

Shepherd & Murphy Mine, Moina, Tasmania Heritage Assessment



October 2011

Gary Vines

Shepherd & Murphy Mine, Moina, Tasmania Heritage Assessment

**Report for TNT Mines (Moina)
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ABBREVIATIONS

AHC	Australian Heritage Commission
AMG	Australian Map Grid
ATSIC	Aboriginal and Torres Strait Islander Commission
BP	Before Present
ICOMOS	International Council on Monuments and Sites
REP	Regional Environmental Plan
RNE	Register of the National Estate

Plate 1: Cover: 1950s concentrating mill at Shepherd & Murphy Mine

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1.0 INTRODUCTION

This assessment has been commissioned by TNT Mines (Moina) Pty Ltd (“TNT Moina”) to determine the heritage values of sites for proposed exploratory drilling at the site of the former Shepherd and Murphy Mine, Moina, northern Tasmania. The report outlines a brief history of the site, describes the result of archaeological survey, assesses the potential heritage significance of archaeological features and makes recommendations for their management.

A detailed Aboriginal archaeological assessment has not been undertaken, but consideration of factors effecting archaeological potential has been made on the basis of the site survey and a background review.

Gary Vines carried out the site inspection, report writing and project management. Paul Young prepared mapping figures.

1.1 Study Area

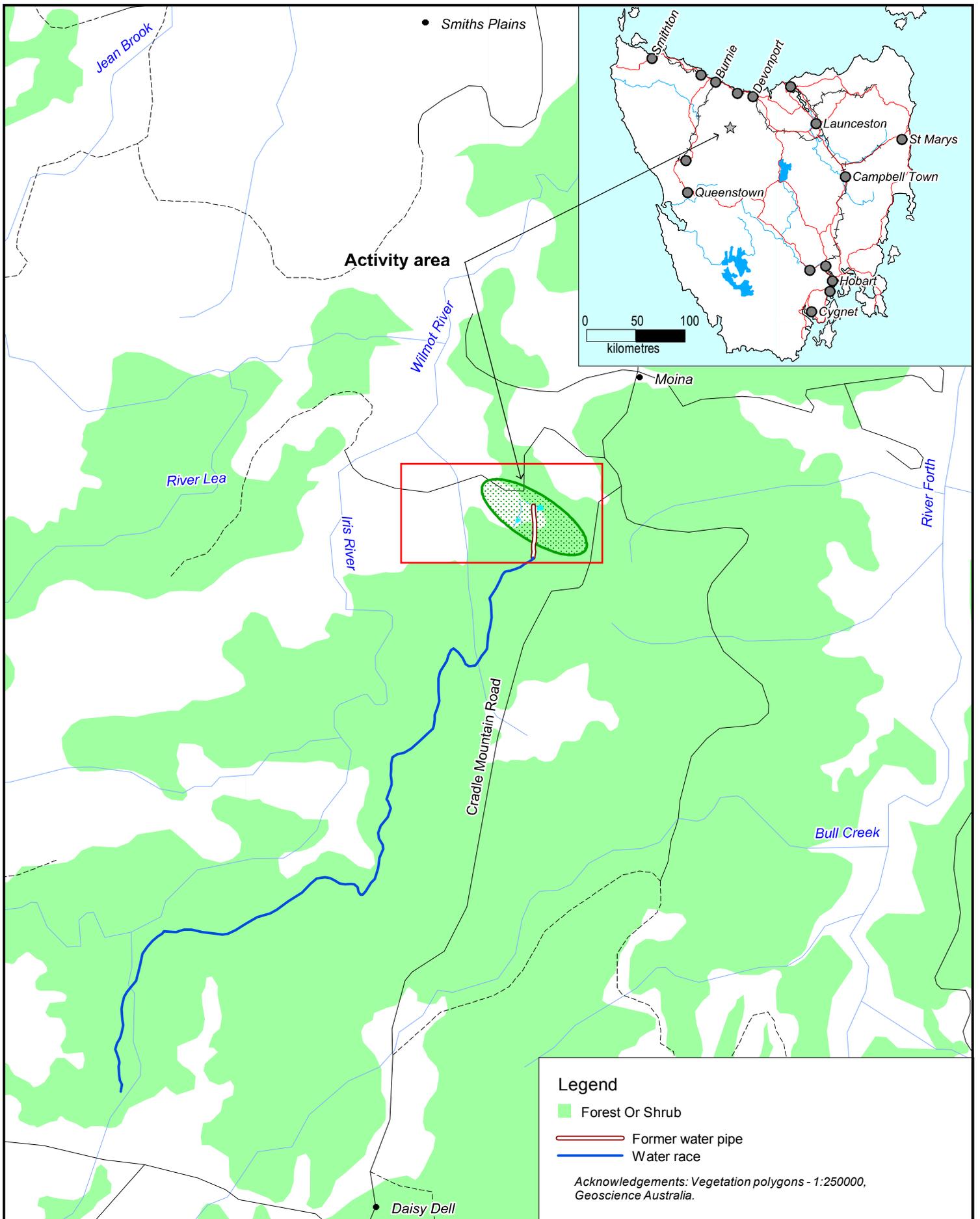
Moina is located on the Cradle Mountain Road in Northern Tasmania. Moina has a minimal population and few scattered buildings and is located in the Kentish council district with the nearest town Sheffield, being 24km away with a population of around 980. It is located at about 612m above sea level and so is one of the higher mines in Tasmania.

The current area being assessed is the site of the former Shepherd and Murphy mine, located between the Moina Road and Cradle Mountain road on the west side of Bismuth Creek. The mine is located just off the Iris River into which Bismuth Creek runs, and where the junction of these waterways and the Lea River has been dammed to form Lake Gairdner. Downstream of the dam the waterway becomes the Wilmot River. The Shepherd and Murphy Mine was a bismuth, tin and tungsten mine later known as the S & M mine and sometimes Moina Mine.

The site has previously been recorded for the *Tasmanian Historic Places Index* by L. Scripps in January 1990, with the Site No 8115.023 allocated to the ‘Shepherd & Murphy Mine’ with grid ref – Map 8115- 4235, 4068.¹

The location of the study area is shown in Figure 1.

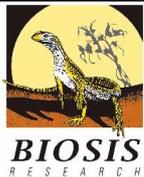
¹ Tasmania Historic Site Inventory. – note the record also lists oral informant Trevor Mahoney of Devonport.



Legend

- Forest Or Shrub
- Former water pipe
- Water race

Acknowledgements: Vegetation polygons - 1:250000, Geoscience Australia.



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Figure 1: Location of the activity area, Shepherd & Murphy Mine, Moina.

DATE: 29 July 2011

Checked by: GV File number: 13255

Location: ...P:\13200s\13255\Mapping\13255 Fig 1.wor

Scale:



2.0 BACKGROUND HISTORY

2.1 Exploration

Exploration of the Mt Roland area may be traced back to about 1823 when it was reported that Captain John Rolland of the 3rd (Bufs) Regiment, was stopped in his course by what was known as ‘Rolland’s Repulse’. A Van Diemen’s Land Company party that included Henry Hellyer and Joseph Fossey were the first to climb Mt Roland in 1826. They named the neighbouring peaks of the Roland massif Claude and Vandyke. Fossey marked the track for the Van Diemen’s Land Company through from Deloraine in about 1827, naming the Vale of Belvoir and Lake Lea (South of Black Bluff) and Hellyer. Kentish was named after the Governor of Van Diemen’s Land, Nathaniel Lipscombe Kentish.²

The Van Diemen’s Land Company established a route over the Middlesex Plain, for depasturing their cattle when they were being driven to and from Westbury and Circular Head. The area used by them, and later acquired by the Fields, consisted of about 1000 acres. There were no fences till the middle of the 1800’s. The Weaning Paddock and Round Paddock are evidence of this use.³

2.2 Gold mining

James ‘Philosopher’ Smith, discoverer of Mount Bischoff tin mine, was the first man to traverse the Forth & Wilmot Rivers and along with J. Jones and J. Johnson, prospected along the Forth River discovering alluvial gold at Golden Point in 1859. Reef gold was discovered in Campbells Reward opened by Malcolm and Alex Campbell in 1882 and was the first hard rock gold mine in the Cethana-Moina district. It is located on the eastern side of the Forth River and about a kilometre upstream from Golden Point. At the Mount Bell gold mine, near Moina, 100 men were soon at work. Gold was first discovered in the Moina area by T. Bessell and C. L. Stewart in 1893.⁴

There have been approximately thirty mines and prospects in the Moina and Mount Round districts, but only three mines have achieved significant production. These are the Shepherd and Murphy tin-tungsten-bismuth mine at Moina, the Round Hill silver-lead mine at Round Mount, and the Bell Mount alluvial goldfield. A high failure rate in an area which initially was considered particularly rich in metallic minerals was summarised by Reid:

“Those responsible for the early development of many of the mines have failed to appreciate the peculiar structure of the geological formations encountered here, consequently many mining companies have little to show for the heavy expenditure incurred. In some instances companies were formed for the purpose of carrying out operations on sections which were pegged in alignment with ore-bodies existing on neighbouring properties, on the supposition that the ore bodies would be continuous and pass into them. At the time of the gold-mining boom in this locality, metallurgical plants for the treatment of the ores were erected before they were warranted by developed ore reserves. Plants were erected even on the supposition

² *Examiner*, 6th March 1844 - Kentish and VDL Co.

³ A General History of the area according to Dr. G. F. Bergman? (Weekly Courier 1904?)

⁴ Pluton Resources, *Mining History* <http://www.plutonresources.com/projects/tasmania/mining-history>

that the gold content and the size of the veins would increase with depth; in other cases this procedure was followed for purely speculative purposes. This policy, naturally, has had a ruinous effect on the mining industry, the direct result being the abandonment of the fields before extensive developmental work had been carried out."⁵

However, it was estimated that 1000 Oz. of gold were recovered from the field, both by underground mining and surface sluicing methods. Higgs and Devonport mines were the only mines where gold was exclusively produced. The major alluvial workings were on the Bell Mount goldfields, 1.5 km north of Moina. A. H. Higgs commenced mining in 1934 and production was continued intermittently until 1947. Since then the mine has been idle. The area has been known as 'Higgs' Mine" and "The Sunrise Mine" ⁶

In February 1913, Governor Sir Harry Barron turned the first sod of the Roland Railway, of which great things were expected and for which much hard work had been done by the Wilmot Railway League. On the occasion of the opening ceremony, November 1914, John Hope MHA, in addressing the crowd said, "*I look upon the line to Roland as only the first section of what must eventually go right back to Middlesex and Wilmot.*"⁷

This line eventually reached Skipton... east of the Forth river, but it did not achieve the expected role of opening up the inland mining areas.

2.3 Moina settlement

The township of Moina was established as a direct consequence of the mining development – serving not only the Shepherd and Murphy, but also the Bell Mount Goldfield on Mosquito Creek, the nearby Lady Barron and All Nations mines, Higgs at Narrawa Creek and the more distant Stormont, Devonport, and Campbell's Reward mines.

By about 1909, a school and post office were established and in the 1910s and 20s substantial work was carried out in road improvements by the Public Works Department.⁸ The post office appears to have been the centre of the community and reflected the fortunes of the mining endeavours, with the longest operator being George Andrew Godwin 1/10/1937 - 1/2/1957.⁹

Initially straddling the Moina Road between Bismuth Creek and the Iris River, with the flats to the north cleared for farms, the only remaining structures from the town are the former Moina post office and residence and some later farm buildings. ¹⁰ By the 1950s only one

⁵ Reid, A McIntosh, The mining fields of Moina, Mt Claude and Lorinna, Tasmania Geological Survey Bulletin, no. 29, Department of Mines, Hobart, 1919, p. 66

⁶ Blake, F. Higgs' Gold Mine-.Narrawa Creek. Tas., Geol. Survey; Typewritten Reports, 1987 (unpublished). Keid. H. G. W. The Sunrise Mine, Narrawa Creek, Moina. Tas. Geol Survey: Typewritten Reports, 1947 (unpublished).

⁷ General History of Wilmot According to Dr. G. F. Bergman, Wilmot Online - http://www.tco.asn.au/oac/community_history.cgi?oacID=14&articleID=176488

⁸ [Tasmanian Archives Online database](#) see for example [PWD18/1/8500](#) 64 Vic 63 Item 9120 - Moina Road (Bismuth to Middlesex)

⁹ Wilmot online, Community History, http://www.tco.asn.au/oac/community_history.cgi?oacID=14&articleID=185366

¹⁰ Jennings IB 1979, *Geological Atlas 1 Mile Series Sheet 37 Sheffield. Explan.Rep.Dep.Mines Tasm.*, 64-69.

residence including the post office and store remained on the old Moina Town Reserve. The settlement for the reopened mine in the 1950s was clustered in the vicinity of the mine.¹¹



Plate 2: Former Moina Post office.

2.4 Shepherd and Murphy

The Shepherd and Murphy Mine (also referred to as the Moina Mine and later the S & M mine or just the Bismuth mine), is located just off the Iris River in north Tasmania. At about 612m above sea level, it is one of the higher mines in Tasmania. It has produced bismuth, iron ore, molybdenum, tin and tungsten, from the 1890s to 1950s. Tasmanian geologist Ralph Bottrill also identifies the mine as producing lithium and fluorite, although it is unclear if this simply refers to the minerals being present and samples taken, rather than actual economic production.¹² Subsequent investigations have also identified fluorite present at the site, but production by the Shepherd & Murphy syndicate is not recorded in historical sources.¹³

The main products of the mine were tin, tungsten and bismuth. Tungsten, also known as wolfram, is a metal element with properties of hardness and a high melting point used for light bulb filaments, metal alloys and military applications such as penetrating projectiles. In

¹¹ Blake, F. 1957, Report of The Director of Mines for 1956, Geological Survey of Tasmania, p.4.

¹² Bottrill R., 1997. *Mir797. Mineral Resources Location and Characterisation System (mirloch)*. Mineral Resources Tasmania, <http://www.mindat.org/locentry-427561.html>

¹³ Acacia Metals Pty Ltd, RI. 8810-Moina, Tasmania, Annual Report for the period to 21-10-96 Report No.:08.8464: C.R Mackay October 1996

the late nineteenth and early twentieth century, its major uses were for armour plating (which became important during World War I) and making self-hardening steels for lathe tools. Bismuth is a metal element with a low melting point, which is increasingly used as a lead substitute.¹⁴

The lode deposits of the Shepherd and Murphy mine were discovered in 1893 by prospectors Thomas Shepherd (sometimes spelled Shepheard) and Thomas Murphy. They were credited with the discovery of the All Nations Mine near Moina, and Shepherd was also one of the discoverers of the silver-lead deposits in Claude Creek (later to become the Round Hill mine).



