Worthing Mine and its historic enginehouse

G.J. Drew

Department of Mines and Energy, P.O. Box 151, Eastwood, S.A. 5065.

J.E. Connell

State Heritage Branch, Department of Environment and Planning, G.P.O. Box 667, Adelaide 5001.

The Worthing Mine near Hallett Cove, 20 km southwest of the city of Adelaide, belongs to Australia’s first mining era, which took place in South Australia between 1841 and 1851 (Figure 1). Operations began in 1849 only six years after the commencement of metal mining in Australia at Glen Osmond. Although not as historically significant as Glen Osmond (1841), or the much larger copper mines of Kapunda (1844) or Burra (1845), its importance lies with its Cornish enginehouse and chimney.

The Worthing enginehouse, built in 1851-1852 is the oldest remaining in Australia and certainly the most significant relic of Australia’s first mining era. Six other stone enginehouses were built during that period: at Kapunda in 1848 and 1850; at Burra in 1849, 1850 and 1851; and at Tungkillo in 1849. All of these houses have long since disappeared although the foundations of one (Kapunda, 1850) still remain. The significance of the Worthing site is enhanced by its magnificent environmental setting in the bare, steep valley of Field River.

Currently (1986) the Worthing Mine is the only site within the City of Marion which is on the Register of State Heritage Items. The site is also included in the Classified List of the National Trust of South Australia and on the Register of the National Estate.

History

In 1847 brightly coloured copper ore was found on the property known as Worthing Farm belonging to John and Alfred Hallett. It is not recorded who made the discovery but, as at Kapunda and Burra, it may well have been a shepherd. Samples were assayed in England and an association of ten members was formed, each subscribing £1000 to prospect the property. A mining captain and five miners from Illogan, Cornwall, were dispatched to the Colony and within 12 months of their arrival they had proved ‘the existence of large and well defined copper lodes on the property’.

The mine captain was John Phillips, who had worked as a mining surveyor in Cornwall. Phillips established a similar business at his residence in North Adelaide, consulting to a number of other mines including Kapunda and Tungkillo. He eventually became Surveyor-General in N.S.W. in the 1870s. Amongst the miners was Zacharias Carthew and family. His son Stephen worked as a picky boy at Glen Osmond and as a miner at Kapunda, Burra, Moonta and, later, Broken Hill.

As a result of the encouraging results the Worthing Mining Company was registered in July 1849. Richard and David Hallett were two of the English directors and John Hallett, Frederick Beck, and William Sandford, members of the colonial committee. The company consisted of 10 000 shares of £10 of which 7000 shares at £2 deposit were to be issued and 3000 shares were given free to the promoters of the company and the vendors of the Worthing Estate. Nearly 5000 shares were issued in the first year and from the money raised, £4000 was paid to the Halletts for the part-purchase of 880 acres of the Worthing estate (Figure 1).

First mining operations

During late 1849, mining operations began in earnest under the general management of Alfred Hallett with Captain John Richards as underground manager. Four men commenced sinking a whim or engine shaft at a location determined by Captain Phillips and another four men were set to work sinking an experimental shaft, known as Middle Gully Shaft, midway between the two original workings. The other principal shaft was Waterwheel Shaft. By December 1849, Phillips had decided that the Middle Gully Shaft would probably be the best location for the engine, particularly if the lode was intersected.
Figure 1 Locality plan.
Tenders for the erection of six miner's cottages and a horse whim were advertised in September 1849. A Cornish beam engine and waterwheel was ordered from Cornwall, the engine being purchased near new for £500.

The horse whim was erected at the Waterwheel Shaft and completed by the end of 1849 at a cost of £65. This shaft, measuring 9 feet by 6 feet, was sunk by six miners and three labourers at £14 per fathom. The six stone two-roomed cottages were completed at a cost of £343. Arrangements for the erection of two additional pairs of cottages (making ten in all), captain's residence, office, stores, and powder magazine were made in March 1850 and completed by the end of that year when a small community of about 100 had developed.

The cottages were located on section 496 on high ground near the present highway where evidence of them remained until the 1960s when the Hallett Cove housing development removed the last traces.

The other mine buildings were located on section 505 near the mine workings.

