable to mechanical failure.
- Stabilising the standing timber structure to ensure it's not liable to mechanical failure.
- Ensuring that the earth foundations of the original set of blanket tables are stable.

The Wallaroo Mine is another site which could be used for public interpretation. The processing area would be good to interpret as an example of a larger complex and could be used to illustrate the arrangement of the processing plant under the gravity feed principle and to explain each of the steps within this process through the plant. If the Wallaroo site is to be interpreted to the public this will first require a more detailed assessment of its interpretive potential and the safety issues which flow from this (see CP7.5), as well as stabilisation, through:

- Ensuring that the concrete foundations for the processing area are stable, which may involve some cleaning up of some of the concrete rubble so that the site can be traversed safely.
- If this occurs, ensure that an established path only is cleared across the site, and design the placement and dimensions of this path in accordance with the

interpretation plan. In other words, decide on the interpretation of the site first, before deciding on where to place a cleared path.

CP2.3 A monitoring and maintenance program will be developed for the SRA. Any changes in monitored status will require stabilisation or maintenance. If more intensive intervention is required this will be assessed and documented beforehand in consultation with CHSD.

CP2.4 All evidence of historic landuse should be recorded to an adequate standard and its significance assessed before it is subjected to any actions that may cause loss of fabric or significance, e.g. by altering the context or setting. Where relevant, the assessment should be part of the REF process to determine significance and potential impact.

Significance as basis for management

CP3 Manage historic places and landscapes within Torrington in accordance with their significance and the requirements for the retention of significant fabric

While all historic places and landscapes in Torrington are recognised as important, priorities for conservation will be based upon the overall significance of each place and, where existing integrity or condition are important values of significance, the retention of these will be given priority over places that have lost these values.

Strategies and actions

CP3.1 Roaring Meggs Creek Stockyards (TCH1)

- Take appropriate precautions to prevent fire from further damaging the timbers.

CP3.2 Wallaroo Lode (TCH4)

- Standing timber structure of the lunch shed and office, Bismuth Dam site
- Standing timber poppet head, Elliott's wolfram mine
- Standing timber structure and shaft timbering, McDonald's wolfram mine

Bismuth Dam should be stabilised and maintained to enhance its interpretive potential, but not through anything more extensive than:

- Clearing leaf litter and accumulated soil off the two concrete sets of blanket tables, partly to reveal them for interpretive purposes, but also to ensure that people do not trip over the raised bolts covering one set of tables. A warning to be careful around these should also be included as part of any interpretive information.
- Stabilising the stone chimneys and walls to ensure they are not liable to mechanical failure.
- Stabilising the standing timber structure to ensure it's not liable to mechanical failure.
- Ensuring that the earth foundations of the original set of blanket tables are stable.

The Wallaroo Mine is another site which could be used for public interpretation. The processing area would be good to interpret as an example of a larger complex and could be used to illustrate the arrangement of the processing plant under the gravity feed principle and to explain each of the steps within this process through the plant. If the Wallaroo site is to be interpreted to the public this will first require a more detailed assessment of its interpretive potential and the safety issues which flow from this (see CP7.5), as well as stabilisation, through:

- Ensuring that the concrete foundations for the processing area are stable, which may involve some cleaning up of some of the concrete rubble so that the site can be traversed safely.
- If this occurs, ensure that an established path only is cleared across the site, and design the placement and dimensions of this path in accordance with the

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Strategies and actions

CP3.1 Roaring Meggs Creek Stockyards (TCH1)

- Take appropriate precautions to prevent fire from further damaging the timbers.

CP3.2 Wallaroo Lode (TCH4)

- Monitor reservoir and floor tiers of milling unit at regular intervals to detect damage.
- If any monitoring detects damage, consult specialists for appropriate remedial action.

CP3.3 Back and Wall Creek Lode (TCH13)

- Monitor haul road and floor tiers of milling unit at regular intervals to detect damage.
- If any monitoring detects damage, consult specialists for appropriate remedial action.

CP3.4 Back Creek alluvials (TCH14)

- Ensure the broken section of dam wall is not lost through repeated flooding.
- Ensure the standing section of wall is not further damaged by flooding.

CP3.5 Flagstone and Cartwheel Lodes (TCH25)

- Take appropriate precautions to prevent fire from damaging the timbers of the tramlines.
- Monitor tramlines, stone retaining walls, dam wall and floor tiers of milling unit at regular intervals to detect damage.
- If any monitoring detects damage, consult specialists for appropriate remedial action.

CP3.6 Bismuth Dam (TCH32)

- Take appropriate precautions to prevent fire from damaging the timbers of the office and lunch shed.
- If possible, prevent regular vehicular access across the dam wall.

CP3.7 Bismuth Mine (TCH33)

- Take appropriate precautions to prevent fire from damaging the timbers of the two standing structures and the windlass.

CP3.8 Elliott's wolfram (TCH34)

- Take appropriate precautions to prevent fire from damaging the timbers of the poppet head and shaft.

CP3.9 McDonald's (TCH38)

- Take appropriate precautions to prevent fire from damaging the timbers of the poppet head and the standing timber structure.