Plate 3: Examples of Scheelite and Wolframite¹⁵

The first report on the mine is a brief note by Montgomery (1894), soon after discovery of alluvial cassiterite and gold, and lodes containing cassiterite, bismutite and bismuthinite in small creeks flowing north into Seven-mile Creek (now Bismuth Creek). Descriptions of the early workings are given in reports by Smith (1897, 1899) and Waller (1901). Between Smith's visits, the operations at the mine were transferred from surface trenching to underground development from two adits (no.1 and 2).¹⁶

Surface trenching disclosed seven lodes sufficient to see the Shepherd and Murphy Tin Mining Co formed in Launceston in 1895. The company drove several adits, including the lowest (No. 3) which constituted the main haulage level for many years. However, the complexity of the concentrates prevented adequate profits and operations were suspended.¹⁷

The mine and processing plant appear to have been in full production in 1901, when a reporter for the Launceston Examiner described the venture as follows:

SHEPHERD AND MURPHY T. M. COMPANY. For some time the country rock through which the low level is being driven has been very hard, consequently progress was slow, but at present a favourable class of garnet rock is being met with, and better progress is being made. The total distance driven from the opening set is 475ft., and should the present favourable conditions continue, it is confidently expected to cut the first lode early in April. The tramline connecting with the battery

¹⁴ Stwertka, Albert (2002). *A Guide to the elements* (2nd ed.). New York: Oxford University Press.

¹⁵ <http://www.mindat.org/loc-172.html>

¹⁶ Geological Survey Explanatory Report from the Department of Mines Tasmania 1979, Sheffield Sheet 37, Wilmot Online - http://www.tco.asn.au/oac/community_history.cgi?oacID=14&articleID=176488

¹⁷ Loftus-Hills, C, *The Moina Tungsten - Tin – Bismuth Project*, Tasmanian Mines Department 1952.

is completed, and immediately after the lode is cut vigorous operations will be carried on. A large hopper capable of holding 60 or 70 tons of ore is being constructed at No. 4 level, and it is the intention of the mine manager (Mr. Stevenson) to start stoping operations, in order to be in readiness with a supply of ore for the battery immediately after the rains set in and give the necessary power. Two of the directors, Messrs. Hinman and Pepper, paid the mine a visit last week. The Assistant Government Geologist (Mr. Waller) is also here, and is busily engaged preparing a geological report on the field. The question is very often asked as to when the department is going to lay out the £600 vote which was placed on the estimates last year for opening up the track from the Shepherd and Murphy to the Middlesex mines. The season is getting well on, so if some thing is not done shortly, it will mean a considerable delay, as very little can be accomplished in the matter of roads during the winter months.¹⁸

In 1906 an attempt to solve the problem of the mixed tungsten/bismuth ores was made when one of the directors, Mr. A. Hinman, succeeded in interesting a London group and the S. & M. Syndicate (London) took over the mine. Hinman was manager and local director for the Shepherd and Murphy syndicate (as well as a local timber merchant and a director of the Magnet and Mount Farrell mining companies). A mill was erected to process the ores but the concentrates again presented a difficulty. Hinman visited London in 1907 on behalf of the company with the object of deciding on the best process for the treatment of the concentrates. After much consideration he decided on the Wetherell type of magnetic separator.¹⁹ In 1907 Loftus-Hill was engaged to tackle the problem. A successful process was evolved based on electro-magnetic separation and a plant erected in Cimitero Street, Launceston, to treat the concentrates, ‘with gratifying results’. For the next 10 years (1908-1918) good profits were made and yearly dividends of upwards of 50% were paid.²⁰

This electro-magnetic separation plant was the first of its type in Australia, and appears to have been essential to the success of the Shepherd and Murphy Mine. It proved of value to other mines, treating ores from Zeehan at least up to 1916.²¹

Late in 1918 a bushfire destroyed all surface equipment including the mill. A new mill was erected incorporating the electro-magnetic separation plant transferred from Launceston. This was completed in 1921 and milling was resumed. However, the only ore treated was that which had been mined during the interval and stored in stopes and ore-passes. No mining was done after the mill started because in 1922 the collapse of the metal market compelled the London directors to order all operations to cease. The mine remained idle from then until the brief reworking in the 1940s by Godwin, and the complete mill was subsequently sold to the Aberfoyle Coy.²²

¹⁸ *Examiner* (Launceston, Tas. : 1900-1954) Thursday 7 March 1901 Page 8

¹⁹ DEATH OF MR. A. HINMAN. (1914, July 18). *Examiner* (Launceston, Tas. : 1900 - 1954), p. 7 Edition: DAILY. Retrieved July 21, 2011, from <http://nla.gov.au/nla.news-article50767496>

²⁰ Loftus-Hills, 1952; A MAGNETIC SEPARATOR. (1908, August 18). *The Mercury* (Hobart, Tas. : 1860 - 1954), p. 3. Retrieved July 21, 2011, from <http://nla.gov.au/nla.news-article12679207>

²¹ ZEEHAN NOTES. (1916, April 8). *The North Western Advocate and the Emu Bay Times* (Tas. : 1899 - 1919), p. 5. Retrieved July 21, 2011, from <http://nla.gov.au/nla.news-article64790718>

²² Loftus-Hills, 1952.

A number of different companies appear to have been involved in prospecting and operating the mine. For example a Mr D. Room finalised purchase of the Shepherd and Murphy Mine for a Ballarat mining syndicate in 1895.²³

The Tasmanian Mines Department received applications for registering mining companies including the Shepherd & Murphy Tin Mining Co (MIN66/1/977 24 Oct 1893), the Moina Mining Syndicate Ltd (MIN66/1/1842 11 Jun 1923), the New Shepherd & Murphy Mining Co (MIN66/1/1846 28 Nov 1923), and the Moina Tungsten Tin Mine Co (MIN66/1/2061 04 Mar 1953).²⁴

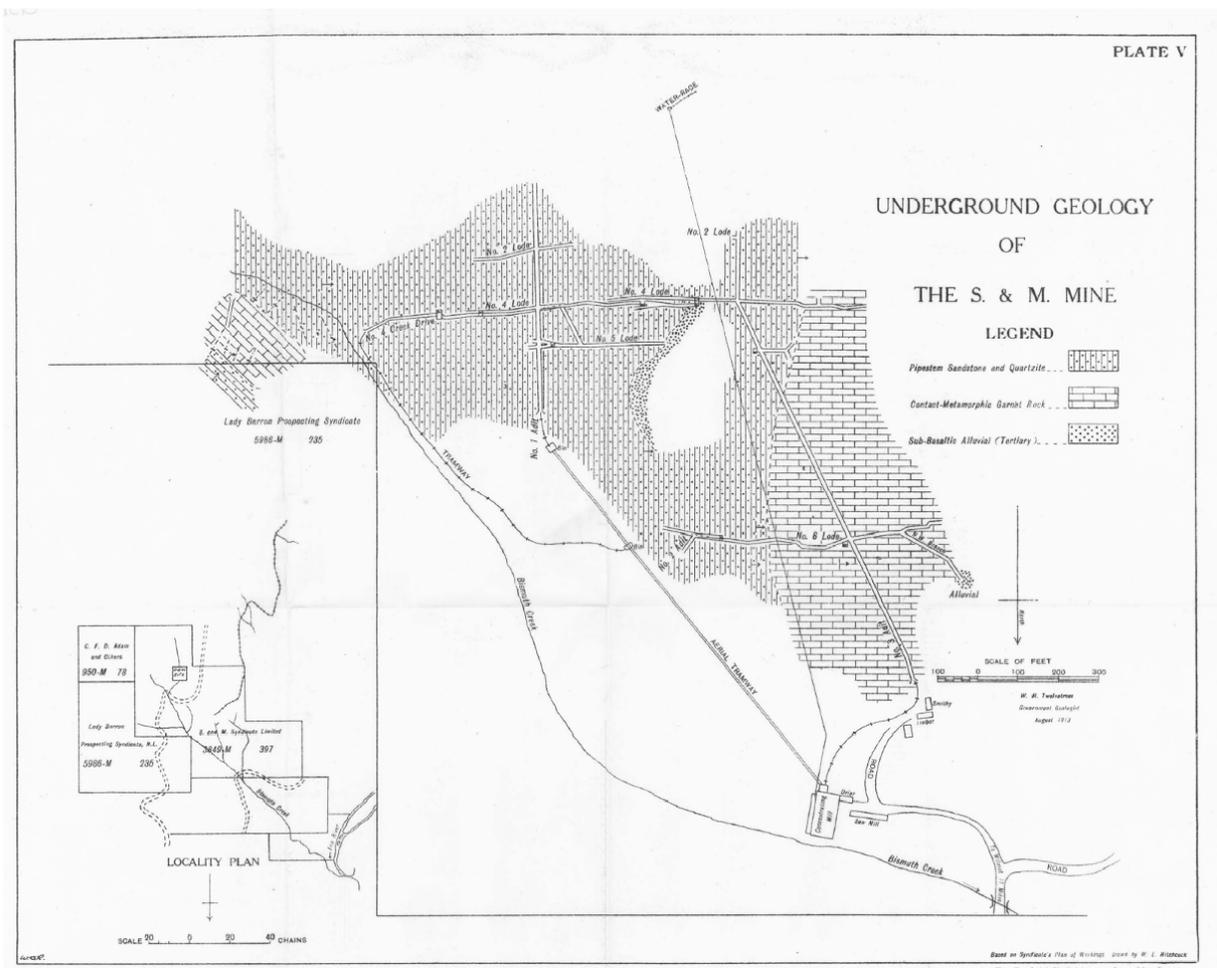


Figure 2: Plan of Shepherd & Murphy mine 1913.²⁵

The first major report on the mineral deposits in the Moina and Round Mount districts is by Twelvetrees in 1913, while summary descriptions of the Shepherd and Murphy mine, the All Nations mine, and other mines in the vicinity were published in 1916.²⁶

A comprehensive description of the lodes, the milling and mining methods, and of the then innovative process of electromagnetic separation of the cassiterite, wolframite and

²³ *The Age* - Jun 14, 1895 p.6.

²⁴ Tasmanian Archives Online database Applications by mining companies for registration and associated papers.

²⁵ Twelvetrees 1913

²⁶ Twelvetrees, 1913, p.130; Loftus-Hills 1916.

bismuthinite is contained in the report by Twelvetrees. At the time of this inspection, No. 2, 4, 5 and 6 lodes were being worked from No.1 and 3 adits and No. 4 creek drive. By the time of Reid's (1919) inspection the workings were at a most advanced stage, with development and mining being undertaken on most levels to the no.3 shaft level. Alluvial workings south of the main shaft and up the hill had been extensively worked for tinstone to a depth of 15 feet or more.²⁷ Also, long and deep costeaning trenches were noted in 1907, running up the hill disclosing veinstuff carrying tin ore, wolfram and carbonate of bismuth.

According to Twelvetrees, processing at the mill was undertaken in 1907 using a "...stone breaker, rolls, jigs, 10 heads of stamps, 2 Wilfley tables, and 2 Frue vanners, and it is intended eventually to erect a magnetic separator at the mine."²⁸ The main shaft included a "first-motion steam-driven winding engine...firmly set on a concrete foundation and comfortably housed". The pumping plant comprised an "Evans force-pump, connected by rods to a crank-shaft at No 3 Adit Level and driven by means of a Pelton Wheel."²⁹ By 1916, compressed air rock drills were in use, with the compressors powered by Pelton wheels for nine or ten months of the year and an auxiliary steam engine being used for the dry summer months.³⁰

The Commonwealth Year Book for 1918 indicates that 177 tons of Wolframite, valued at 28,714 pounds, was mined in Tasmania in 1917, mostly from Avoca and the Shepherd and Murphy Mine, which also produced 4 tons of Bismuth, valued at 895 pounds.

However, in 1919 a bushfire destroyed the milling plant and the mine closed down. The erection of a new mill commenced in 1921 by the Shepherd and Murphy Syndicate Limited, and was completed in the following year by the New Shepherd and Murphy Mining Company.

*SHEPHERD AND MURPHY.SHEFFIELD. May 2. The reconstruction of the mill at the Shepherd and Murphy mine, Moina, is proceeding as rapidly as possible, but the work is necessarily slow, owing to the isolated situation and the difficulties of transport. There are about 20 men engaged. Yesterday the mine manager stated that it would be some months before the reconstruction of the mill, which had been destroyed by a bush fire last summer, would be finished.*³¹

During the early stages of prospecting and mine development, production was intermittent, but from 1907 to 1918 regular production of tin, tungsten and bismuth was maintained. Prior to 1914, mining was confined to the lodes above no. 3 adit, but by 1915 the main shaft had been sunk below that level to a depth of 52 m. From this period up to 1919, no. 4 and 6 lodes, together with the north-west branch of the latter, were developed from the shaft levels, the greater part of the stoping being carried out on no. 6 lode. Underground workings at its greatest extent comprised 6 lodes down to a depth of 103 m, accessed from four adits (No.1, 2 and 3 adits and No. 4 creek drive) and a main vertical shaft.³² Reid inspected the mine in 1943, but the operations then were directed towards recovery of alluvial cassiterite,

²⁷ Twelvetrees, 1913, p.130, 76

²⁸ Twelvetrees 1907, p.14.

²⁹ Reid 1919, p.78

³⁰ Loftus-Hills, Tungsten and Molybdenum, Geological Survey mineral resources / Tasmania. Dept. of Mines; no. 1 1916.

³¹ *The Mercury* (Hobart, Tas. : 1860-1954) Monday 3 May 1920 Page 8.

