Heritage Award Nomination

of

ADELONG FALLS GOLD MILL RUINS
THE REEFER BATTERY

for the award of an Engineering Heritage Marker

Reefer Battery ruins Adelong Creek *courtesy of Chris Russell*

by
Doug Boleyn
Sydney Engineering Heritage Committee
October 2012

Table of Contents

Glossary

SMH	Sydney Morning Herald
TCJ	Australian Town and Country Journal
DMR	Department of Mineral Resources
T&A Times	Tumut and Adelong Times
TW	Tom Wiles

Terms

also refer Appendices 3, 4, 5, 6

Adelong Falls Reserve	The Adelong Falls Reserve, Reserve R88410, comprises 20 parcels of reserved Crown Land [including a large northern area, comprising 2 lots, that is under licence to a neighbouring landholder], 2 road reserve parcels, and 4 [at present] land parcels or part parcels of 'unidentified' tenure/ status; in total 61.22 hectares.
Adelong Falls Gold Mill Ruins	the ruins of the Reefer Battery.
Amalgam	mercury mixed with any other metal.
Amalgamation	collection of gold, silver etc. by passing the crushed ore over or through mercury troughs – mercury combines (amalgamates) readily with most other metals**.** *[Amalgamation treatment of gold and silver ores was known to the Romans]*
Amalgamation Tanks	(tables) shallow troughs lined with mercury coated copper plates.
Assay	the testing of ore to determine the content of valuable minerals. Can be wet or fire.
Battery	A **stamp mill** (or **stamp battery** or **stamping mill**) is a type of mill machine that crushes material by pounding rather than grinding, either for further processing or for extraction of metallic ores. In most literature a battery refers to a mill not just a stamper battery.
Berdan [pan]	a hemispherical iron pan that revolves on an inclined axis and with either heavy drags a heavy iron ball. Tailings or concentrates are added to the pan and are ground by the drag or ball against the lower part of the pan to a very fine state to release the fine gold. *see description Appendix 5*
Backshot	*ref to waterwheels* – the wheel rotates in opposite direction to the inflow from the flume. Also referred to as *pitchbac*k and *reverse overshot.*
Blanketings	the washings from the washing of the blankets
Blanketing Tables [Strakes]	a shallow sloping trough lined with a specially made heavy corduroy textile – with the corduroys running across the table, or sacking to catch free gold particles.
Buddle	a machine for separating particles based on their specific gravity. Material is distributed across a circular concave surface with rotating sweeps pushing the material up-slope and a water current washing material downwards. The heavier materials concentrate on the upper outer slope of the buddle and the lighter material is washed down towards the centre and removed. *See description Appendix 5*
Casing	is the contact zone of the quartz vein with the native rock side walls, often rich in sulphides and sometimes carboniferous shale.
Chilean Mill	variously spelt *Chillian*, *Chilian* It consist of a pair of heavy wheels erected vertically, which rotate on a horizontal axis while being revolved around a central pivot in a circular trough. to further reduce the particle size of the crushed ore – pulp [to around 100 micron], from the stampers *see description Appendix 5.* *[These mills were o*riginally developed for Chilean silver mines.*]*
Concentrating Shoot / Chute	a tapered "V" shaped trough, divided into compartments, narrow at the top end and widening so that only the heavy introduced tailings fall into the 1st compartment, finer into the 2nd , fine in the 3rd and slimes in the last . [the aim of the concentrator is to separate the heavy valuable materials from the light worthless gangue].
Crusher/ Rock Breaker	there were 2 types: one has 2 jaws, one of them movable, the other has an eccentric head rotating in a funnel shaped chamber.