By mid-1850 the main activities were the sinking of Waterwheel Shaft and Engine Shaft in Middle Gully. Waterwheel Shaft was down 84 feet and was being sunk by six miners and five labourers at £32 per fathom, the men having to haul their own rock and water using the whim. The Middle Gully or Engine Shaft, sunk by six miners and three labourers, was down 54 feet but work was suspended in June 1850 awaiting the erection of a second whim to remove water. This whim was erected in July but was not of sufficient power to keep the water down and work was again suspended pending the erection of the steam engine nearby.

Waterwheel Shaft had reached a depth of 141 feet by September 1850 but the sinking of Middle Gully (Engine) Shaft was still suspended awaiting the erection of the steam engine.

Figure 2 Site plan, 1986.
The enginehouse

Specifications for the enginehouse were completed and tenders for its erection were called in October 1850, with plans and specifications held by Captain Phillips at his North Adelaide residence or by Mr Ham, the engineer, at the mine.12

Construction of the enginehouse adjacent to Engine Shaft was not completed until August 1851 when the engine went to work keeping the water ‘in fork’ at four and a half strokes per minute.13 By this stage sinking of Waterwheel Shaft, which had reached 210 feet, had been suspended owing to the influx of water. The long delay in erection of the enginehouse was apparently caused by a difference of opinion between Captain Phillips and engineer Ham over specifications for the engine bed and walls of the house, Phillips considering that they were not of sufficient strength.14

Mine closure

Captain Phillips’ services as Inspecting Agent were terminated by the colonial committee of management prior to commencement of the engine ‘due to his overbearing and dictatorial manner to them and other parties on the mine’.15

Following commencement of the engine, any unnecessary work was discontinued and labour concentrated at Middle Gully (Engine) Shaft, where the lode was increasing in width with depth. The waterwheel was still on site awaiting erection.

By now the Company had realised it had made a mistake in virtually working three mines instead of one: that is, in sinking three shafts half a mile apart instead of concentrating their efforts at one site. Lack of results by the Company was reflected in the value of the £4 shares which had fallen to 13 shillings during 1852. The Adelaide correspondent for the London Mining Journal suggested that shareholders try to cut their losses by attempting to recover the original amount paid for the property:

Will the shareholders of the Worthing Mining Company condescend to take wholesome advice? Perhaps not; but I will, nevertheless, place on record that advice, so that, after they have fooled away a few more thousands on property not worth as many hundreds, they may repent not having taken it.16

Engine Shaft reached 156 feet by the end of 1852 but operations were suspended owing to the exodus of miners to the Victorian Goldfields.

No further work was carried out until early 1856 when a contract to sink the engine shaft to intersect the lode at 300 feet was let to Captain Alfred Phillips for £2000. Alfred Phillips, who had been captain for several years of the Tungkillo Mine near Reedy Creek, was expected to provide all materials and sink at the rate of 12 feet per month.17 The engine was restarted in April 1856 forking the water to the bottom of the shaft within three weeks and allowing sinking to proceed.18 However this second period of operation of the Worthing engine was shortlived for, by the end of 1856, operations at the Mine had ceased and in 1857 the Company transferred operations to the recently purchased Bremer Mine near Callington.

The heritage

Enginehouse (Figure 3)

The building, built of bluestone (limestone) from the site, at first glance seems similar to the Cornish pumping enginehouses at Moonta (Hughes) and Burra (Morphets) but closer inspection indicates significant differences. There is no bob wall, all upper openings being windows, and the internal structure also differs. The enginehouse measures 11.3 m long by 4.8 m wide. The adjacent boilerhouse, now in ruins, measures 11.8 m long by 4 m wide and housed one Cornish boiler.

The floor is an irregular arrangement of stonework; how this suited the engine is described later. External to the eastern wall is a large collection of stones, partly in their originally man-made positions and others disturbed. These comprised the base for the winding drum operated by the crankshaft passing through the lower front opening in the eastern wall.

Chimney

This is a typical Cornish chimney, 2.75 m diameter at the base and about 20 m high. It is built of random bluestone with red brick cap on a rise above the enginehouse. Evidence for the location of the flue is the slightly domed ground which sweeps in an arc from the northern end of the boiler house to the chimney. There is no visible connection of the flue with the chimney.

Engine (Figure 4)

Few details of the engine are available but the enginehouse, standing largely intact except for its roof, enables a general description of the engine to be given.

From the S.T. Gill sketch of the Draft enginehouse at Kapunda Mine (Plate 1) it can be seen that the Worthing enginehouse was almost identical externally and that the engine was similar but arranged ‘opposite hand’.