³² Loftus Hills 1952.

wolframite and bismuthinite. He noted at the time that the lodes had been almost completely stoped out to the surface above no.3 adit (no.1 shaft level) leaving very broken ground. Most of the development and mining was undertaken prior to 1920.³³

The Shepherd and Murphy Mining Company milled some 2,000t of ore, principally from broken material in stopes above no.3 adit and from surface dumps, for a return of approximately 22t of concentrate. The shaft levels were not de-watered and operations ceased in 1924.³⁴

Between 1933 and 1950, J.P. Godwin carried out intermittent sluicing operations on alluvial and detrital deposits and a limited amount of under-ground stoping and prospecting. Godwin's adit is situated approximately 55m north-east of no.2 adit and extends south-east for 24m, intersecting four east-west trending quartz veins carrying wolframite and minor cassiterite and molybdenite.³⁵

Proposals to reopen the mine were floated in the early 1950s. Loftus-Hills proposed that "the mine reopening and mill construction [could] proceed immediately and coincidentally and ... a new mill site should be adjacent to the shaft-head." He also proposed reuse of the old water-race which supplied power to the old S. & M. mill (which was still in good order), reopening No. 3 adit, and installation of a new penstock and pipe-line, to be used for unwatering the shaft. "Erection of head frame at the shaft and winding engine, reconditioning of the shaft and No. 3 Level, erection of the mill and the provision of housing should proceed concurrently. The design of the mill should be based on that at Aberfoyle which is a remodelled form of the old S. & M mill. The capacity of the first unit should be 5 tons per hour." As the old S. & M. power supply was subject to summer failure and water-power yielded 37 H.P. only in suitable weather, either diesel power or connection to the State Hydro Electric power lines at Eriba (within 4 miles) was proposed.³⁶

It would seem that the works Loftus Hills proposed were carried out much as he described, and the Moina Tungsten Tin Mining Co. N.L. completed the unwatering of the mine by December 1953 and re-opened the underground workings, while the new mill and concentrating plant was in course of erection at that state. By the end of 1954, the company had treated 2,500 tons of ore.³⁷ The company evidently ceased active mining at the end of 1955, although cleaning up operations continued into the next year. Production ceased in 1957 and the company was placed in liquidation.³⁸ In the petition to the court for liquidation, the directors stated that due to low metal prices they were unable to operate at a profit. When it was known that operations at the mine were about to cease once again, much of the available information on the underground workings and the mineralogy of the lodes were recorded.³⁹

³³ Keid H.G.W. Report on the Moina Mineral District, Department of Mines, Hobart, 18 Oct, 1943.

http://www.mrt.tas.gov.au/mrtdoc/dominfo/download/UR1943_181_198/UR1943_181-198.pdf

³⁴ Geological Survey Explanatory Report from the Department of Mines Tasmania 1979, Sheffield Sheet 37, Wilmot Online - http://www.tco.asn.au/oac/community_history.cgi?oacID=14&articleID=176488

³⁵ Blake 1956

³⁶ Loftus-Hills 1952, p.5

³⁷ Blake 1956.

³⁸ Blake 1956

³⁹ Robinson R. G. (1958) Report on the Moina tungsten tin deposits, Technical Report, Department of Mines Tasmania, 2. 46-62. Williams, K. L. (1958) Tin-Tungsten mineralisation at Moina, Tasmania Proceedings of the Australian Institute of Mining and Metallurgy. 185, 29-50.

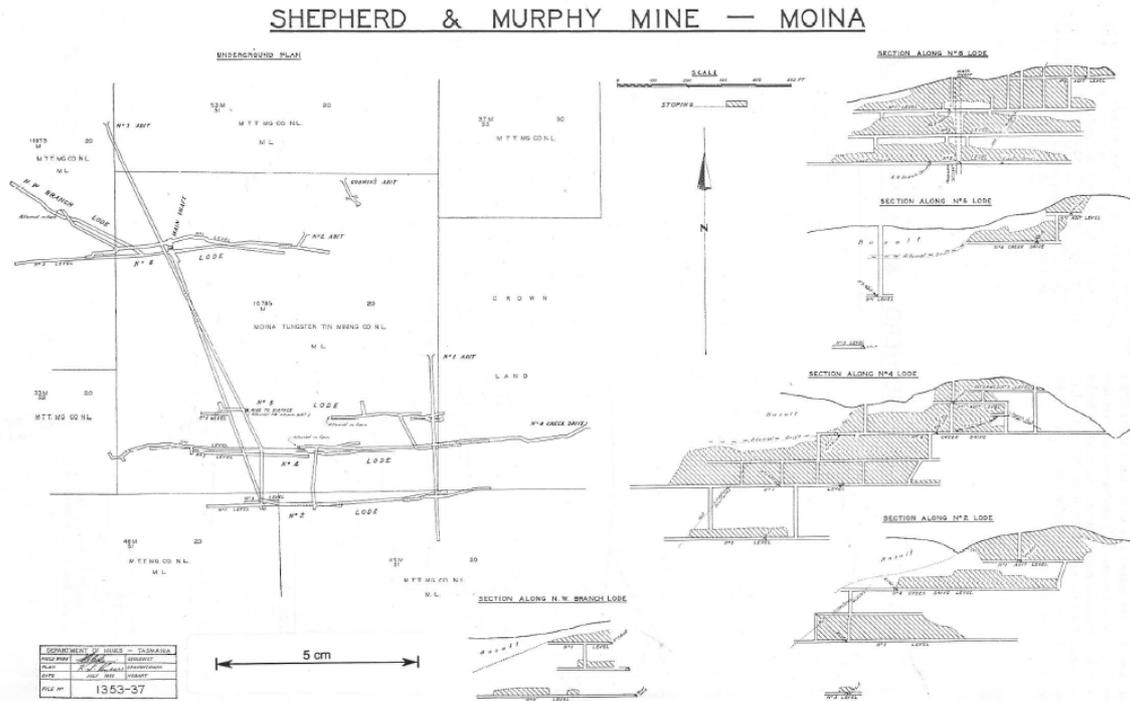
The closure was brought about by economic factors such as a falling market, but also the excessive overbreak on narrow loads and failings in ore dressing.⁴⁰ The mine has been abandoned since 1957, but sporadic interest has been shown in the deposit.⁴¹

Up to 1942, the mine had produced a total value of £145,931 worth of tin wolfram and bismuth. The vast majority of which was won in the period 1907-1919.⁴²

Production during the period 1907 to 1956 is summarised in the following table.

	1907-20	1920-52 (incomplete)	1953 - 1956	1955-56
tin (metal), Sn,	479	8.17		53.821t concentrate
wolfram (concentrate) WO ₃	305	8.56		31.374t concentrate
bismuth (metal) Bi	69	1.9		
Total ore treated			18 580t	15 784.4t

Table 1: Production statistics as Shepherd & Murphy Mine⁴³



production between 1893 and 1957, an estimated 525t of tin, 255t of wolfram and 71t of bismuth were recovered from the underground and surface workings at this mine.⁴⁴

2.5 Ore Processing

Mining and processing at the Shepherd and Murphy underwent a number of phases of development. The principle processes involve crushing the ore, sieving through a series of trommel screens, and concentrating using a variety of machines including Wilfley tables and Frue vanners. Both dry and wet processes tend to be employed. The machinery was relatively modern at the time of the mine's commencement, with Wilfley tables having been devised in about 1896 by Arthur R. Wilfley, and were first used that year in his mill in Colorado.⁴⁵ The Frue vanner was an earlier device invented in about 1874 by W.B. Frue, who was superintendent of the Silver Islet Mine in Ontario Canada.⁴⁶ Both used a wet system of processing slimes to concentrate the metalliferous component of the ores. These both required raised supports of timber or concrete, similar to the concrete blocks evident on the mill site at Shepherd and Murphy.

The earliest detailed description of the processing at the Shepherd and Murphy mine comes from Twelvetrees in 1907.⁴⁷ He describes treatment of tin and wolfram from the same load as being difficult, and requiring the use of a process of magnetic separation. A separate plant for this purpose was erected in Launceston in 1908 by Messrs Hinman and Wright.⁴⁸

A plan of the mine site from 1913 shows a single main concentration mill at the north of the site near Bismuth Creek. This location corresponds with the concrete structural features recorded near the large dam on that creek. Adjacent to the concentration mill on the plan is a smaller building marked as a 'drier' and a long structure housing the sawmill. The track from the Wilmot road appears to branch from beside Bismuth Creek, although this may be artistic licence. The mill was located "above the creek and below the mine" and was designed by W. E. Hitchcock, the general manager. In 1913, it was extensively renovated, with the old timber replaced by celery-top pine and concrete.⁴⁹

Other structures shown in this plan include a 'Timber' shed, 'Smithy' and another building, all located around the No. 3 adit entrance. A tramway is shown from the No. 3 adit to the concentrator mill, an aerial tramway from the No. 1 adit to the concentrating mill with an ore bin at each end, and a second conventional tramway from the No. 4 Creek Drive to midway

⁴⁴ Reid, A McIntosh, *The mining fields of Moina, Mt Claude and Lorinna*, Tasmania Geological Survey Bulletin, no. 29, Department of Mines, Hobart, 1919.

⁴⁵ Mill Machines: The Wilfley Table, <http://www.coppercountryexplorer.com/2007/09/mill-machines-the-wilfley-table/>

⁴⁶ E. Henry Davies, *Machinery for Metalliferous Mines*, London: C. Lockwood & Son 1894. p.320 (on Google Books)

⁴⁷ Twelvetrees, W.H. Report on the Bell Mount and Middlesex District, government Geologist's Office Launceston 17, June 1907.

⁴⁸ Loftus-Hills, C Electro-magnetic Separation of Tin, wolfram and Bismuth Ores, Tasmania Geol. Surv., Hobart, Bull. No. 14, 1913. ; see also Great Britain. Imperial Mineral Resources Bureau. *The mineral industry of the British Empire and foreign countries*. War period. Tungsten (1913-1919)

⁴⁹ Twelvetrees 1913 p.51.

along the aerial tramway where a bin was used to transfer ore. Broken ore was trucked to the mill bin by hand trucks of 12 cubic metres on an 18 ½ inch steel tramway.⁵⁰

Water supply for the concentrating mill was fed by a pipeline from a water race about 600 m south of the mill. While there are several water races closer to the mine, these are likely to have been for domestic supply, and possibly supplementary to the main supply for power and dressing, which was recorded as having been completed in 1907 and "...provided by a water race, 5 miles 57 ½ chains, from Weaning Paddock Creek, a tributary of the Iris River."⁵¹

Five separate Pelton wheels are described by Twelvetrees, powering the ventilation fans, smithy fires, air compressor for machine drills, rock breakers, rolls, trommels, elevators, course jigs, Wilfley tables and Frue vanners. Prior to this, two Ruthinger Spitzlutte classifiers (spelled Rittinger by Twelvetrees) were used to feed to the Wilfley tables and Spitzkasten concentrators to feed the Frue vanners.⁵² The concentrates were "...furnace dried upon an iron tray in a compact drying room attached to the mill, with an open brick flue".⁵³

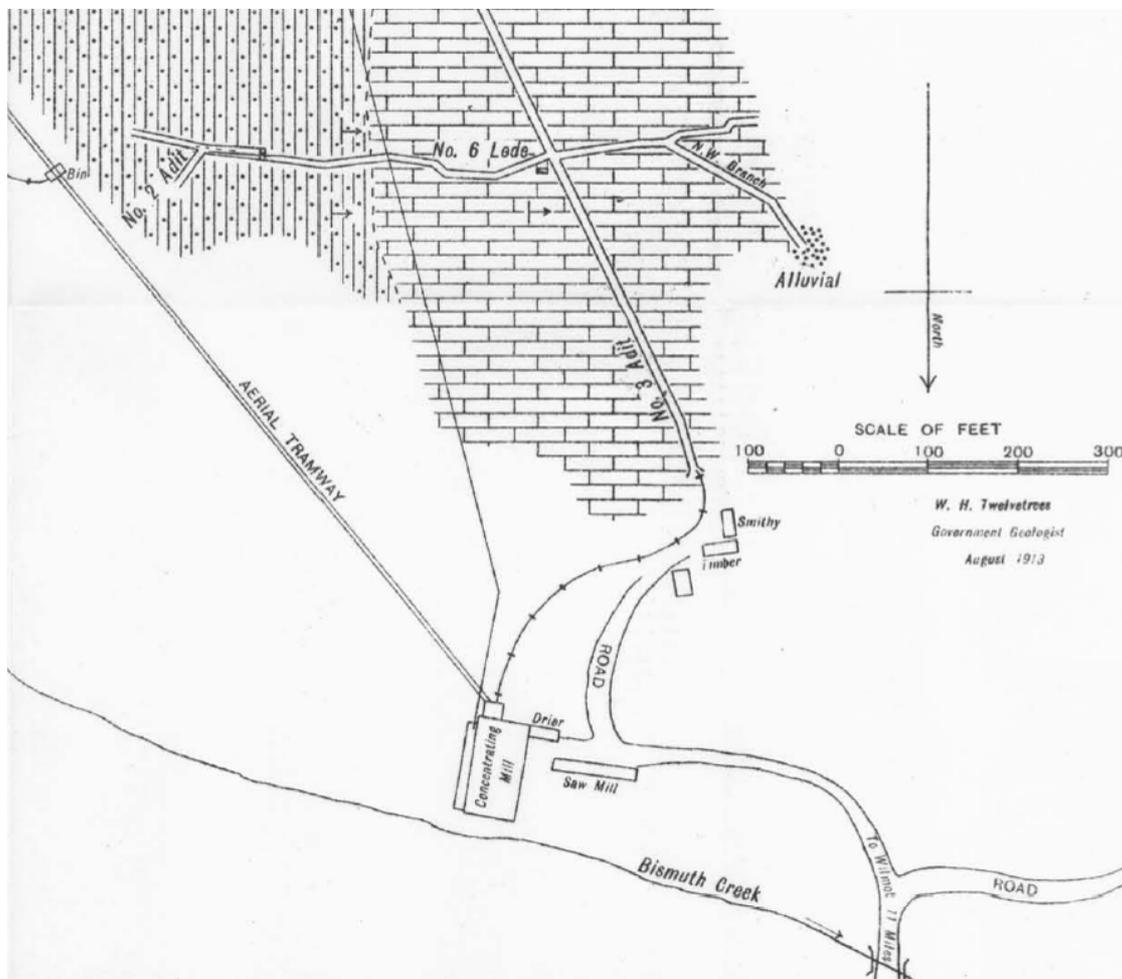


Figure 4: Plan of S & M Mine 1913 (Twelvetrees)

⁵⁰ Twelvetrees 1913 p.53.