General historic heritage management principles

CP4 Ensure that site management is low key, cost effective and appropriate to conservation requirements, levels of interpretation, visitor needs and safety

Specific principles for the management of historic heritage, whether these are maintained or reconstructed, must be followed to ensure that there is minimal incremental loss of significance or context for historic places. These can be seen as 'rules of thumb' in determining which of several competing choices is most suitable in making management decisions on a particular place.

Having recognised that the sites within the Torrington SRA are at least of regional [?] significance, the Service is obliged to continue managing the sites in an appropriate manner as defined by legislation, NPWS Field Management policies, the Burra Charter and other relevant guidance.

Strategies and actions

CP4.1 Ensure that representative fabric from all periods of occupation and use (including the spatial arrangement of elements, moveable and in situ artefacts, and structures) is retained and preserved.

CP4.2 Retain as essential the 'patina of age' belonging to many of the sites and represent this character to visitors. Patina refers to the aged or weathered appearance of fabric within sites, and thus of sites in general. Often this is a combination of exposure to the elements over time and successive occupation or use phases at the site. The naturally weathered timber at the Butler mine,

the successively patched newspaper linings on the internal walls of the Turner house, or the rusty 22 gallon drum used as a makeshift chimney pot on top of one of the stone chimneys at the Bismuth Dam site, are all equally significant examples of patina. As such:

- Buildings or complexes of buildings should not be 'fixed up' or 'tidied' in any way, unless this is mandated as part of a general site safety measure.
- Old/original construction materials should not be removed from sites or structures.
- Old/original construction materials should not be replaced with newer versions.

CP4.3 In retaining the patina of age, emphasise the continually changing nature of the mining industry and the succession of cycles which have occurred within the SRA over time, through retaining a mix of:

- original (preserved) elements
- stabilised elements
- elements from later phases and
- recent non-significant elements.

CP4.4 Retain as essential the sense of isolation of many of the sites:

- Do not allow future development to take place close to sites or within the visual catchment of sites.
- Do not allow major clearing to take place close to sites or within the visual catchment of sites.
- Retain existing fire trails and access routes to and from sites and discourage the expansion of existing routes and/or the establishment of new access routes to sites.

CP4.5 Control works and activities in the setting of the place. Allow intervention in the fabric only for specified reasons, including maintenance, fire prevention,

research and interpretation.

- CP4.6** Conserve all moveable artefacts and do not remove them from their original location, unless they are specifically threatened by fire or theft.
- CP4.7** Where removal of artefacts is deemed necessary, and before any work on structures ensues, ensure that they are recorded to a suitable standard and that there is full documentation of work processes and recording. This will generally require prior consultation with NPWS Historical Archaeologist and other specialists.
- CP4.8** Following an expanded survey around the Bismuth town site, Mine site and Dam site, formulate a more detailed and specific conservation policy for this area.
- CP4.9** Guide all activities at the place by the provisions of the Australia ICOMOS Burra Charter and this conservation plan.

Interpretation

CP5 Interpret the sites in accordance with their significance and within their wider spatial and historical contexts to provide an overview of the historic significance of the area, the diversity of the surviving historical evidence and the range of individual sites which contribute to this overall picture.

An overall strategy is needed to explain and identify historic heritage in Torrington, and to place individual locations into their historical and spatial contexts.

Interpretation can provide various levels of complementary information, from specific details on the history and archaeology of individual sites or elements of sites, to how these sites fit into wider historical or geographical trends. Specific interpretation

requirements are needed for some locations.

Strategies and actions

- CP5.1 In general, continue to provide access to sites within the SRA for education and tourism.
- CP5.2 Encourage recreational uses of the place related to the significance of the place, especially small scale, low key access via horse riding and walking to all sites.
- CP5.3 Discourage uses of the place which compromise the significance of the place, particularly continued mining activity, or large scale public access to sites with extant machinery.
- CP5.4 If Bismuth Dam is to be interpreted, formalise car parking facilities on the eastern side of the dam well away from the picnic area and encourage people to walk across the dam wall to the site rather than drive. If possible, regular vehicular access across the dam wall should be prevented.
- CP5.5 In all interpretive materials, discourage people from creating new tracks to sites and encourage them to use already established access routes.
- CP5.6 In all interpretive materials, discourage people from interfering in the fabric of sites, removing relics or altering the spatial arrangements of relics in any way.
- CP5.7 In all interpretive materials, discourage people from constructing camp fires from bricks or stones removed from sites.
- CP5.8 Interpret the significance of the landscape as a whole, as well as of individual

sites within the landscape, to the public and to specialists, using interpretive devices, both on and off park.

CP5.9 In interpreting both the suite of sites and individual sites, emphasise the continually changing nature of the mining industry and the succession of cycles which have occurred within the SRA over time, through interpreting a mix of:

- original (preserved) elements
- stabilised elements
- elements from later phases and
- recent non-significant elements.

CP5.10 Emphasise the early development of mining within the SRA, relative to Vegetable Creek, and the wider Vegetable Creek tin field.

CP5.11 Emphasise the significance of Battery Mountain as the first excavated tin lode in the state, associated with the first tin crushing battery in the colony.