Newspaper reports confirm that the engine at Worthing was double acting with a cylinder 22 inches in diameter and a stroke of 6 feet. In September 1850 Captain Phillips reported to the director of the Company:
Figure 3 Enginehouse detail.
Figure 4 The Worthing engine.

Figure 5 Operation of pump and flat rods.
I advise you at once to erect the 22" engine on the Middle Gully Shaft (now 11 fms) taking care to place the machine so as to serve ultimately for winding.19

From the proportions of the building and the arrangement of stonework at the base (Figure 3) the following description of the engine can be given with reasonable certainty (Figure 4):

- It was a double acting steam engine with vertical cylinder 22 inches in diameter and a stroke of 6 feet.

- A horizontal beam 18 feet long was pivoted on a wooden cross member built into the side walls of the building. One end of the beam was connected by a linkage to the top of the piston rod which caused the beam to oscillate. The other end of the beam was connected by a sweep (or connecting) rod to the crank on the main shaft. The crank shaft was extended through the eastern wall of the building, on the outside of which was a crank to drive flat rods to operate a pump in the shaft (Figure 5), and a winding drum for hauling from the shaft. A dog clutch would have enabled the driver to engage gearing to drive whichever of the two functions was required.

- Inside the house adjacent to the eastern wall was a flywheel 12 feet in diameter, on which was a brake band with toggle action operation to stop and hold the engine while hauling.

- Steam was supplied from a single Cornish boiler housed on the western side of the engine house. Probably wood fired, it would have supplied steam at a maximum of 50 pounds per square inch by a steam pipe passing through the engine house wall.

- The engine would be reversible by means of the linkage which operated the valves.

- Being double acting, steam was admitted alternatively to each end of the cylinder and discharged to a condenser in the pit under the engine base.

All of the engine components were completely enclosed within the house.

The base on which the winding drum stood can still be seen outside the eastern wall of the house and the stonework of the boiler house lies on the western and northern sides (Plates 2, 3 and 5).

In 1860 the engine was transferred to the Bremer Mine, owned by the Worthing Company. There it was installed as the third engine on the mine to operate winding, crushing and dressing equipment (Plate 4). It was installed in a half house only: that is, only the cylinder was housed, its diameter of 22 inches being confirmed by newspaper reports.20

These rotative beam engines were still very much the same as the first rotative engines built by

Plate 1 S.T. GILL (1818-1880). Kapunda Copper Mine. No. 1 Enginehouse and Sectional Sketch. 1849. This contained a 36-inch Cornish beam engine, known as the Draft Engine, which operated pumping, winding and crushing machinery. Note the winding rope and flat rods which transmitted power to the pump shaft at left. Collection: The Art Gallery of South Australia, Adelaide.
Plate 2 Worthing mine around 1956. Note the intact boilerhouse wall at the right hand end of the enginehouse.

Plate 3 Worthing enginehouse in 1986 (east wall). A winding drum was mounted on the pile of stones beside the front opening. Note stones on right from collapsed boilerhouse wall.
Plate 4 Bremer Mine around 1863. The enginehouse (left) contained a 60-inch Cornish pumping engine erected in 1859. The centre building with the chimney held the 22-inch engine transferred from Worthing Mine in 1860; this engine powered a crusher in the building at right.

Plate 5 Worthing enginehouse and Engine Shaft. In left foreground is the levelled area for the whim (whim plat). The collapsed shaft (right) has a masonry block for the pump mounting. Flat rods connected the pump with the driveshaft mounted on left side of enginehouse. A flue connecting chimney and boiler runs in an arc just right of the track.
James Watt in 1781. Wooden construction had changed largely to iron, and steam pressures had increased from 5 pounds per square inch to 25 or 40 and the valve gear had improved considerably.

By 1850 small horizontal engines were available but were not readily accepted by all Cornish miners and were probably more costly than a second-hand beam engine, although this saving would be more than offset by the cost of the engine house.

Rotative beam engines continued to be built for some years, the last to be installed new in South Australia was Hancocks in 1875 at Moonta Mines.

An almost identical engine and enginehouse at the Levant Mine, Cornwall, was inspected by one of the authors (G. Drew) in 1985 (Plate 6). This houses a 24-inch double acting rotative beam engine. Plates 7 to 12 show the internal layout of the Levant house and the arrangement of stonework at Worthing from similar positions by way of comparison.