⁵¹ Twelvetrees 1913 p. 51.

⁵² Twelvetrees 1907 p. 14

⁵³ Twelvetrees 1913 p.51.

By 1919, a more sophisticated processing sequence had been developed at the mine with multi stage breakdown. A large ore bin fed the primary jaw crusher, with trommels initially separating sizes for further reduction by rolls and the 2 and 3-compartment jigs. A hydraulic classifier fed the Wilfley tables and a further settler fed two Frue vanners. It would appear that at least some of this machinery was continuing in operation from the original mill. The destruction of the mill in 1918 may have caused the cessation of processing on the site (as also suggested by production statistics) although comments were made that the owners intended to erect a new mill, including machinery for magnetic separation of magnetite from the concentrate.⁵⁴ The site of this pre 1920s mill corresponds best with the structures recorded near the dam. In particular, the steel plate hints at the drier described in the mill. The following flow diagram shows the sequence of reduction and metal extraction used at the mill.

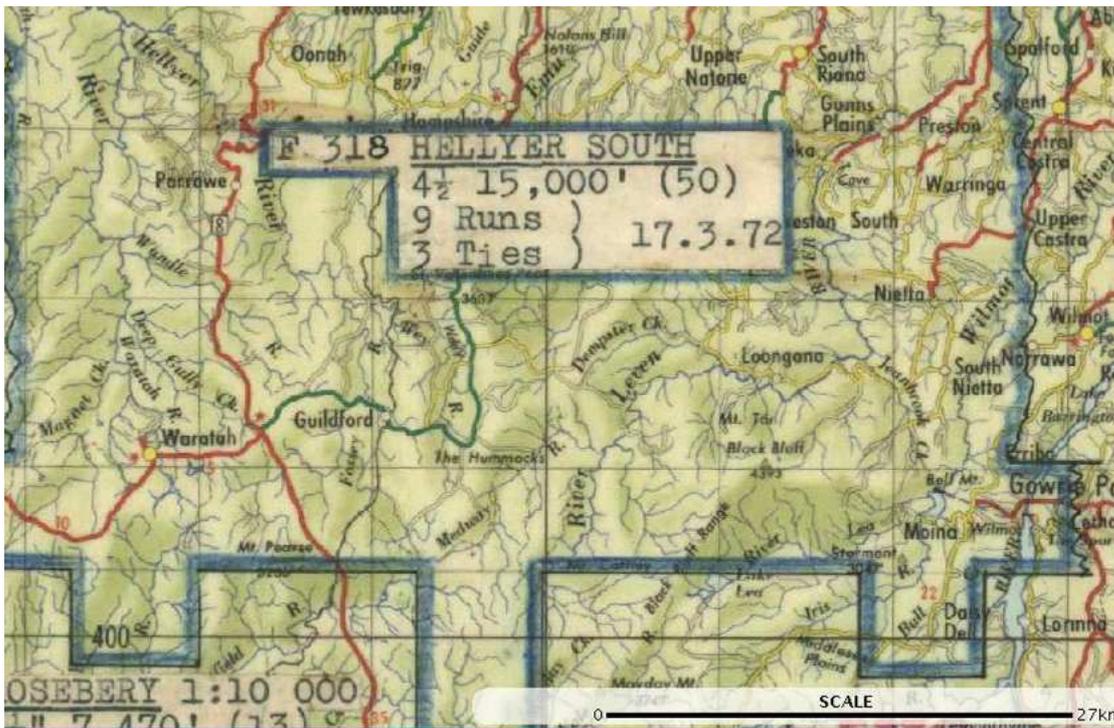


Figure 5: Aerial Photo run Map 1972 – Tas Map – Moina

⁵⁴ Reid, A McIntosh, *The mining fields of Moina, Mt Claude and Lorinna*, Tasmania Geological Survey Bulletin, no. 29, Department of Mines, Hobart, 1919. pp.71-80.

3.0 DESCRIPTION

Site survey involved inspection of remains of the mill site and other features such as adits, open stopes, shafts and other building and structure foundations existing in relation to potential future drill pad sites near the mine, in the area between Moina road and the Cradle Mountain Road. Inspection and recording of known historical mining features was undertaken by Biosis Research PL archaeologist Gary Vines, in June 2011.

Due to the very dense vegetation cover and broken ground, access to some areas was restricted. While base maps showing approximate locations of some historic features were available, a combination of difficult terrain, poor visibility and inadequate GPS coverage meant some of these features could not be relocated.

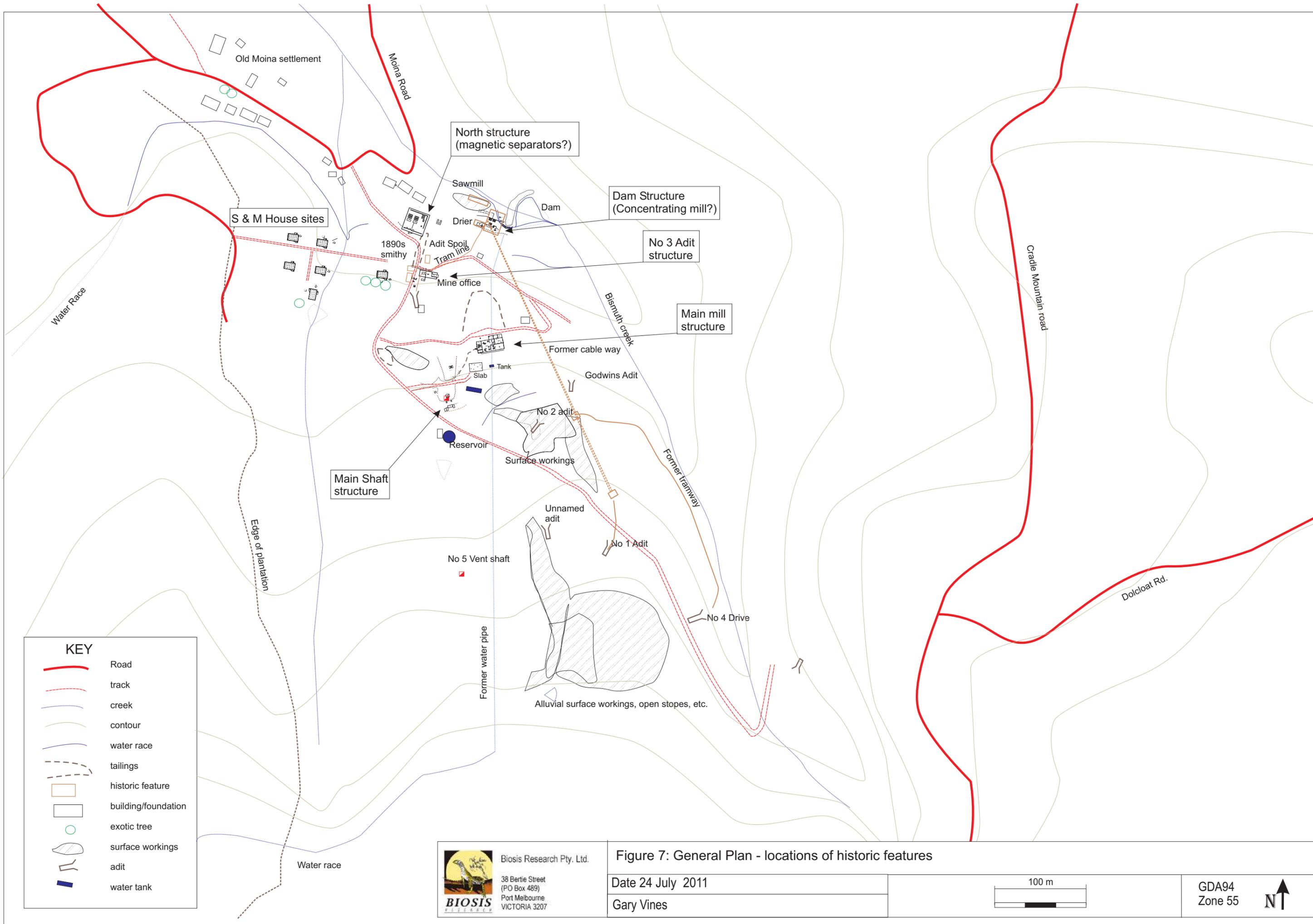
However it was possible to identify several discrete areas of former buildings, including the former Moina town site straddling Moina road, the S & M workers housing site, three substantial industrial sites including the main processing mill, several adit and shaft sites, as well as numerous surface workings. The general locations of identified historical features are shown in Figure 7.

In addition to the present survey, past archaeological recording has been undertaken by the Tasmanian Mines department and Forest Practices Authority, the following features were recorded by Denise Gaughwin, and are identified in the accompanying plans where possible.

Table 2: Features and grid references recorded by Tasmanian Historic Sites Inventory.

Eastings	Northing	Number	Name	details
423351	5406640	1	shaft	fenced off / barb wire - signs; big grate over entrance small hole above main shaft 2m deep 1m x 2m wide (Trimble position)
423367	5406596	2	big hole	5m deep 2m x 2m wide Water Race 70m long x 4m wide - just behind No.2 shaft (Trimble position)
423341	5406554	3	Building Site	flat excavation - 14m x 4m size (Trimble position)
423361	5406547	4	Hole	4m x 3m - overgrown (Trimble position)
423393	5406555	5	Tailings & shaft	(fenced off) Big metal grate and building foundation metal; Dump & Sluice pit (Trimble position)
423420	5406605	6	Big slab	on its own 20m x 30m
423436	5406612	7	Big Mill	site (Trimble position)
423453	5406637	8	foundations	Two concrete
423455	5406575	9	Pond	10m diameter & water trench; Dirt mound & Posts timber 5 feet high
423486	5406550	10	Big trench	joining bigger trench and mine shaft & air vent. Bigger trench goes towards (presumed) caved-in shaft
423493	5406523	11	Small trenches	
423560	5406445	12	2 shafts	1.2m wide x 10m x 1.8 ht; other Rail Line in shaft part caved-in
423557	5406362	13	Big Cuttings	loading to shafts; 4 known shafts (Trimble position)
423605	5406418	14	Mine Shaft	1.8m high x 1.5m wide x 50m long (Trimble position)
423514	5406455	15	Narrow trench	800m long; near Track (Trimble position)
423388	5406498	16	reservoir	Round Concrete Slab (Trimble position)
423215	5406682	17	5 House Foundations	& Concrete Steps (Trimble position)
423368	5406525	18	Concrete Slab	with little blocks of concrete in middle of slab
423558	5406309	19	Trenches &	(Trimble position)

Easting	Northing	Number	Name	details
			Pine	
423507	5406212	20	Trench	petted out
423412	5406324	21	Trenches	Earth Mounds 2m deep x 15m long
423465	5406203	22	Mining Trench	Long (3 Trimble positions)
423193	5406103	23	Mining Trench	
423145	5406059	24	Mining Trench	
423008	5406415	25	Earth Mound	
423005	5406497	26	Flat Area	

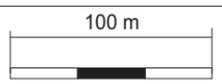


KEY

- Road
- track
- creek
- contour
- water race
- tailings
- historic feature
- building/foundation
- exotic tree
- surface workings
- adit
- water tank

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Figure 7: General Plan - locations of historic features
 Date 24 July 2011
 Gary Vines



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N ↑

3.1 Moina settlement site

This site is an extensive area of level terraces with some stone and brick footings, straddling the Moina Road between the bends on Bismuth Creek and the junction of the forestry track to the west. Other buildings associated with the settlement were likely to have been located further to the west, where the Moina Post Office and other early farm buildings are located.

On the south side of the Moina road are a series of rectangular level terraced areas below a water race. The terraces appear to correspond with the buildings shown in a photograph of the township from about 1919.