CP5.12 Emphasise the interconnections between the tin industry and the wolfram and bismuth mining industries, particularly in terms of technological innovation, the rise and fall of settlements, and the movement of people.

CP5.13 Prepare an interpretation plan for the site of Bismuth Dam. This site is easily accessible and has a high level of integrity at both the level of the complex and of individual elements. It is already a popular picnicking spot and displays a number of complementary concentrating techniques, and in the spatial arrangement of its features, it demonstrates some of the most common methods for treating tin and wolfram (buddles and blanket tables). It also has the ability to demonstrate:

- The uses for wolfram and tungsten and the links between the local

wolfram mining industry and world events.

- The development of water retention dams (such as the Bismuth dam) as a necessary strategy to cope with variable rainfall.
- The methods used to construct such a large scale dam at the turn of the century.
- How tin and wolfram processing technology changed over time.
- How improvements in concentration technology improved the percentage of ores which could be extracted from a deposit.
- How cycles of supply and demand, as well as improvements in technology, made it viable to rework old deposits periodically.
- How newer mining sites and ventures relate to the location of older sites and earlier worked deposits, and thus how they affect the material traces of these older sites.

CP5.14 Incorporate details of conservation work into interpretive materials to illustrate some of the issues surrounding the management of heritage items, and the emergency measures which can be taken, and to help broaden community awareness of the responsibility of the NPWS to preserve such features.

Further research and investigation

CP6 Improve our understanding of the significance and history of the sites within the SRA through further research and investigation

Having recognised that the sites within the Torrington SRA are at least of regional significance, the Service should encourage appreciation and understanding of the significance of the place by interpreting sites for their historical, social and technological value. Mechanisms are required to make sure that all incidental

information which is gained, e.g. oral histories, photographs, site recordings and assessments, is able to be kept and managed. Additional systematic investigation and research, such as detailed archaeological surveys, should be encouraged to develop a better understanding of Torrington for management and conservation purposes.

Strategies and actions

- CP6.1** Ensure that the location of all archaeological sites recorded during the present archaeological survey which are located close to the SRA boundaries, be resurveyed to determine their exact location.
- CP6.2** Encourage further research into the archaeology and history of sites within the SRA.
- CP6.3** Only allow physical investigation to take place when it is guided by specific and scrutinised research goals and when there are adequate resources to undertake and complete the study and to leave the sites in a stable condition.
- CP6.4** Broaden the initial database of 41 sites recorded during this survey to include other sites.
- CP6.5** Purchase the Department of Mineral Resources CD-ROM computer database for the Emmaville and Mole River map sheets to provide an initial reference database for use in a continuing site identification and evaluation program.
- CP6.6** From the Department of Mineral Resources CD-ROM database and from the results of the current archaeological survey, create a Torrington-specific database for known sites within the SRA. This should be located at, and managed by, the Glen Innes District office, but should be linked to the

NPWS Heritage Places Register in CHSD. As part of this:

- Institute training for field staff to record new sites.
- Customise a version of the Heritage Places Register place recording form to serve as a Torrington recording form.
- Add new sites to the SRA database as these are located or identified by field staff.
- As new sites are located or identified by field staff, also add site recordings to the NPWS s.170 Historic Places Register.

CP6.7 Institute a further program of oral history research. For best results take interviewees into the field to visit sites to identify specific archaeological features and prompt them by visual cues. Terry Clifford from Emmaville, in particular, would well repay further interviewing at length.

CP6.8 Collect information relating to machinery already removed from sites within the SRA, particularly that housed at the caravan park.

CP6.9 Locate the bullock track and, if possible, the site of the yards at Carpet Snake Creek, which are both evidence of rare alternative past land uses.

CP6.10 Research the puddler at Donoghue's more intensively, particularly its relationship to the overall process for producing wolfram here and whether there are other similar examples still in existence elsewhere.

CP6.11 Expand the survey around the Bismuth Mine site and town area. Both areas are easy to access and could be used to interpret a range of past technology and practices. Locating the site of the two-storey Manager's house associated with the Bismuth Mine would provide a highly instructive contrast to the more ephemeral miner's structures situated elsewhere in the Bismuth town site. Ultimately such contrasts could be incorporated into

interpretation materials, to illustrate the range of lifestyles enjoyed by mine employees.

CP6.12 Attempt to identify the precise location of the Battery Mountain tin lode and battery. Given that this was the first excavated lode tin deposit in the state, and possessed the first tin crushing equipment erected in the colony, it would be an extremely significant site and should any associated archaeological remains survive, these should be recorded and suitably managed.

CP6.13 Expand the survey around the Wall Creek alluvials site, as other sites were noted along the road to this site, but were not recorded due to time constraints.

CP6.14 Survey the Carpet Snake Creek area, as other sites were noted in this vicinity, but were not recorded due to time constraints.

CP6.15 Liaise with the Department of Mineral Resources, Armidale, to determine the location of other sites which would be worthwhile to record, particularly those which might lend themselves to interpretation and visitation. Harvey Henley noted the location of several sites which might be worthwhile, but which could not be included in this survey due to time constraints.

Public safety

CP7 Ensure that all sites are managed and interpreted with due regard to issues of public safety

Both active and closed mining sites are dangerous for casual visitors and require

specific management considerations to make them safe. The form of safety work must also respect the identified significance of the places.