Dry crushing	stamper batteries used no water when initially crushing the introduced ore.
Extraction	the process of taking out the good ore or targeted metal from the waste materials.
Frue vanner	a rotating belt with adjustable slope onto which crushed material is placed and a flow of water maintained. The heavier particles settle on the belt and are carried up a slope by its movement and the lighter material is washed down the slope.
Leader	a thin vein of quartz or can be just sulphides, that is followed along in a drive or rise until it "makes" or gets wider.
Long Tom	is a long washing/ sluice box/ trough used in alluvial mining 6-12 feet long with an extension at the top end to receive gravel and with a perforated screen to catch larger-sized rocks and debris and under the screen, a riffle or sluice board to trap gold particles.
Mullock [heaps]	the unwanted spoil from the mine.
Mullocking	fossicking on a mullock heap.
Mundic	is a Cornish word for pyrites which generally is iron pyrites but can contain copper and arsenical pyrites.
Pulp	the product of the stamper batteries – fine' sugar grain' size
Quick silver	mercury
Reverberatory Furnace	a furnace with a long shallow hearth - like a bread oven, with a low arch. The fumes travel in a wave action (reverberate) to the flue. It is used to burn off (roast) the sulphur in the pyrites.
Riffled	provided with riffles (or ripples) i
Ripples/riffles	low transverse ridges on a table or in a trough or shallow well/ groove about 3ins wide cut in the bottom of the table [riffle board] or trough and sometimes filled with mercury.
Shaking table Percussion table	gravity device, there were various manufacturers and patents. In the early days they held baths of mercury. The aim was to force contact between gold particles and the mercury which might be in wells on the table. Later tables had just riffles without mercury. eg Card, Wilfley etc.
Slime	that portion of the crushed ore which is minutely subdivided
Stamper battery	a multiple headed machine that reduces the size of introduced "stone' by dropping heavy weights – stamps, onto the ore to break it down to less than ~ 2mm - see Appendix 5 for a fuller description.

Cornish stamps are stamp mills that were developed in Cornwall for use in tin mining in around 1850. Cornish stamps were used to crush small lumps of ore into sand like material. Constructed from heavy timber or iron lifters with iron "heads" at the bottom were raised by cams on a rotating axle, and fell on the ore and water mixture, fed into a box beneath. The heads normally weighed between 4 and 8 cwt each, and were usually arranged in sets of four, in timber frames. Small stamps were commonly powered by water wheels and larger ones by steam engines.

Californian stamps were based on Cornish stamps and were used in the Californian gold mines. They had heavier round iron stems and stamped at a faster rate. The heads and lifters mechanism was designed to rotate so that they wore more evenly. The other advantage of the Californian stamp was that a single head could crush 1.5 tons/day as opposed to the Cornish stamps which could only crush 1 ton/ day.

Stone	auriferous quartz, if the reef was narrow it would include the parent rock – a hard granite.
Surfacing	washing of auriferous soil from slopes leaving bare rock
Tailings	the ground up ore after most of the gold (or silver etc) has been extracted
Tributor(s)	A person(s) who works another's claim and shares the cost and profits on an agreed commercial basis
Trituration	the process for reducing the particle size of a substance by grinding,
Troy ounce, pennyweight, grains	*see below*
Well	a deep mercury trap
Wet crushing	stamper batteries use water when initially crushing the introduced ore

Measurement and Terms

hp	horsepower 1.0 hp = 0.746kW
rpm	revolutions per minute
1 load	~ 23 cubic feet of ore = a dray load actually around 20 hundredweight [cwt]

Currency

Prior to 14 February 1966 legal tender was expressed in pounds [£], shillings [s] and pence [d]

1 pound [£] = 20 shillings [s] 1 shilling [s] = 12 pence [d]

Gold Mass System

The traditional unit of mass for gold in the imperial system is the *troy-ounce*.
Despite the gradual conversion to the metric system, the troy ounce remains a traditional fixture of the gold trade.

1 [International] avoirdupois ounce	= 28.349 grams
1 troy ounce	= 31.103 grams

[1 troy ounce is approximately 1.09714 avoirdupois ounces]

The troy ounce also know as a *fine ounce* is again divided into pennyweights [dwt] and grains

1 troy ounce	(oz)	= 20 pennyweights = 480 grains	1 grain = ~64.8 milligrams
1 pennyweight	(dwt)	= 24 grains (grs)	
32,150 troy ounces		= 1 metric tonne	

Changes to title of Department of Mines NSW ref Mineral Resources Library

Department of Mines NSW	1875 -1889
Department of Mines and Agriculture	1890 -1899
Department of Mines NSW	1900 -1980
Department of Mineral Resources	1980 -1982
Department of Mineral Resources and Development	1982
Department of Mineral Resources	1983
Department of Mineral Resources and Energy	~ unable to confirm
Department of Mineral Resources and Department of Energy	unable to confirm
Department of Mineral Resources and Office of Energy	~ unable to confirm
Department of Mineral Resources	1996 - 2004
Department of Primary Industry –Division of Minerals	2004 –
Department of Industry and Investment – Minerals and Energy Division	2010 -2011
Department of Trade and Investment	2011

Introduction.