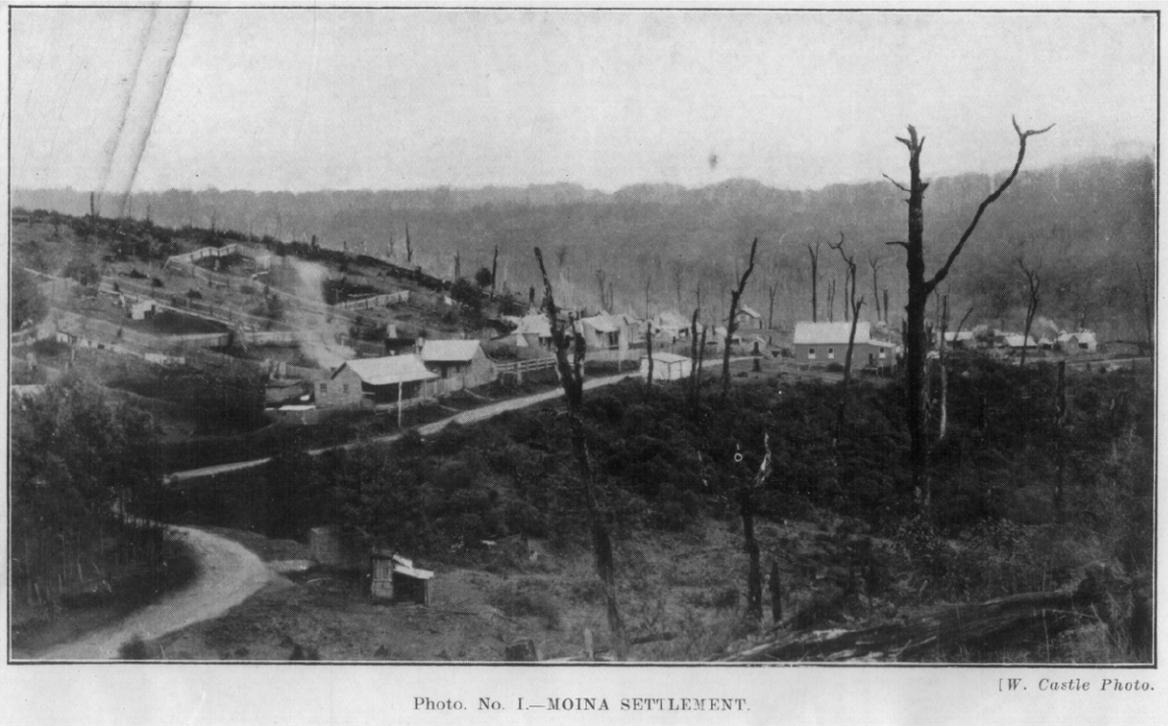
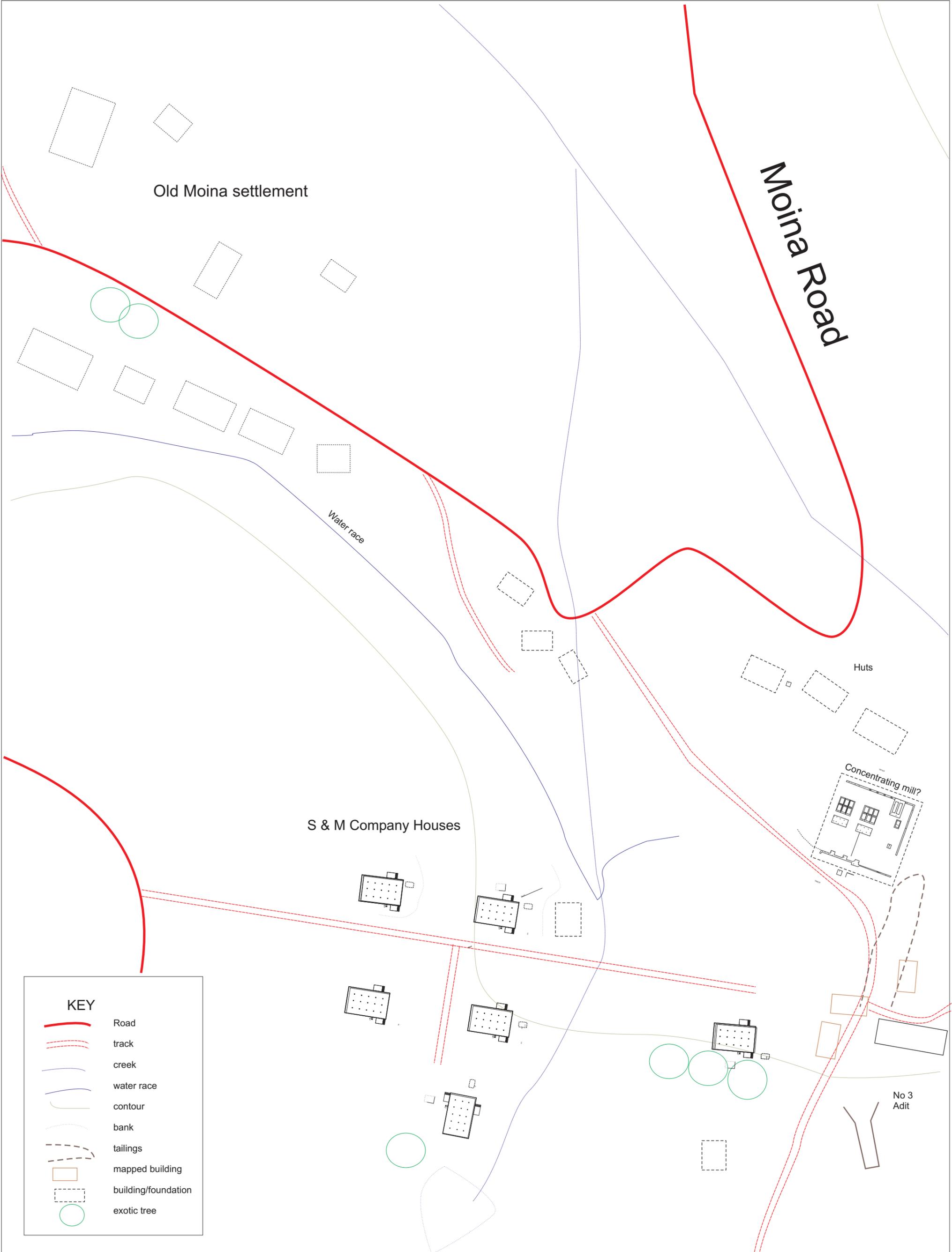


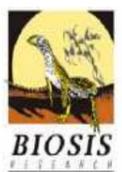
Plate 4: Moina settlement site in 1919 evidently shortly after the fire.⁵⁶

⁵⁶ McIntosh Reid 1919_GSB29.pdf



KEY

- Road
- track
- creek
- water race
- contour
- bank
- tailings
- mapped building
- building/foundation
- exotic tree



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Figure 8: Plan of Settlement site

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30 m



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Plate 5: Linear stone footings north of Moina Road – probably large building shown right of centre in 1919 photo



Plate 6: Stone pillar footings north of Moina road



Plate 7: Terrace from building site, south of Moina Road



Plate 8: Water Race – linear depression across centre of photo.

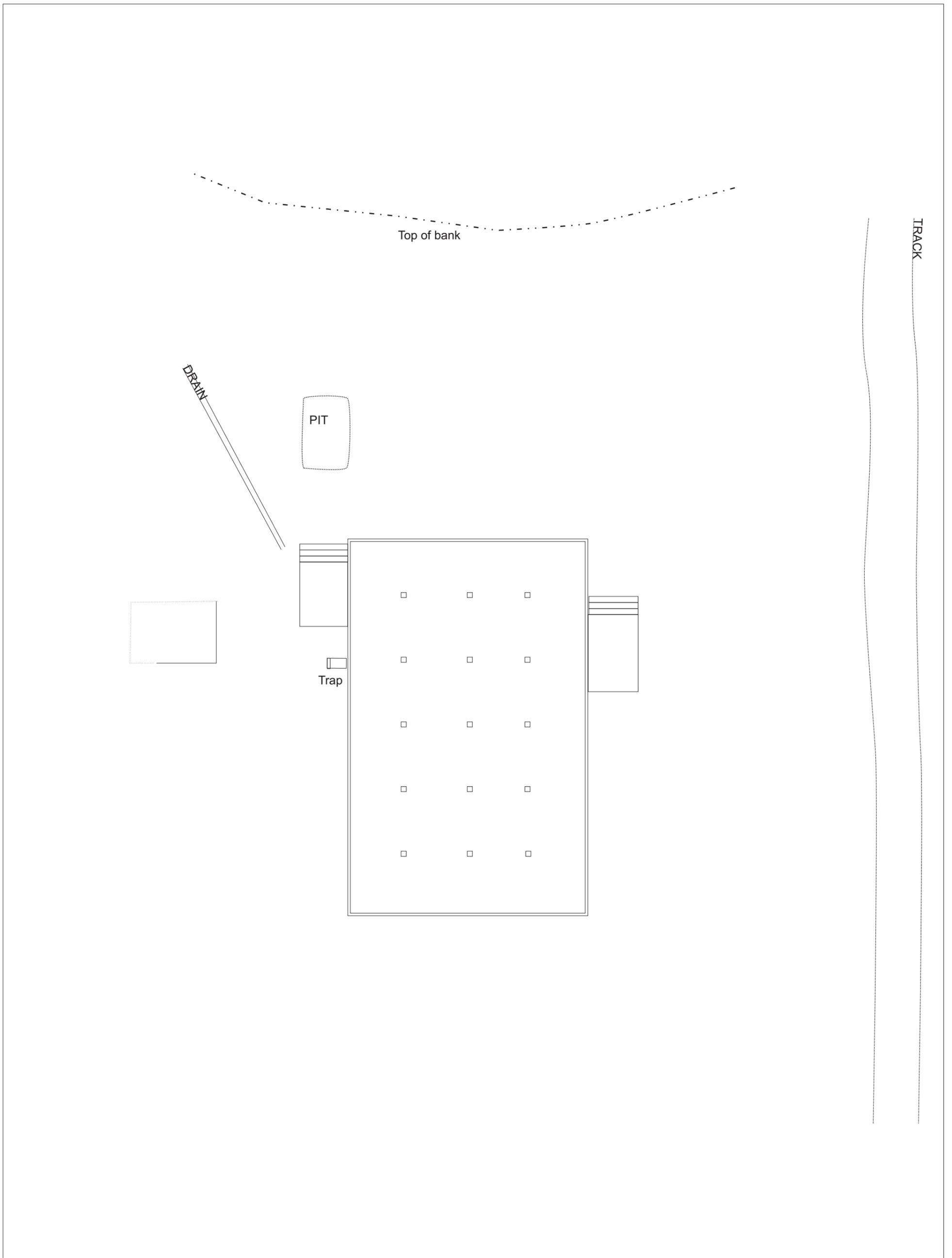
3.2 S & M company houses

To the west of the main mill about 100m south of the Moina Rd. and across a small creek, are a group of six house footings comprising a grid of concrete stumps and surrounding concrete apron, with a set of concrete steps and platform on each side. Most have evidence of the drainage and sewage systems in the form of a gully trap and a pit a few metres from one of the stairs. This was probably for an outdoor pit toilet. Some also have evidence of a small out-building with concrete slab floor – possibly a laundry or shed.

The floor plans of the buildings are almost identical, indicating that these were company houses built to a standard design. As these concrete features have steel reinforcing, they are most likely to date from the reconstruction of the mill and reopening of the mine in the 1950s.



Plate 9: Typical house footings.



3.3 Main Shaft structures

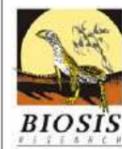
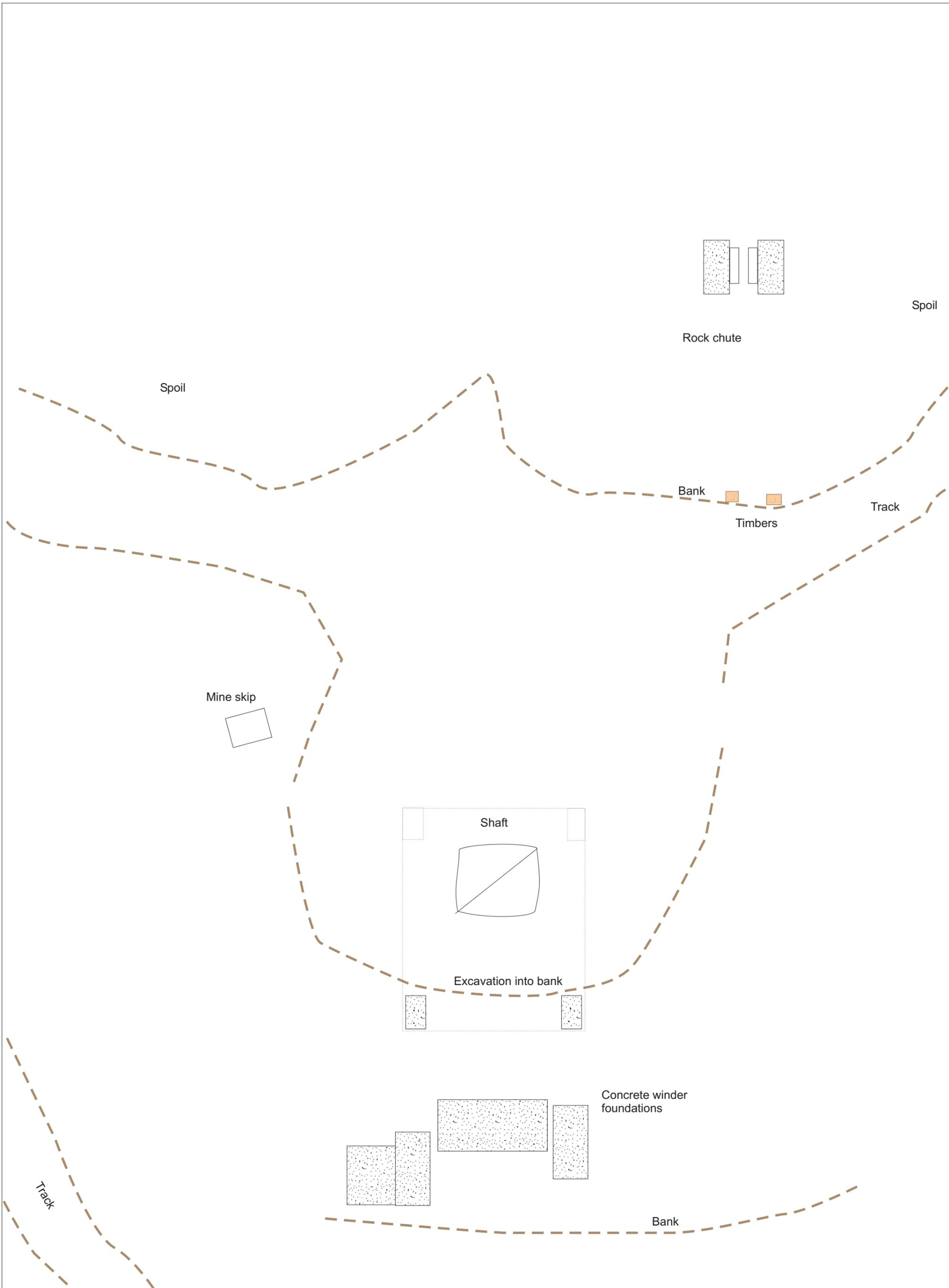
The main shaft is marked by a steel mesh cover, with excavated bench and spoil to the north. On the south side at a higher level, about 6 m above the bench, is the concrete footings of the poppet head and winding house. Two prominent concrete blocks with steel plates projecting are probably the bases of two of the poppet head's four legs. South of these are a series of concrete slabs and foundation blocks from the winding engine. To the north of the shaft, on the edge of the terraced area, are some squared timbers overlooking a deep cut, and in the base of the cut is another large concrete structure with remnant steel plate chute, probably from a former rock chute and skip loading facility.