- CP7.1** Liaise with the Department of Mineral Resources to discuss and identify safety issues and the possibility of jointly developing a safety strategy.
- CP7.2** Include warnings on all interpretive materials about the danger posed by marked and unmarked shafts, particularly in terms of throwing objects over the edge of shafts, or of examining the edge of shafts too closely.
- CP7.3** Include warnings on all interpretive materials about the danger posed by entering adits, particularly as these are likely to contain unmarked shafts linking the various levels of the mine.
- CP7.4** In preference, steer visitors towards sites without shafts (eg. Bismuth Dam).
- CP7.5** Formulate a more detailed safety policy for the Wallaroo Mine site, which contains many deep shafts and is easily accessible from the road.
- CP7.6** Specific safety works are to be carried out on:
- The standing timber structures associated with the Bismuth Mine site, to ensure that these are stable and not liable to mechanical failure.
 - The shafts at the Bismuth Mine site, which are partly obscured by the remains of old protective timbering.
 - The shafts at Cunliffe's lode, which are partly obscured by the remains of old protective timbering.
 - The poppet head and standing timber structure at McDonald's wolfram mine, to ensure that these are stable and not liable to mechanical failure.
 - The poppet head at Elliott's wolfram mine, to ensure that this is stable and not liable to mechanical failure.

Control of mining activity

CP8 Ensure that mining activity does not adversely impact upon the significance of historic heritage sites within the SRA

Mining is currently permissible within the SRA. Existing and future mining and exploration activity has the potential to severely affect the integrity and survival of significant historic heritage within the SRA. NPWS will seek to influence the Department of Mineral Resources into restricting adverse impacts in the issuing of leases or through requiring appropriate environmental planning controls. This policy requires that ways of minimising such risks are pursued.

Strategies and actions

CP8.1 NPWS to ensure that the Department of Mineral Resources is made aware of the conservation plan and the significance of historic places within the SRA.

CP8.2 Ensure that NPWS responses to all mining lease applications and other applications which require comment by the Service, draw attention to the historic heritage of the SRA, the historic heritage impacts and the requirement for environmental planning controls.

CP8.3 Encourage the Department of Mineral Resources to develop acceptable model provisions for sensitive mining activity within or near significant sites.

CP8.4 Ensure that Department of Mineral Resources guidelines on post-activity rehabilitation take account of historic heritage and significance.

CP8.5 Develop guidelines for public activity on mining sites which does not compromise the significance or integrity of historic heritage, i.e. acceptable

fossicking locations, illegality of metal detecting in the SRA, deterrence of bottle collecting.

Recognition of significance outside SRA

CP9 Recognise that sites located outside of the SRA boundaries are part of the same significant cultural landscape, and, although outside of NPWS jurisdiction, contribute to the significance of sites within the SRA.

Strategies and actions

- CP9.1** Provide copies of this report to all private landholders on whose properties sites were recorded.
- CP9.2** Ensure that neighbours are aware of the significance of sites on their land and their rights and responsibilities regarding them, through formal neighbour relations contact and fostering liaison with the NSW Heritage Office and local government.
- CP9.3** Hold a workshop to encourage and assist adjacent land holders to identify and appropriately manage and care for significant items of cultural heritage on their property.
- CP9.4** Identify and encourage private landholders whose property contains historic landscape values which are complementary to or enhance that within Torrington SRA, to develop voluntary conservation agreements with the Service.
- CP9.5** Work with Severn and other relevant Shire local government areas to identify places to be entered onto the Severn and other relevant Shire Council Local

Environmental Plan Heritage Schedules.

Further conservation planning

CP10 Ensure that the conservation plan is able to respond to new situations that may arise and remains a useful, fundamental document for management within the SRA.

Strategies and actions

CP10.1 Review this conservation plan no later than 5 years from date of adoption, including any interim policies

CP10.2 If situations arise that are beyond the ambit of the conservation plan and general principles are inadequate to guide a decision, a panel comprising representatives from district, Region and CHSD will meet to develop a specific policy. This will become an interim policy within the conservation plan once it is endorsed by all three parties.

6.3. Implementation schedule

The following is a proposed schedule for the implementation of the conservation policies outlined in the previous section. For ease of reference, these have been organised by site.