Gold exploration, winning the ore and its processing, are a much romanticised part of Australian history because gold was one of the few ways in which men, who were poor and had little or no capital, could become rich – and at times fabulously so.

The Adelong Goldfield was among the earliest reef mining localities in Australia.
Payable alluvial gold was discovered in 1852 and gold mineralised in reefs in 1857.

The total yield of the Adelong Gold-field over a productive life of nearly 100 years is estimated to be 25 tons, as such, Adelong ranks as one of the major gold producing districts in NSW.
[NSW Department of Primary Industry Prime Facts 558 February 2007]

By the 1860s, Australia was producing 40% of the World's gold. [Aust Mining History Assoc Bibliography of Australian Mining History]

The Reefer Battery - now known as the Adelong Falls Gold Mill Ruins, is an integral part of the significant 19th century Adelong Goldfield mining landscape. Its significance relies upon those once productive sites along Adelong Creek with which the **Reefer Battery** had an important contextual relationship. It is an important reminder of the legendary 19th C gold rush era during which great wealth was produced for the Colony of NSW and as a result ensured the Colony's financial viability.

The Reefer Battery started life as the Reefers Battery upstream of the Reefers Battery site in 1858 and was re-established at Adelong Falls site in 1870 where it worked for a further forty-five years and in 1915 was the last mill to close on the Adelong Goldfield.

The then Inspector of Mines with the NSW Department of Mines [in 1878 appointed Chief Inspector] W H Slee who advised in his 1876 report on the Adelong Goldfields.

My practical experience of gold-mining during twenty-two years on the principal gold-fields of the Australian Colonies has led me to form these opinions. Ref 7 p 12

The Adelong Gold-field deserves better attention by *bon fide* capitalists. With capital judiciously invested, and prospecting carried out in a systematic manner, Adelong would take first rank among the gold-fields of New South Wales. Ref 7 p 12

The Adelong Falls Gold Mill Ruins are of engineering heritage significance because of:

- its place in the history of nineteenth century Australian goldmining. It is one of the few extant remains of the rich Adelong goldfield, a goldfield which few, if any, goldfields in Australia can match with the range of methods used to recover its gold;
- its association with important local figures and an important Colonial engineering works;
- its place as one of the early gold mills in Australia to come up with a solution for the processing of "mundic" - pyritical ore.
- the technical ingenuity and inventiveness of the owner/ operators of the mill in managing the machinery and processes to optimise the extraction of gold from the processed ore.
- its importance, as one of the four large mills[1] on the Adelong Goldfield with extended treatment processes; in contributing to the economy of the Colony of NSW through the processing of auriferous ore.
- its research potential for the evolution of mineral – in particular gold ore, processing technology and treatment over the latter part of the nineteenth century.
- what can be achieved by determined heritage advocacy of a community to preserve its local heritage.

1. The *Gibraltar* had 40 head of stamps, the *Perseverance* 20, the *Great Western* 16 and the *Reefer* 15. The Reefer was the last mill on the Adelong Goldfield to close.