The lode

Although several lodes were reportedly discovered on the property, operations were confined to the one considered to be 'the champion'. This lode, which can be clearly identified on site, averages 1.5 m in width and occupies a fault zone extending through the property in a northeast-southwest direction (Plate 13). The three main shafts occur along the line of this lode.

Shafts

Two shafts, both collapsed, are evident about 40 m north of the enginehouse. One shaft is directly in line with the winding drum mounting on the eastern side of the house. A level platform, obviously for a horse whim or man capstan, is adjacent to the shaft and a large masonry block, presumably for the flat rod operated pump mounting has toppled into the shaft crater. This is clearly the shaft referred to as Middle Gully (Engine) Shaft, sunk midway between the two original workings. The other shaft, about 40 m to the west, is probably a ventilation shaft connected to Engine Shaft.

A third shaft, about 500 m northeast of the enginehouse, borders a horse whim platform with dry stone walling (Plate 14). The whim plat and the fact that the water level in Waterwheel Shaft was reached at 55 m suggests that this shaft is Waterwheel Shaft. However, how water was to be conveyed to a waterwheel at this site remains a mystery.

A ditch (leat), almost certainly designed to convey water from a dam in a spring-fed tributary of Field River about 200 m east of the enginehouse, can be traced for about 200 m. It is possible that this water was to feed the water wheel that arrived on site in 1850. However it is not certain that the wheel was ever erected as there is no evidence of its location. The wheel was still on site in 1872 when Henry Ayers, secretary of the South Australian Mining Association, reported its existence to his manager at the Burra Mine. At that time Burra was looking for a replacement for its worn out 32 feet diameter waterwheel and, hence, the Worthing wheel was probably of similar dimensions. Such a wheel would have required a substantial wheel pit which should still be obvious today.

The adit

An exploratory adit about 80 m northeast of Main Shaft was driven about 30 m in a northwesterly direction to intersect the lode. About half way along the adit the quartz lode was intersected and a winze sunk about 18 m. The entrance to the adit was closed in 1985.

Conclusion

Although the mine was insignificant as a copper producer the site gives an insight into how a mine, barely able to justify steam power, was arranged in the earliest period of mining in Australia. The Worthing enginehouse is important because it reveals how the small beam engine was used to provide power for a number of purposes.

The site is of national and international significance as it contains the oldest remaining enginehouse in Australia. This should be preserved in its original setting.

NOTES:

2. S.A. Gazette, 5 December 1850.
4. S.A. Gazette, 4 December 1851.
5. Mining Journal, 26 January 1850.
6. S.A. Gazette, September 1849.
8. ibid, 14 March 1850.
9. ibid, 28 September 1850.
10. ibid, 12 October 1850.
11. ibid, 21 December 1850.
12. S.A. Gazette, 26 October 1850.
14. ibid, 6 March 1852.
15. ibid, 8 November 1851.
16. ibid, 26 June 1852.
17. ibid, 14, June 1856.
18. ibid, 2 August 1856.
19. ibid, 21 December 1851.
20. Register, 13 May 1861.
Plate 6 Levant Mine, Cornwall, in 1985. A 45-inch pumping engine was housed in the right hand building. The building at left housed a 24-inch winding engine and is almost identical in layout to the Worthing enginehouse.
Plate 7 Levant engine steam pipe (centre) can be seen connected to the top of the cylinder.

Plate 8 Worthing enginehouse, similar view. The cylinder was mounted on the stonework at rear and a fly wheel in the long slot (extreme left). The pit on top of stonework in the foreground housed a crank shaft.

Plate 9 Levant enginehouse showing beam connecting rod and fly wheel.

Plate 10 Worthing enginehouse, similar view showing fly-wheel slot (far right) and crank pit. A drive shaft passed through the small opening at right and a condenser and air pump were located in the cavity in foreground.
Plate 11 Levant enginehouse beam on upper floor; this iron engine beam is about 5 m long.

Plate 12 Worthing enginehouse. The upper walls show holes for flooring joists (back wall) and openings for the wooden beam (side walls) which provided the bearing for the cast iron engine beam.
Plate 13 Worthing mine looking southwest along the lode which crops out in right foreground. Two shafts are located in the small gully to right of the enginehouse. An adit near the olive bush (centre) intersects the lode.

Plate 14 Whim plat (left) bordered by a partly collapsed dry stone wall adjacent to the shaft (right) located 500 m northeast of the enginehouse.