Site name	Works/Actions	Priority
Roaring Meggs Creek stockyards	Stabilisation: Stabilise the standing timber posts and rails.	High
	Maintenance: Take appropriate precautions to prevent fire from further damaging the timbers.	High
Bismuth Dam	Stabilisation: Stabilise the standing timber structure of the lunch shed and office to ensure it's not liable to mechanical failure.	<i>Medium</i>
	Ensure the earth foundations of the original set of blanket tables are stable.	<i>Medium</i>
	Stabilise the stone chimneys and walls of the tin drying area to ensure they are not liable to mechanical failure.	<i>Medium</i>
	Maintenance: Take appropriate precautions to prevent fire from damaging the timbers of the office and lunch shed.	<i>Medium</i>
	Formulate a more detailed and specific conservation policy for the area, including the Bismuth mine and Bismuth town.	High
	Interpretation: Prepare an interpretation plan for the site.	<i>Medium</i>
	Clear leaf litter and accumulated soil off the two concrete sets of blanket tables.	Low
	Include warnings about protruding bolts as part of interpretive literature.	Low
	Prevent regular vehicular access across the dam wall.	Low
	Formalise car parking facilities on the eastern side of the dam well away from the picnic area and encourage people to walk across the dam wall to the site rather than drive.	Low
Bismuth Mine	Recording: Expand survey around the site.	Low
	Stabilisation: Stabilise the standing timber structure near open cut mine.	<i>Medium</i>
	Maintenance: Take appropriate precautions to prevent fire from damaging the timbers of the two standing structures and the windlass.	<i>Medium</i>
	Formulate a more detailed and specific conservation policy for the area, including the Bismuth town and Bismuth Mine.	High
	Recording: Expand survey around site.	Low
	Locate the site of the two-storey Manager's house.	Low

Bismuth Town	Maintenance: Formulate a more detailed and specific conservation policy for the area, including the Bismuth Mine and Bismuth Dam. Recording: Expand the survey around the site.	High Low
Wallaroo Mine	Stabilisation: Ensure that the concrete foundations for the processing area are stable. Maintenance: Monitor reservoir and floor tiers of milling unit at regular intervals to detect damage. If any monitoring detects damage, consult specialists for appropriate remedial action. Safety: Formulate a more detailed safety policy for the site. Interpretation: Prepare an interpretation plan for the site.	Medium Medium Medium Low
Flagstone and Cartwheel lodes	Maintenance: Take appropriate precautions to prevent fire from damaging the timbers of the tramlines. Monitor tramlines, stone retaining walls, dam wall and floor tiers of milling unit at regular intervals to detect damage. If any monitoring detects damage, consult specialists for appropriate remedial action.	Medium
Back/Wall Creek lode	Maintenance: Monitor haul road and floor tiers of milling unit at regular intervals to detect damage. If any monitoring detects damage, consult specialists for appropriate remedial action.	Medium
Back Creek alluvials	Stabilisation: Ensure the broken section of dam wall is not lost through repeated flooding. Ensure the standing section of wall is not further damaged by flooding.	Medium
Bullock Track	Recording: Locate and record the bullock track.	High
Battery Mountain	Recording: Attempt to identify the precise location of the Battery Mountain tin lode and battery. Record and assess the location of the Battery Mountain tin lode in further detail. Interpretation: Emphasise the significance of Battery Mountain as the first excavated tin lode in the state, associated with the first tin crushing battery in the colony.	High Medium Medium

Carpet Snake Creek alluvials	Recording: Record the site of the yards at Carpet Snake Creek. Expand the survey around the site.	<i>Medium</i> Low
Elliott's wolfram	Stabilisation: Stabilise the standing timber poppet head. Maintenance: Take appropriate precautions to prevent fire from damaging the timbers of the poppet head and shaft.	Low Low
McDonalds wolfram	Stabilisation: Stabilise the standing timber structure. Maintenance: Take appropriate precautions to prevent fire from damaging the timbers of the poppet head and the standing timber structure.	Low Low
Wall Creek alluvials	Recording: Expand the survey around the site.	Low
Donoghue's	Recording: Research the puddler more intensively, particularly its relationship to the overall process for producing wolfram and whether there are other similar examples still in existence elsewhere.	Low

7. GLOSSARY

Other terms are referred to in the text

- Adit** A horizontal passage from the surface, on or along the vein, into a mine.
- Alluvial terraces** Terraces formed by the accumulation of alluvial deposits.
- Artefact** (In historical archaeology) any deposit, object or material evidence relating to the settlement of Australia which is at least fifty years old.
- Banjo** Named for the distinctive shape of the shovel used to throw the dirt, which is reminiscent of a banjo. A banjo is a sloping trough or an excavated trench in a creek bank, into the rear of which the wash dirt and water is continually shovelled by an operator standing in front of the banjo. The continual action of the water running down the slope of the trough causes the heavier ore particles to precipitate out.
- Cradle** A trough or box mounted on rockers to wash ore-bearing material.
- Dredge** Apparatus for extracting sand and mud containing ore from the bottom of waterways.
- Gangue:** The worthless or undesired portion of the material contained in an ore body (Mining Handbook of Australia 1936, 25).
- Launders:** Narrow inclined troughs used for transporting units of pulverised solids and water by gravity flow. The slope must allow sufficient

water velocity to overcome frictional resistance and the inertia of the solid material (Taggart 1927, 1088).

Lode	Vein of metal ore.
Mullock	Waste rock which does not contain ore.
Pan	A shallow dish used to wash dirt to see if it contains ore.
Puddler	Machine for agitating wash dirt so as to separate ore from gangue or to remove heavy clay content. A puddler was a circular depression, often lined on the sides and base with timber or iron, with a raised central mound containing a perpendicular shaft moved by steam or horse power. Harrows were attached to the shaft and dragged around the circular depression to agitate the wash dirt.
Race	A channel cut into the ground to convey water to the diggings.
Reef:	Chiefly Australian term, originally applied to an outcrop standing above the surface. It is also used to describe the rock walls confining an old buried channel or 'deep lead'.
Riffles:	Transverse bars in a sluice box to trap the heavy minerals (Mining Handbook of Australia 1936, 27).
Shaft	A vertical opening into a mine.
Skipway	Railed transport system for hauling skips.