Plate 10: Poppet head footings



Plate 11: Rock chute below Main shaft level

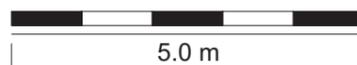


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Figure 10: Main Shaft structure

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3.4 No 3 Adit structures

Located north of the No. 3 adit entrance, this area includes concrete machinery footings, probably for conveyor systems and pumps, and several small concrete slabs. Plans of the mine from the 1950s identify a 'Mine Office' in this area, which may be the purpose of the slabs.⁵⁷

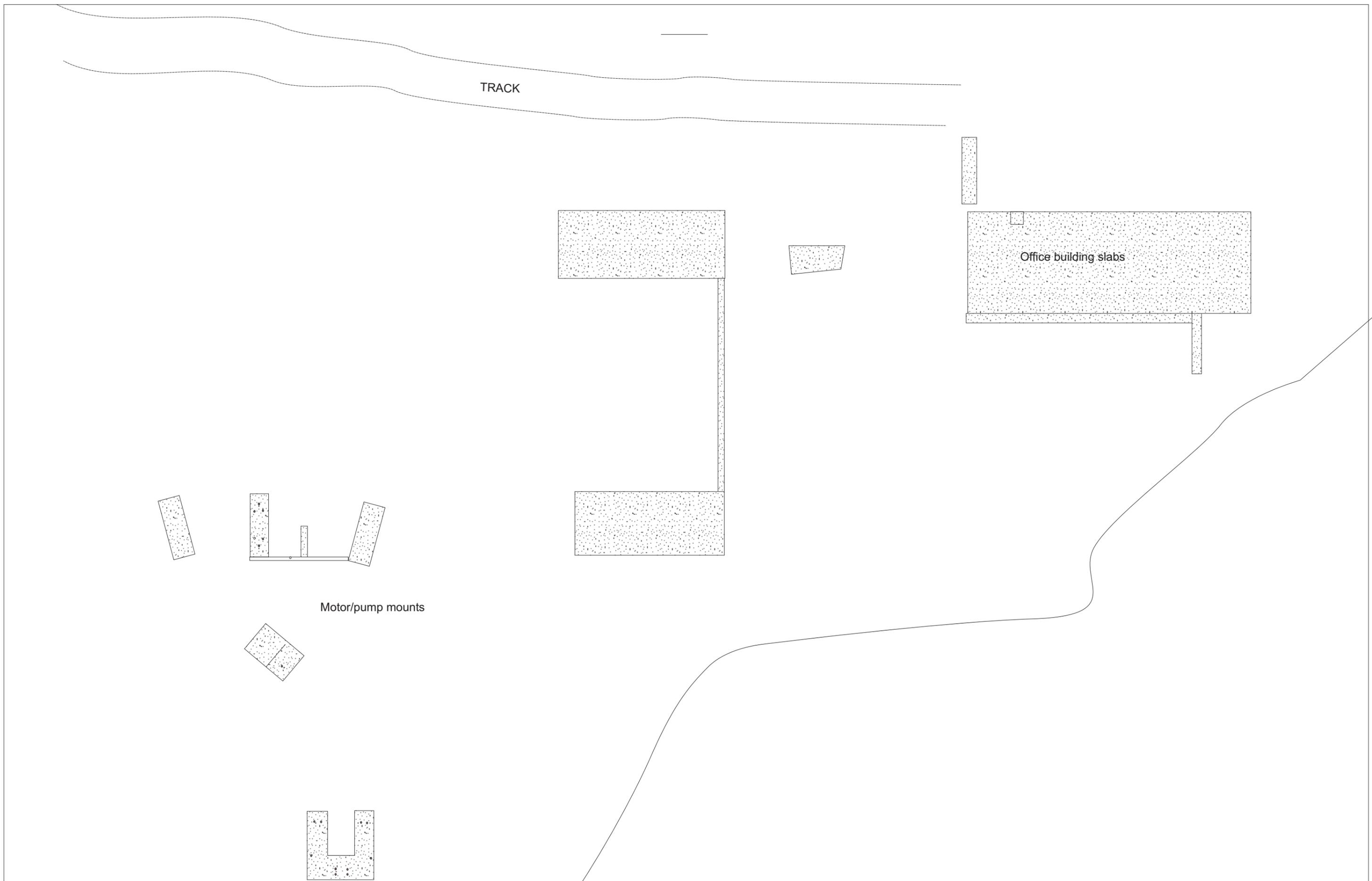
Earlier plans show a 'Smithy', 'Timber' shed, and another structure in the same area, evidently straddling the track immediately west of the adit spoil. No physical evidence of these structures was visible during the inspection.

The area of the machine foundations is mostly under water, evidently from seepage from the adit itself.

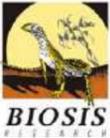


Plate 12: Concrete footings at No. 3 adit.

⁵⁷ Blake, 195

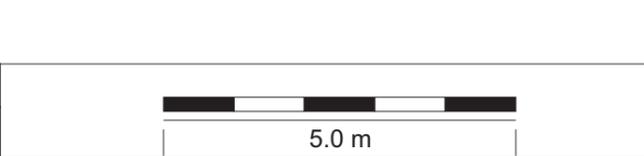


To Adit

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Figure 11: Number 3 Adit structure
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3.5 Dam and concrete structure

This area is located on the west bank of Bismuth Creek adjacent to the earth-wall dam. An extensive series of concrete floors, machinery footings and other features is found in conjunction with the dam, spillway, and possibly a turbine structure. It is highly likely that this is the site of the original concentration mill, built in the 1890s, and refurbished with celery-top pine and concrete in 1913. As well as the various water driven machinery, a drying kiln employing metal floors was noted. Such a structure is evident in the raised metal plate on concrete walls in the south west corner of the site.

The timber structure at the eastern end of the site is probably from the primary ore crusher, while the concrete weir and timber sluice structure from the dam, may relate to diversion of water for a steam engine. Rectangular concrete footings on the terraced area may relate to the Wilfley tables and Frue vanners. Power for the mill was primarily from a series of Pelton wheels supplied by a 600m pressure pipe. Secondary steam power was also available. A 1913 plan also identifies a 'sawmill' to the west of the concentrating mill. Some terraced areas and (displaced) concrete blocks may relate to this structure.



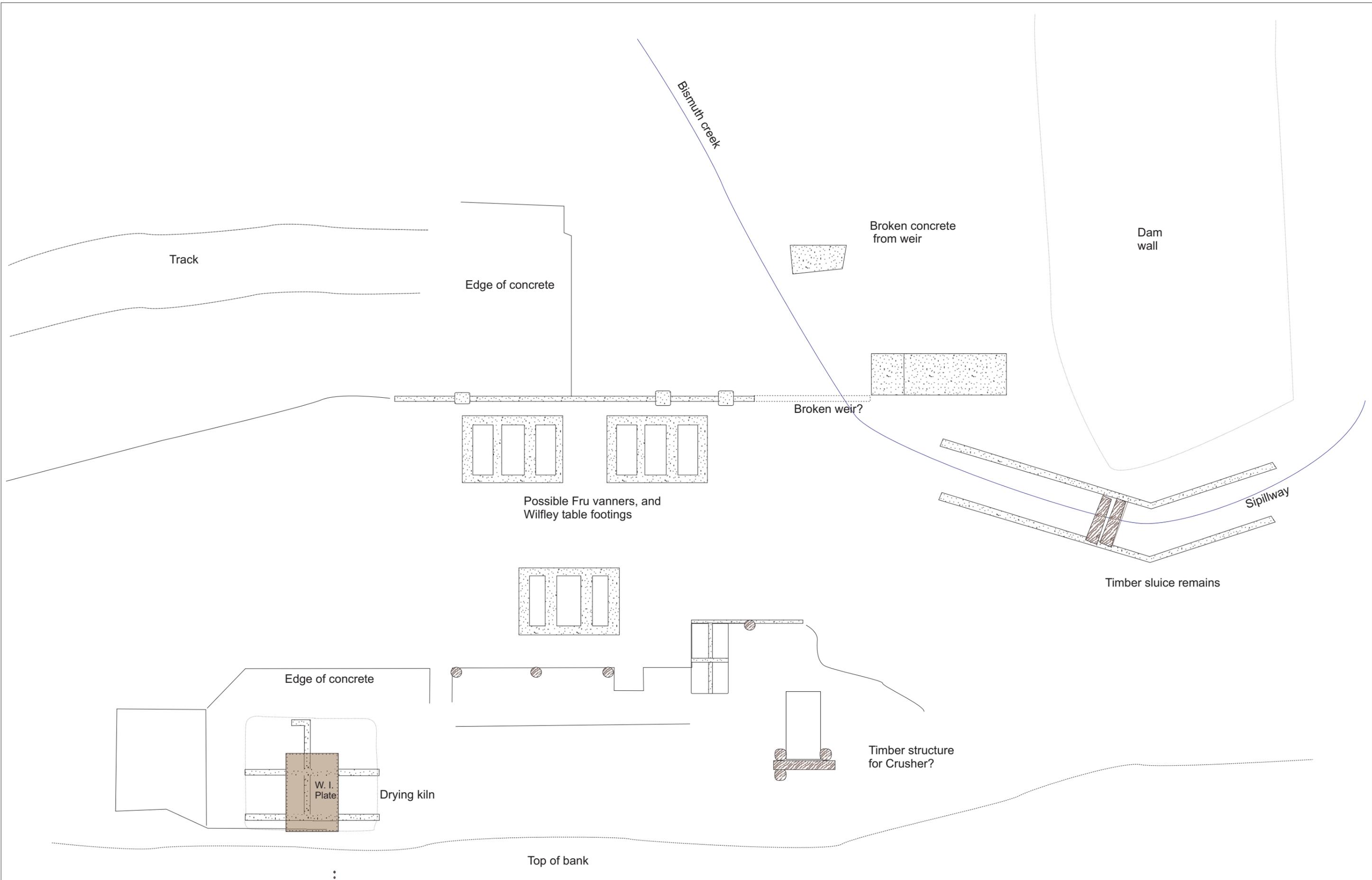
Plate 13: Concrete structure near small mine dam. Showing metal plate base of drying kiln



Plate 14: Concrete weir on creek



Plate 15: Concrete flooring at northern structural feature.



3.6 North structural feature

This complex of concrete footings, floors and timbers is located about 30m south of the Moina road near its crossing of Bismuth Creek. The feature comprises a series of concrete machinery footings, likely to be associated with ore processing equipment or other machinery. It cannot be associated with any specific period of operation, although would appear to predate the 1950s reconstruction of the main mill.

A possible historical candidate is the magnetic separation plant that is believed to have been installed on the site in the rebuilding after the 1918 fire.



Plate 16: Concrete machinery footings at northern structural feature.



Plate 17: Concrete machinery footings at northern structural feature.



Terrace

PIT

Swampy area

TRACK

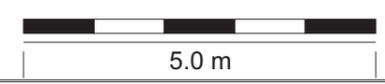


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Figure 13 Northern structure

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3.7 Main Mill site

The main mill site is the most prominent structure in the area, comprising a large concrete slab measuring about 30m by 13m, with an elevated structure on the western end and a number of large concrete machinery footings, pillars and other structures. The building appears to have been a timber framed structure, supported by a 3m by 5m grid as evidenced by the remaining concrete pads with metal stirrups for tying down the bottoms of the posts. The several sets of concrete pillars are most likely from crushers, trommel screens, Frue vanners and Wilfley tables. The large concrete pillar of the elevated section is probably from the primary jaw crusher and the secondary (roller?) crusher may have been installed on the pillars immediately below this (where sands have accumulated).



Plate 18: Main Mill slab showing concrete machinery supports and post ties.



Plate 19: Main Mill slab showing looking west.



Plate 20: Primary Crusher supports at main mill.

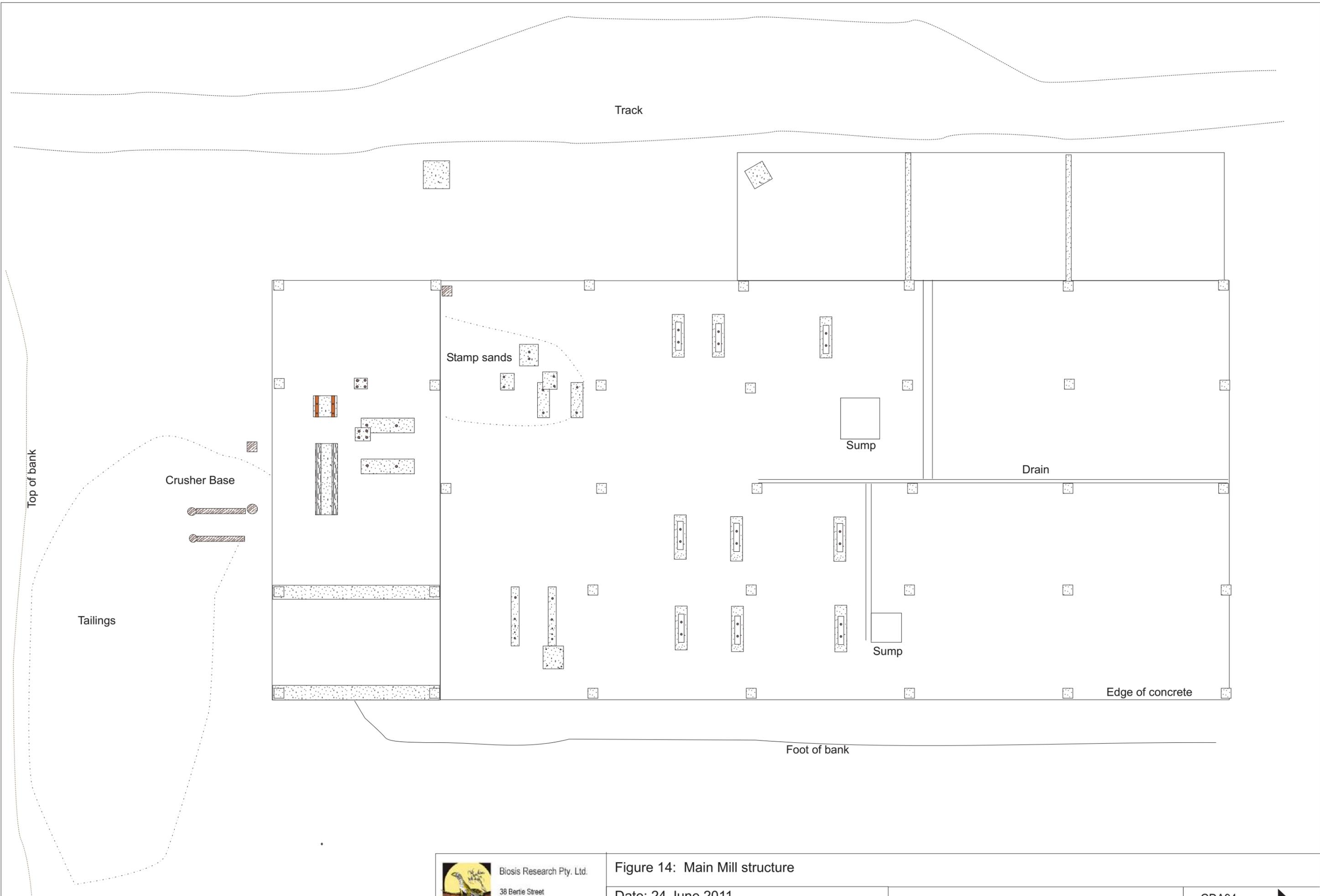
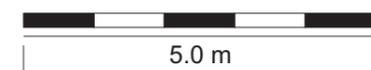


Figure 14: Main Mill structure

Date: 24 June 2011

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3.8 Other Adits and features

Four other named adits and other minor adits and shafts are present in the Study area. The No. 1 adit is readily accessible from the track, while No. 2 adit can be found relatively easily. The No. 4 Creek drive could not be seen during the field inspection due to soil collapse and heavy vegetation in the creek gully. This was also the case with Godwin's Adit, although the collapsed state of several features and uncertainty regarding its precise location hindered discovery.