Sluicing A method of washing ore-bearing earth by means of rinsing or scouring with a flow of water.

Tributors: Miners who work a section of an ore body belonging to a company on their own account and pay a royalty of a percentage of the value they recover (Mining Handbook of Australia 1936, 29).

Vein Fissure in rock.

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MR0779: Butler's Mine
MR1362: Black Swamp Mine
MR1431: Rockvale Wolfram Mine, Carter's lode
MR1467, MR3371: Wallaroo Mine, Torrington tin mines
MR1504, MR2221: Garth's battery, Breakfast Creek
MR1524: Donaghue's lode
MR1853: Block 14, Torrington Ore Company
MR2036: Bismuth Mine
MR2506: Yankee/Kathida lodes, the Gulf
MR2592: Blatherarm Creek
MR2863: F. Higgins, the Gulf
MR2864: Bollinger's lode
MR3178: Curnow's tin mine
MR3428: Westley's lode, Carpet Snake Creek
MR3431: Planet tin lode
MR3435: Battery Mountain lodes, Lee's Gully, Chapman's lode
MR3441: Elliott's lode
MR4136: Plant on site of old village of Bismuth

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9. APPENDICES

APPENDIX 1: *Interview with Ginger Burton, Torrington, 29/4/98.*

The following is an abbreviated series of notes, rather than an actual interview

Ginger's mother was born at Cow Flat and she told Ginger lots of stories. Ginger herself has lived at Binghi, Tungsten (moved there when she was 7 years old), Stannum (for a while), Bismuth and the Gulf. As children, Ginger and her brothers all worked tossing tin.

Ginger and her brothers, Don and Lance, worked on quite a few mining sites. They worked the old Bismuth Mine first then the tin up the hill towards the track. They also worked out at the Duck Creek mine in the late 1970s and early 1980s. They first worked for themselves and later for the Avocado Mining Company. The site is located just off the Duck Creek firetrail (a road goes off the firetrail just before the creek and the road ends at the mine). The ore (bismuth) was used in medicines and makeup. About ten years ago the Duck Creek Mine was rehabilitated.

Ginger used to drive the winch and the backhoe, because she was careful and wouldn't muck about. At the Gulf Ginger used a jackhammer.

Won't find any tram wheels still attached to ore carts because these wheels are the same gauge as used now so you can re-use them in lots of different ways. Very sought after.

The Chinese miners around Torrington did not mine very deep and Ginger has only known them to do alluvial mining. There was one Chinese miner who used dynamite. His name (nick name) was 'No Bark', because one day he set a charge of dynamite which didn't go off. He said 'no bark', and had gone back in to the mine to check it when it went off. He wasn't killed.

There is a big tunnel you can walk into at Feathertop. It's on the Torrington side of the ramp between Emmaville and Torrington. After the Wallaroo mine there's a road to the right and at the end of that road is the tunnel.

The dam at Tungsten was built by G. F. Holmes and Darky Walden, Ginger's great grandfather and company. It's over 100 years old.

At Torrington there was a three classroom school house. Don and Ginger used to ride in from Tungsten to school on horse back. Miss Carter, the school teacher, lived in the yellow shed next to the church. The mining company took over her house and used it as a garage for vehicles. They dug a ditch in the floor to work below the vehicle.

There was an Aboriginal rockshelter which Ginger saw once. She saw it when she got lost during a prospecting trip for a mining company, although she didn't often get lost. It's located somewhere down on Duck Creek. The rock art must have been done by people standing on rocks, because the pictures are about 20 feet up. They were a goanna and some lines.

APPENDIX 2: *Interview with Terry Clifford, The Gulf, 28/4/98 [During the interview we visited the sites of Kathida, the Yankee lodes, Company's Hill, Clifford's Mine and Raines Gully. The following is an abbreviated series of notes, rather than an actual interview]*

Terry's great grandfather came out to the Gulf and the Cliffords have lived there ever since.

The Chinese miners worked around the clock, sleeping two people to a bunk.

The boiler on site at Kathida was constructed during the depression years (the 1930s), Terry's father Rex did the brickwork. Originally it was encased entirely in brick, although this has since been pulled down leaving only the chimney. Boiler connected to a large air compressor and to a pump. There used to be brass taps on one end of the boiler, but these have long since been removed by collectors. Brass fittings like this are extremely popular as collector's items and don't last long. One man came and asked Terry's father, Rex, for one of the maker's plates off the air compressor for his collection, because these are also extremely sought after. There was a round tank further up hill to hold the water for the boiler. Most of the mining was done with hand steel until the boiler was built.

Jim Garth (Senior) and his son, also called Jim, had the battery on Breakfast Creek. Originally mined pre World War I by the Garths, until the Wilcoxes returned to the area and used it during the late 1940s and early 1950s. The Wilcoxes had originally mined at the Gulf before WWI. There was also a flying fox at Specimen Hill to transport ore etc, before the track was put in.

Wilcoxes Garden shaft is one of the earliest shafts at the Gulf (pre-World War I), this is probably the shaft from which TWE David took specimens to give to the Smithsonian Museum in Washington D.C. It may have been named Wilcoxes Garden

because this was the site of an old orchard (there's still an old fruit tree nearby). Doctor's shaft, Garth's shaft and the Yankee shaft are all pre-World War I as well. Doctor's shaft was named after a Doctor who had been kicked out of the medical profession and so turned to mining to make a living.

There were two main mining blocks at the Gulf - the bottom block was mined by the Wilcoxes, the upper block by Higgins.

There were so many people at the Gulf prior to World War I, mostly men who had been employed building the northern railroad, but once this had finished were out of work and so turned to mining.

Company's Hill: old workings here are c1900. One shaft, called the Chinamen's lode, was probably worked by the Chinese, and worked by hand because there were no boilers. This shaft has a wall left inside the shaft at one end, the Chinese would often leave a wall inside the shaft like this.

The first company to work Company's Hill went bust, their shafts and adits were on top of the hill, later the adits were completed by another company, and extended again in the 1970s.

Cliffords mine was an extension of the Yankee lodes. It was first worked c1901/1902. There were old workings (a shaft) there already when the Cliffords began working on it.

Old alluvial pans were made differently to the pans they make today-the original ones had a shallow groove around one half of the pan about half way down. This allowed you to winnow the sand from the side without the groove. These pans were also used to carry tin to the drying tables as well.

Most mines at the Gulf were worked by hand, so no machinery was associated with them. The Gulf originally had a communal water supply, the well is still there. This was built by Europeans, although the Chinese looked after it. It is located beside an old Chinese market garden and near Chinese alluvial mines. The well is round, made of stone and once had a flat stone covering the top. It is more than 100 years old. Near the well, there is also the remains of a round stone oven which was built and used by the Chinese who lived here for smoking fish etc. Jacky Ah Hin (or Ah Hen) and Andrew Ah Kim lived here and ran the market garden (and looked after the well) up until World War II.

There is a shaft nearby (further up the gully—called either Reins Gully or Jacky's Gully) which was also worked by the Chinese. It has the possible remains of 'powderwork' visible on some of the walls. This indicates that it dates to around 1900. Before dynamite came into use, the older shafts were sunk using gunpowder which required a larger drill hole (around 5cm in diameter?). Once dynamite came in, because it was more explosive it used smaller drill holes (around 1-2cm in diameter).

There are only three known Chinese graves at the Gulf: Ah Hip and Ah Young are buried further up the same gully as the well and the shaft.

Also in Reins Gully is a dam wall built by the Chinese. It crosses the entire neck of the gully. They would let the water build up behind it and then release it to wash the dirt.

Rumsby is also buried at the Gulf. He was a miner who worked here prior to World War I, mining wolfram when there was a good price for it on world markets. He had a girlfriend who was a bar maid in Emmaville who would bank all of his money for him. When the wolfram finally ran out, so did his girlfriend and took all of his money with her. Rumsby walked back out to the Gulf when he found out that she had skipped town and shot himself. Terry's dad, Rex, was ten at the time, and his uncles sent him

into town to get the police (he rode his horse). While they were waiting for him to come back, his uncles decided they would watch over Rumsby's body until the police arrived. Two of the brothers decided to play a trick on the other two when they changed shift for the night. They rigged up some fishing line to Rumsby's shoulders and ran it outside the hut, when the other two brothers arrived they pulled on the fishing line and the body sat up in bed and all the gas escaping from the body made it groan. In the dim lamp light this scared the other brothers witless, who tore out of the hut and ran a mile.

APPENDIX 3: *Interview with Geoff Finnigan, Torrington, 14/5/98. [During the interview we visited a number of sites where Geoff had worked. The following is an abbreviated series of notes, rather than an actual interview]*

Geoff was born in 1918 and has lived in Torrington on and off all his life.

Cleghorn's cut: Cleghorn's cut at end of tramway at Tungsten (opposite to Carter's cut). The tramway had a small steam engine used to draw the ore carts from Cleghorn's and Carter's to Cleghorn's mill near Lock's dam. Geoff calls it Cleghorn's because Cleghorn was the managing director of the company which operated the mine and mill around 1921 or 1922.

Although the mine and mill were largely in operation before Geoff's time, he remembers seeing a horse drawing the train as a child - this may have been part of the cleaning up operations for the site as he cannot remember it ever being in regular use. Cleghorn's cut has two leads, a large mullock mound and the mound for the tramway leading to the mill. There was an underlay (incline) shaft at Cleghorn's also.

The mill has a timber stamper bed with a timber frame above it to lift the chain blocks. There is an engine bed nearby and a buddle base. Tables would have been placed in between the buddle and the stampers. It was the mill for Carter's and Lock's cuts and Cleghorn's cut. It is located beside Lock's dam.

On the other side of Black Swamp Creek was another mill and mine site [Torrington Wolfram Proprietary Ltd] which had a retort used to make gas. This was filled with charcoal and was still there twenty years ago. It was located behind Geoff's aunt's house at Tungsten.