Plate 21: No. 1 adit from the north

In addition to the adits and shaft there are various forms of trenches, small earth terraces, surface workings, stope channels and other earth features scattered widely over the study area. Other smaller level areas from former buildings or storage areas, concrete floors and machinery footings can also be found throughout the main mining area.

These features are of interest, but of lesser significance than the larger and better documented structures and mining features. They provide physical evidence of the extent of mining and the various techniques used on the site. The locations of the various adits and shafts are shown in Figure 7.

A number of other structural features are located around the main processing building. Immediately south of the main mill is a concrete in-ground tank, with a larger earth tank beyond that, near a large concrete slab probably for an amenities or storage building. A circular concrete base from a large steel tank is located further up the hill beside the track. A number of other small terraced areas indicate locations of other buildings.



Plate 22: Concrete tank near main mill.



Plate 23: Basalt cliff exposed at Bismuth Creek crossing.

4.0 ABORIGINAL ARCHAEOLOGY

4.1 Background

Archaeological investigations of Aboriginal occupation in Tasmania have resulted in a pattern of archaeological sites concentrated on the midlands, coastal fringe, and thanks to some specifically directed investigations, the mountainous west. There are, however, few recorded sites near the present study area.⁵⁸

Archaeological evidence of Aboriginal sites in Tasmania has demonstrated that occupation dates back at least 35,000 years in the example of the limestone cave deposits in the Maxwell Valley of southwest Tasmania.⁵⁹ This was during the period of the Last Glacial Maximum or “Ice Age” when cooler temperatures reduced the forest cover of the region. Aboriginal people occupied the Tasmanian Highlands during the Last Glacial Maximum (LGM) when ice sheets covered most of the Central Plateau. This is demonstrated by the site of ORS 7 in the upper valley of the Shannon River, which drains the plateau.⁶⁰

The LGM lowered sea levels by 150 m causing a land bridge to form between Tasmania and the Australian mainland. In northern Tasmania, Aboriginal people occupied rock shelters on Hunter Island and King Island when the islands were joined to the mainland.⁶¹

Stone tool technology also changed during this period of occupation. Bone points and undifferentiated quartzite flakes characterize the early assemblages but around 5,500 years ago bone points disappear from the tool kit to be replaced by stone artefacts made from a wider range of raw materials. Another early Aboriginal site in northern Tasmania is the Warragarra rockshelter in the Upper Mersey Valley below the Great Western Tiers. This shelter contains evidence of Aboriginal hunting from before 9,000 years ago. Most coastal sites in Tasmania (and the Australian mainland) date from 6-7,000 years ago, when global sea levels stabilized following the melting of the glaciers and ice-caps. Shell middens in the Furneaux Group of islands are the oldest, dating to 9,000 years ago.⁶²

The Parmerprar Meethenar rockshelter, located along the deep gorge of the Forth Valley near Sheffield, was also occupied during the last ice age with an oldest date of 35,000 years.⁶³ This is presently the closest well documented Aboriginal site to the present study area. An ochre quarry, and a number of surface and rock shelter sites have also been found downstream on the Forth and Wilmot rivers.

⁵⁸ Jones Rhys, 1966, "A Speculative Archaeological Sequence for North-West Tasmania", *Records of the Queen Victoria Museum Launceston*, Launceston, Tasmania, p. 4.

⁵⁹ Cosgrove, R. 1995. Late Pleistocene behavioural variation and time trends: The case from Tasmania. *Archaeology in Oceania*, 30:83-104.

⁶⁰ Cosgrove, R. 1995a. The illusion of riches. Scale, resolution and explanation in Tasmanian Pleistocene human behaviour. BAR International Series No. 608. Oxford.

⁶¹ Bowdler, S. 1977. The coastal colonisation of Australia. In Allen, J., Golson, J., and Jones, R. (eds.) *Sunda and Sahul: prehistoric studies in southeast Asia, Melanesia and Australia*, pp.205-246. Academic Press, London.

⁶² Lourandos, H. 1983, 10,000 years in the Tasmanian Highlands, *Australian Archaeology* 16: 39-47.

⁶³ Cosgrove, R. 1992. The management of archaeological resources in forested areas: Preliminary report of Phase 2 fieldwork, Forth River valley. Department of Archaeology, LaTrobe University.

4.2 Aboriginal Archaeological assessment

There are a number of factors which may influence the presence of Aboriginal archaeological sites in the study area. The most prominent is the degree of disturbance in the historical period, which may have destroyed any evidence that may have previously been present.

The evidence of distribution of archaeological sites in northern Tasmania, suggests that most areas were occupied, even at the height of the last Ice Age. However, preference in site selection appears to have been given to sheltered locations close to major resources such as open plains, rivers, or coastal rock shelves.

Cave sites have been a focus of archaeology in northern Tasmania, but no cave or rockshelter is evident in or near the present study area. The steep terrain is unlikely to have been a focus of occupation, although flats to the north of the Moina road, and possible small natural terraces along Bismuth Creek, could have provided suitable camp sites in earlier climatic conditions when the forest structure might have been more open.

Due to the unsuitable local geographic conditions (steepness of slope, lack of resources, limited water supplies, etc.) and historical disturbance from mining and forestry activities, it is considered unlikely that significant Aboriginal archaeological deposits will be present in the study area. However, there is potential for isolated artefacts to occur in any of the less disturbed areas (i.e. those that have not been excavated for mining activity, roads and tracks or construction of building and plant), and possibly in any intact sediments along the creek.

5.0 HERITAGE DESIGNATIONS

There are no Aboriginal archaeological sites identified in the present study area.

There is no listing in the planning scheme heritage schedule of the local planning authority (Kentish Council) for the site.

There is no listing for the site on the Tasmanian Heritage Register (THR)

The Shepherd and Murphy mine is identified on the Tasmanian Historic Places Index (THPI) by L. Scripps in January 1990, with the Site No 8115.023 allocated to the 'Shepherd & Murphy Mine' with grid ref – Map 8115- 4235, 4068.⁶⁴

A discussion of the implication of heritage listing is provided in an Appendix of this report.

⁶⁴ Tasmania Historic Site Inventory. – note the record also lists oral informant Trevor Mahoney of Devonport.

6.0 SIGNIFICANCE ASSESSMENT

The Shepherd and Murphy Mine is identified on the Tasmanian Historic Places Index. However, it has not been assessed in any heritage study to the writer's knowledge, and is not included in the Tasmanian Heritage register or other statutory heritage list.

The site is, however, of historical and technical interest due to the unusual history of the mine's operation, and the extent of surviving remains, and therefore an assessment of its cultural significance has been made here. The assessment has been made in reference to the Mining Heritage Places Assessment Manual⁶⁵, the guidelines to the Burra Charter⁶⁶, and *Kerr's The Conservation Plan*.⁶⁷

6.1 Statement of Significance

The Shepherd and Murphy Mine is significant to the state of Tasmania at the state level as a rare and distinctive mining site reflecting a range of mineral extraction and processing technologies, in an important historical context associated with the exploitation of local minerals for export and self sufficient production especially in time of war.

The site is of historical significance as one of the earliest and largest producers of wolfram or tungsten, in Tasmania and Australia. Wolfram mines were established in several Australian states at the end of the 19th century as the value of the metal rose in the wake of its benefits in hardening steel alloys, especially for military use. Australian production was seen as an economic and defensive necessity.

The Shepherd and Murphy Mine is potentially the best preserved site from the first phase of wolfram mining on an industrial scale in Australia. There are a number of mainland wolfram mines of the period, such as Wilks Creek,⁶⁸ Mt Murphy,⁶⁹ and Womoboi in Victoria,⁷⁰ Wolfram Camp at Dimbulah in Queensland,⁷¹ Hatches Creek and Wauchope in the Northern Territory,⁷² and Borowa in New South Wales.⁷³ However, these sites were either developed later than Moina, or their surviving remains are only from the later period of operation.

⁶⁵ Michael Pearson & Barry McGowan, Mining Heritage Places Assessment Manual. Australian Council of National Trusts and Australian Heritage Commission Canberra, 2000

⁶⁶ The Burra Charter 1999 (The Australia ICOMOS Charter for Places of Cultural Significance), Australia ICOMOS.

⁶⁷ Kerr, James Semple. 1996. *The Conservation Plan. A Guide to the Preparation of Conservation Plans for Places of European Cultural Significance*. The National Trust of Australia.

⁶⁸ Peter Evans, *Wolfram Mine, Wilks Creek Track*. Site report In *Historic Sites in the Melbourne East Study Area* by R. Supple, G. Perham and T. Griffiths. For the Land Conservation Council of Victoria.

⁶⁹ Parks Victoria. 1998, Mount Lawson State Park and Mount Granya State Park. p.10.

⁷⁰ Australian Alps Mining Heritage Conservation & presentation strategy Appendix 1 Site gazetteers

⁷¹ Thermo Electric Ore Reduction Corporation Mill Queensland Heritage Register ID:602240, Department of Environment and Resource Management

⁷² Northern Territory's Mining History, <http://www.mininghistory.asn.au/mining-history/northern-territorys-mining-history>

⁷³ Hart J.G. & Dunkin H.H. 1940. Ore dressing investigations, investigations no. 155 and 156, flotation of scheelite-bearing dump materials from the Phoenix wolfram mine, Boorowa, New South Wales. In: Anon (undated) Phoenix Wolfram mine, Boorowa. Geological Survey of New South Wales Mine Record MR2180. Mulholland C.J. 1943. Phoenix wolfram mine, Frogmore. *New South Wales Department of Mines Annual Report 1939–1945*, pp. 68–71.

While the Aberfoyle tin/wolfram deposit at Rossarden, in north east Tasmania is an equivalent large scale wolfram mine, it was not substantially active until after 1926.

The Shepherd and Murphy Mine is of technical significance for demonstrating the evolution of rare mineral mining and processing practices in Tasmania in the early 20th century. The mill provides physical evidence of an important shift in mining practices and employment in the region, from gold to rare mineral mining and processing. The early processing site dating from 1913 and 1919, and possibly incorporating earlier structures demonstrates the introduction and adaptation of equipment developed for processing other minerals such as gold and tin, to dealing with complex mixed wolfram/bismuth/tin ores. The 1950s site shows the evolution of this technology in the mid twentieth century. Of specific technical significance is the association of the mine with the development of electro-magnetic separation of complex ores, initially via a separate plant operating in Launceston, but then from 1918, the same equipment transferred to a new mill on the site – the concrete foundations of which are believed to survive.

The mine is significant in Tasmania's history as an example of overseas (British) capital funding a state-of-the-art ore processing works, despite being short-lived due to foreign market influences and an inability to diversify. The mill and associated remains, especially the scale of the mill foundations, demonstrate the scale and economic importance of wolfram mining in the years prior to, and during, World War One.

The Shepherd and Murphy Mine is representative of an uncommon mining practice in Tasmania, that of rare mineral mining of tungsten ores and bismuth. The site is important locally for the range of functions and periods of mining represented and the variety of ore extraction methods demonstrated in a relatively small area, including drives, drifts, shafts, adits, open stopes padlocking, costeans and other underground and surface workings. It also has evidence of a variety of transport systems, including overhead cable way and narrow gauge tramways, as well as two separate phases of workers housing including a group of standardised designed accommodation, all represented by foundations and archaeological remains.

While further research and analysis may be necessary to establish the detailed functions and meanings of the remains on the site, they provide a unique opportunity for investigating technological transfer and change in mineral processing methods in the late nineteenth and early twentieth centuries, on the one site.

The site is also significant due to its association with Clive Loftus-Hill, who was a chemist, assayer and metallurgist in Launceston, as well as a part-time lecturer in geology, and briefly was head of the mining branch of the government technical school, and then government geologist and director of the Geological Survey, Tasmania.⁷⁴ He played an important role in the development of the base metal and coal mining industry in Tasmania. The Shepherd & Murphy site is representative of Loftus-Hills efforts to solve the technical problems of processing complex mixed ores, which while initiated in a separate plant in Launceston, was transferred under his guidance to this site.

⁷⁴ Banks, Maxwell R., 'Loftus-Hills, Clive (1885–1967)', Australian Dictionary of Biography, National Centre of Biography, Australian National University, <http://adb.anu.edu.au/biography/loftus-hills-clive-7221/text12499>, accessed 26 July 2011.

6.2 Impacts and recommendations

Mineral Resources Tasmania guidelines for works at historic goldmines, recommends the avoidance of the more significant physical evidence of historical mining, such as large machinery and plant, footings and samples of the more important mullock, and tailings, while features such as shafts, adits and other minor structures are recommended for recording prior to disturbance.⁷⁵

The likely future investigations on the Shepherd & Murphy mine area, will involve clearance and track making for geological drilling operations. These works should be undertaken in such a manner that the historic items identified in this report are not adversely affected. In particular, the areas of former buildings, plant and equipment, adits, shafts and other ground works should be protected.

The following recommendations are proposed to ensure avoidance of harm to significant features.

- Prior to clearance of vegetation or construction of access tracks, lay-down areas, drilling pads or other earthworks, the historic features and areas identified in this report should be marked on the ground with suitable identification such as flagging tape or para-webbing, to ensure they are not inadvertently disturbed.
- Any construction, access or environmental management plans for the works, should also have significant features marked, with annotation indicating how they should be protected.
- These areas should then be avoided during any vegetation clearance, or track construction of drilling works.
- Existing tracks can be used for access and vehicle movements, and if necessary lightly regraded or topped up with gravel or other road base.
- With these precautions there should be no heritage impediment to the clearance of the drilling pads and carrying out of drilling operations.