Bismuth Dam site: The office and lunch shed were on the edge of the dam near to the processing site. The road beside the dam (on the same side as the processing site)

went originally from the top of the dam to the sand dump from Fielder's Hill. When Geoff worked at this site (between 1946/1947 to 1949) they re-processed the waste sand from Fielder's Hill. Due to the processing technology of the time (when there were no blanket strips, just tables) at Fielder's Hill they only ever extracted around two-thirds of the tin, so it was profitable in the 1940s to re-process it. It was still never possible to get all of the tin however, because it was so fine.

Water was fed down the Y-shaped drain at the top of the site into both sets of blanket tables. When Geoff worked here the blanket tables were built on top of a timber floor supported on timber stumps. The other sets of blanket strips (on the cement floors) were put in after Geoff's time here. When processing the sand, the clean water would be run gently across the blanket tables. The tables had sacking (bags) on the bottom which caught the metal and there were separators at the apex of the tables to direct the flow of water into various individual strips. There would be four or five holes at the apex of each strip which could be pegged with wooden pegs to stop the flow of water so that the strip could be cleaned and the metal removed. The waste sand would be washed away into the creek, but settling ponds below would catch the water so that it could be re-used. The wolfram concentrate from the blanket tables was put into the large steel vat on site. There was also a large kieve at this site. The wolfram would be fed into it and it was so heavy that a couple of boys could just manage to turn the paddles. They then tapped it with two crow bars dug into the ground. When the wolfram had settled (maybe twenty minutes?), the sand was cut off the top with a scraper. They kept taking the sand off until they got to pure wolfram.

The bank of the Bismuth Dam was built using horse and dray with dirt from Fielder's Hill.

Fielder's Hill: The original Fielder's Hill cut is now full of water and the original underlay shaft is below the water level. There used to be a continuous draw of trucks

up the underlay shaft to the ore bin beside the open cut. Once they pumped water out of the bottom of the open cut when the Bismuth dam ran dry.

A party of miners once put blanket tables below the Fielder's Hill sand dump and pumped water from the open cut to treat the sand on site. Because they started working from the bottom end of the sand dump however, the levels of wolfram were too poor and there wasn't enough to pay. Wolfram would have been richer in the top end of the dump but they didn't know this.

Curnows: The mine was never 1000ft deep as some have claimed, but 800ft instead. They sank the mine to the number 8 level and started on the number 9, but never finished it off.

There was a tramline across to the mill from the end of the mullock dump. The ore from the shaft was sorted here, the rubbish left behind (thrown over the side of the mullock heap) and anything good sent across to the mill. Geoff started work here in 1932 when he was 14. He started on the blanket tables because it was a relatively easy job which paid 7s and 6d a week.

There were two separate drums for the winch and the rope was wound in opposite directions—one up and one down. The winch was driven by a boiler. When they didn't have sufficient power to pump the water from the shaft they would have to bail it with a cage—this was a bucket with a moveable base. This was the only time that Geoff was allowed to drive the winch. There was also a blacksmith's shop beside the shaft and the winch.

The original shaft for the mine is on top of the hill and connects to the adit, which goes for 100m right through to the other side of the hill. The boilers near the processing area drove the mill and the big air compressor. One was a tubular boiler and one was a marine boiler (in the first the fire surrounds the water in the pipes, in

the other the water surrounds the fire in the pipes). The mill had a stamper at the very top; three big Wilfley tables on the next level and two more plus a vanner on the level below them. Below that was the buddle. The small concrete tanks below the level of the tables are called hutches. The tin was steered into them from the tables and when full they knew that they had three ton of tin. It was shovelled out then and taken to the drying shed and dried on the pans. Not many people were required to work the mill: 1 fellow was in charge of the stamps (his job was to know by the sound of the stampers whether anything had gone wrong with the ore feed and when they needed to be adjusted in any way); 1 fellow looked after the tables; there was 1 at the boilers and 1 at the blanket tables.

In 1936 the dam at Curnows ran dry and work stopped. Geoff and a friend went up to Queensland looking for a job and on their way back to Torrington it rained, so they came back and started work again at Curnows.

Most workers lived in town and walked to work at Curnows and the Dutchman each morning. Paddy Spicer lived in a house on the left (facing Curnows) of the road leading to Curnows and Charlie Cassells lived roughly opposite. There were a few other houses along Bates road from the Dutchman corner to Curnows but not many.

Dutchman: The mill was at the bottom of the site (the first road off leads to it), with a boiler to run it. The original Dutchmans workings are on the left of the access road. The square earth-cut foundation near the magazine was for the reservoir, into which they pumped water up over the hill from the dam at Curnows. It had a clay base to stop the water leaking out, although it still did. The larger magazine was built in the 1940s, the smaller one is older than this.

Geoff worked at the Dutchman when he enlisted (from 1936-1939 at least). He came back after the war. When the Butler started up he went there, but didn't like the underground work. The mill from Wallaroo was shifted to the Butler in 1946 or 47.

The Number 9 workings are in the same vicinity as the Dutchman—the number 9 shaft was linked to the Dutchman mill by a tramline.

The pay office was opposite the Dutchman shaft and boiler.