⁷⁵ Bacon 1996.

7.0 APPENDIX 1 STATUTORY REGULATIONS

Aboriginal cultural heritage places in Tasmania are protected under the *Aboriginal Relics Act 1975*, which protects "relics" created before 1876. It is an offence to damage, destroy, interfere with, disturb or conceal without a Ministerial permit.

The *Historic Cultural Heritage Act 1995* forms part of the State's Resource Management and Planning System (RMPS). The Act, through the creation of the Tasmanian Heritage Council, the Tasmania Heritage Register, heritage areas, heritage agreements, stop-work orders and repair notices, seeks to promote the identification, assessment, protection and discussion of places with historic cultural heritage significance in Tasmania.

The Act defines 'historic cultural heritage significance' in relation to a place, as: 'significance to any group or community in relation to the archaeological, architectural, cultural, historical, scientific, social or technical value of the place', and a 'Heritage Area' as '...an area declared as such under Part 5' [i.e. on the Heritage Council's advice or after consulting with any relevant planning authority or any other body].

The Heritage Act regulates the protection and conservation of places of cultural heritage significance to the state of Tasmania. Heritage Tasmania administers both heritage places and precincts included on the Tasmania Heritage Register, while archaeological sites are also managed through the Parks and Wildlife Department's THASC (Tasmanian historical archaeological sites catalogue) forms.

The Tasmanian Heritage Council may enter a place of historic cultural heritage significance in the Heritage Register if, in its opinion, it meets one or more of the following criteria:

- (a) it is important in demonstrating the evolution or pattern of Tasmania's history;
- (b) it demonstrates rare, uncommon or endangered aspects of Tasmania's heritage;
- (c) it has potential to yield information that will contribute to an understanding of Tasmania's history;
- (d) it is important as a representative in demonstrating the characteristics of a broader class of cultural places;
- (e) it is important in demonstrating a high degree of creative or technical achievement;
- (f) it has strong or special meaning for any group or community because of social, cultural or spiritual associations;
- (g) it has a special association with the life or work of a person, a group or an organisation that was important in Tasmania's history.

In practice, the Act allows for the declaration of any area or item by the Tasmanian Heritage Council as an item of cultural heritage, given advice from a relevant body or qualified person. There are no heritage areas or sites listed on the Tasmanian Heritage Register within the study area.

Provision is also made for protection at the local council level through inclusion of places on the Heritage Schedule of the local planning scheme. The planning scheme sets out the requirements for use or development within the Kentish Municipality in accordance with the *Land Use Planning and Approvals Act 1993*. Associated plans show how land is zoned and include provisions on how the land can be used or developed. One objective of the scheme is to ensure that use or development in the vicinity of identified cultural and historic sites does not diminish the values associated with those sites. The strongest practical measures exist in relation to places on the local heritage schedule. The Kentish Council maintains such a list which covers places in the town of Sheffield

The Tasmanian Parks and Wildlife service maintains the Tasmanian Historic Places Index (THPI) - formerly known as the Tasmanian historical archaeological sites catalogue (THASC). While the Tasmanian Historic Places Index does not have any legal status, the listing of a site on the THPI may be relevant to the extent that one of the objectives of the planning process established by the *Land Use Planning and Approvals Act 1993* (LUPAA) is to conserve those buildings, areas or other places

which are of scientific, aesthetic, architectural or historical interest, or otherwise of special cultural value (LUPAA, Schedule 1, Part 2).

The *National Parks and Wildlife Act 1970* provides for the declaration of an area of land as a historic site if the land possesses the values of ‘an area of land of significance for historic cultural heritage’; or adjoins an area of reserved land in the class of historic site possessing those values.

The Commonwealth Australian Heritage Commission Act was recently repealed and in its place amendments to the EPBC Act and the provision of an Australian Heritage Council have also been made in new legislation.

Under the EPBC Act Amendments (No 88, 2003) two mechanisms have been created for protection of heritage places of Commonwealth or National significance. Initially places in Commonwealth ownership may be placed on the Commonwealth list with similar protection measures as under the previous AHC act. In addition the National list provides protection to places of cultural significance to Australia. By law, no one can take any action that has, will have, or is likely to have, a significant impact on any places of national heritage value, without approval. Such actions must be referred to the Australian Government Minister for the Environment and Heritage.

8.0 GLOSSARY OF MINING TERMS

(adapted from Pearson and McGowan 2000, *Mining Heritage Places Assessment Manual*.)

adit	A horizontal or gently inclined passage or opening from the surface into a hillside, for the purposes of exploring, accessing an ore deposit, removing mined material, drainage, or ventilation. Sometimes called <i>drive</i> .
aerial ropeway / flying fox	A system of transporting ore or fuel by means of ropes or cables suspended from towers or timber frames, the transported material being carried in steel buckets or <i>skips</i> , or on a flat platform. The ropeway could carry material over considerable distances, replacing road or tramway transport, or simply run from a high elevation to a lower one, or across a water course, in the latter cases being usually referred to as a 'flying fox'.
air shaft	A <i>shaft</i> driven to connect with underground workings to provide ventilation. Sometimes with a <i>fan</i> at the surface to provide forced air. A chimney was sometimes built over an air shaft to increase draught and was called an 'air stack'.
alluvial gold, alluvial deposit	Gold removed from its parent rock by erosion and incorporated in water deposited alluvium (silt, sand, clay, gravel etc)
auriferous	material – rock earth, sediment etc, containing gold.
classifier	A separating machine that grades crushed material between steps in <i>concentrating</i> processes. ' <i>Spitzkasten</i> ' were one type of classifier, with an inverted pyramidal form, used on some Australian gold mining sites.
concentration	Elimination of the non-valuable lighter portions of a crushed ore and collection of the valuable heavy components.
concentrators	A variety of machines used to concentrate ore by removing non-valuable <i>gangue</i> . See <i>tables, vanner, jigs, buddle</i> .
costean / prospect cut	A trench or slit cut into the ground to expose the geology. Used as a prospecting technique to identify the location of reefs or ore bodies.
country rock	The non-metalliferous rock in which a lode or reef is located.
cut	A deep cutting into rock to cut an ore body or lode. Also used as shorthand to describe <i>costeans</i> and prospect cuts.
drift shafts and tunnels	<i>Shafts</i> and <i>adits</i> dug to test or work auriferous alluvial deposits near the surface (as opposed to 'deep lead' workings). 'Drift' was also used to describe relatively loose alluvial material, and an inclined adit or shaft accessing an underground coal deposit.
drive	A horizontal or gently inclined underground passage driven along the line of a lode, reef or structure within a mine, or connecting the shaft or the surface with the mining face. Sometimes used synonymously with <i>adit</i> , though some drives are not adits in that they do not reach the surface.
Frue vanner	see vanner
gangue	The non-valuable matrix in which valuable metallic ore occurs.
grizzly	A set of parallel bars or grating across which ore is passed, separating out the larger pieces for further primary crushing.
headframe	The seat of wooden or steel legs and platform erected over a <i>shaft</i> , to enable materials to be raised and lowered safely. Also called a <i>poppet head</i> .
jigs	An apparatus used to concentrate ore or separate large pieces (as in washing coal) on a screen submerged in water, either by a reciprocating motion of the screen or by the pulsation of water through it. A jig is also a <i>self-acting incline</i> , a term most commonly used in coal mining.

level	An underground horizontal passage in a mine, driven to give access to ore bodies and to provide for truckways and tramways. Also used generally to indicate the different workings at varying depths within a mine.
mill	A collective title given to the concentrating equipment and grinding machinery used to treat and recover metals or minerals.
mullock dump	Deposited <i>mullock</i> , generally seen as the long heaps extending from an <i>adit</i> or surrounding a <i>shaft</i> or <i>pit</i> .
mullock	Waste, barren or uneconomic rock obtained in the course of mining. The Cornish name 'attle' is sometimes used in South Australia. Either deposited in <i>mullock dumps</i> , or used to backfill worked out <i>stopes</i> . Also termed <i>Tailings</i>
ore	Rock or mineral deposit containing particular metals or minerals in commercial quantities.
paddock / paddocking	A portion of an alluvial area being worked by <i>ground</i> or <i>box sluicing</i> , usually the latter. Also an area for storing washdirt or ore, which was said to be 'at grass'. 'Paddocking' meant to systematically work a small claim on alluvial flats by a series of paddocks. The paddock was rectangular in shape and at the larger claims could measure 20 m x 20 m.
Pelton wheel	A patented water wheel operated by a high pressure jet of water hitting small hemispherical buckets with a central rib and propelling the buckets and the wheel to which they were attached at high speed. Invented in about 1870, Pelton wheels were small and reasonably portable, and were used extensively at mines where a suitable head of water could be provided, to drive machinery.
pit	A depression, usually 2–3 metres in diameter, wider than it is deep. Commonly seen on alluvial fields where they are the remains of shallow <i>shafts</i> dug to access ore-bearing ground. Also known as 'potholes'. Also used generically to describe a coal mine.
poppet head	An iron, steel or timber structure of legs built over a <i>shaft</i> . It is equipped with pulleys over which the ropes or cables run that raise and lower the cages in the shaft. See also <i>headframe</i> .
race	An open channel for conveying water. It can be a simple earth ditch, or lined with timber or metal, or a masonry structure, and often incorporated flumes (which see) to cross declivities and maintain a constant fall. Races ranged from short earthen ditches gathering storm water for opportunistic alluvial mining, to company-operated water supply channels many miles long and linked to supply and storage dams. A race supplying water to a workings or mill was a 'head race' while that removing water or tailings was a ' <i>tail race</i> '. Referred to as 'ditches' in the US literature, and often as 'leats' in British usage.
reef	A well-defined vein of mineralised ore.
rock drills	Term applied to all compressed air-driven drills used to bore holes for explosives. See <i>drifter drill</i> .
rock-breaker	A machine for crushing large pieces of ore before more refined crushing occurred. Three types were built, one consisting of a fixed and a reciprocating jaw set on an angle so as to progressively reduce the rock to a smaller size (<i>Blake</i> type), the second type had rollers instead of jaws, and the third was conical with a gyrating conical muller inside it. Also called 'stone breakers' and 'jaw crushers'.
rolls	Sets of rolls were used at some early gold mining sites to crush ore, but were replaced by the stamper <i>battery</i> . Also used to refer to a rock-breaking machine with steel rollers to crush ore passed between them, sometimes used to crush material to be smelted. Also called 'roller crushers' and <i>Cornish rolls</i> .
screens	See <i>jigs</i> , <i>grizzly</i> , <i>shaking screens</i> , <i>trommels</i> .
shaft	A hole that is deeper than its maximum dimension across at ground level. It may be vertical or inclined. Commonly seen on alluvial fields where they are dug to access <i>washdirt</i> , and in hard-rock country to access ore-bearing leads or coal seams.

	Usually equipped with a <i>windlass</i> or <i>poppet head</i> . Major shafts are commonly divided into two or three sections, one or two being for raising and lowering <i>cages</i> , and the third for a ladderway and piping.
shaking screen	A machine used to separate large from small pieces of ore, or in coal mining used to separate small coal before the larger coal moves on to the picking belt. Cylindrical screens are called <i>trommels</i> .
skip	A rail mounted wagon or container used for hauling material at a mine. Either fitted with a door for easy unloading, or able to be tipped.
slimes	Finely-divided tailings resulting from the crushing process, which remain in suspension in water for a long period.
spitzkasten	See <i>classifier</i> .
stope	An underground excavation formed by the extraction of ore. Sometimes exposed at the surface by working an ore body upwards, or by later open cutting of the deposit (an 'open stope'). <i>Stulls</i> are inserted into the stope to support the roof and provide a working platform.
surfacing	The removal of surface soil for treatment to extract gold.
tables	A machine with a table-like surface covered with <i>riffles</i> and used for the <i>concentration</i> of heavy minerals. It is given a horizontal shaking motion and the pulp, which is passed over it, is sorted according to weight. A common type is the <i>Wilfley table</i> . In a gold <i>battery</i> the tables were sloping shallow boxes set below the discharge of the <i>mortar box</i> , and consisting of <i>amalgamating tables</i> and <i>blanket tables</i> . Sometimes shaking tables were also included.
tailings	Rock, earth, gravel, sand etc that is the residue from the separation or other treatment of washdirt or ore by water. Different types of tailing can indicate different mining processes (see Ritchie 1981 and McGowan 1996b).
trommel	A cylindrical screen or sieve used to separate ore or minerals from larger rocks. The trommel could operate dry or wet. The screen was placed at a slight angle, and rotated by a machine. Material was loaded at the higher end, and the smaller mineral-bearing particles passed through the screen holes, while the larger material continued out the end of the trommel. Water could be sprayed through the material to assist in the separation process.
tunnel	A passage in a mine that is open to the air at both ends. (Often used in mining parlance to describe (inaccurately) an <i>adit</i> , which is only open at one end.) underlay Also 'underlie'. An <i>inclined shaft</i> following the dip of an ore body.
vanner	A concentrating machine in which minerals are sorted according to weight by running the mineral in suspension onto an inclined continuous belt washed by streams of water. <i>Tables</i> largely replaced vanners in most fields. A common type was the 'Frue vanner'.
Wheeler pans	A machine for crushing ore. Consisted of a circular pan or bowl with a circular steel die set into its base, like the bottom stone of a flour mill. A circular steel muller rotated by a central shaft ground ore against the lower die. Usually used to regrind gold ores with mercury added to amalgamate released gold.
Wilfley tables	Perhaps the most common form of <i>concentrating table</i> used at Australian gold mines. Wilfley tables, invented in 1844, had a slightly sloping table top, linoleum coated, with timber <i>riffles</i> of gradually reducing size attached to its length. The table was shaken and water and crushed ore poured down it, the fractions of the mixture being sorted by weight as they travelled across the table.
winding engine / winder	Steam or electric machinery that hoists and lowers the <i>cages</i> in a mine shaft. Winders often have two drums around which the cable is wound, one letting out cable while the other takes it in, thus raising and lowering cages at the same time in adjacent compartments of the shaft (see Wegner 1995 for examples).

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