Indeed Slee was correct in writing in the NSW Mines Department 1876 Annual Report [Ref 7 p11] regarding the *Reefer Battery*:

….the [mill] is one of the best, if not the very best, on the goldfields of New South Wales.

and later stated …

The quartz crushing and gold-saving machinery [that makes up the Reefer Battery] is a credit to New South Wales, and ranks foremost of any in Australia. [Ref 7 p11]

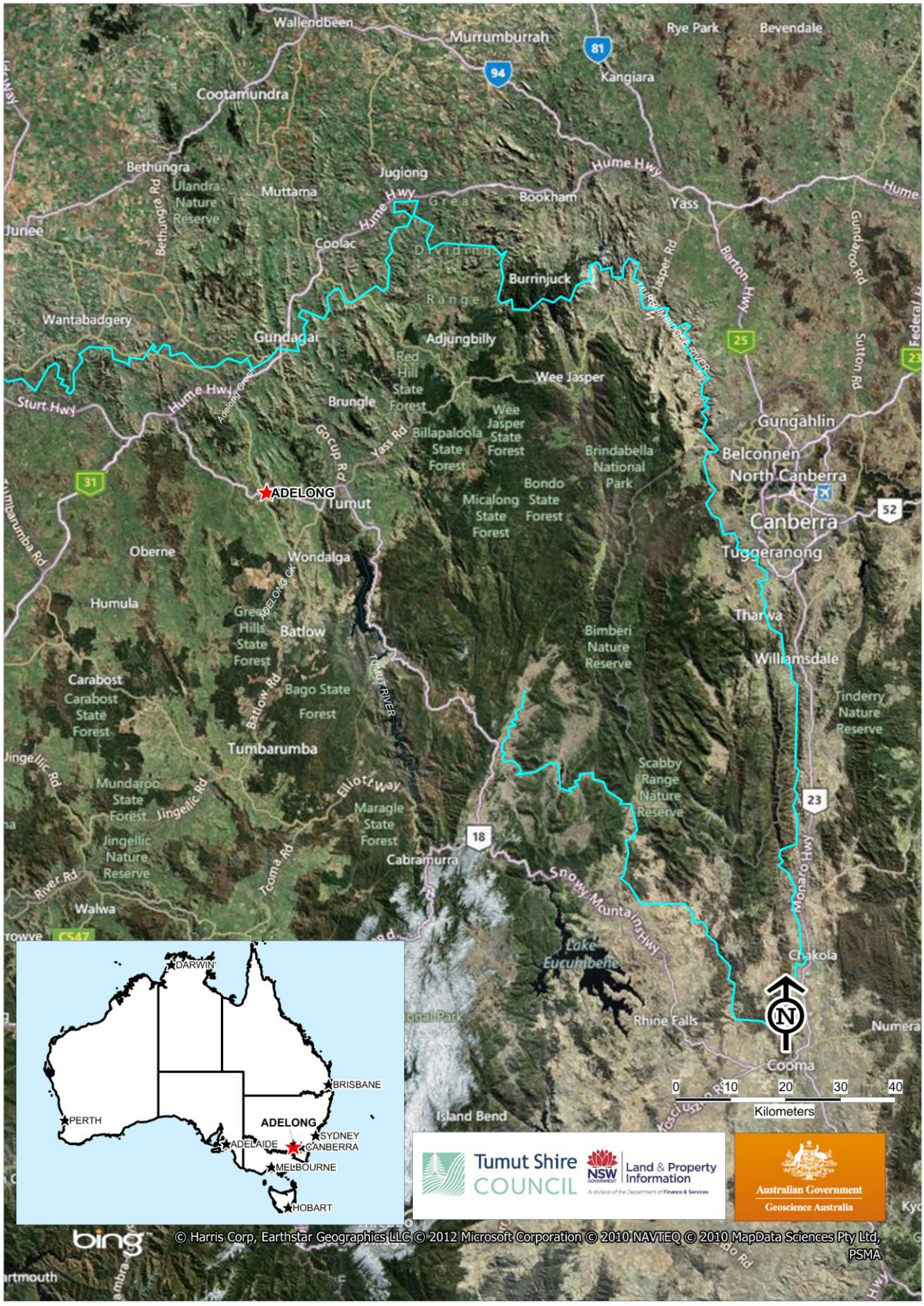
Following evaluation of these values - *refer Appendix 8,* it is recommended that Adelong Falls Gold Mill Ruins - the Reefer Battery, and associated infrastructure be recognised by Engineering Heritage Australia the award of an **Engineering Heritage Marker.**

Comment:

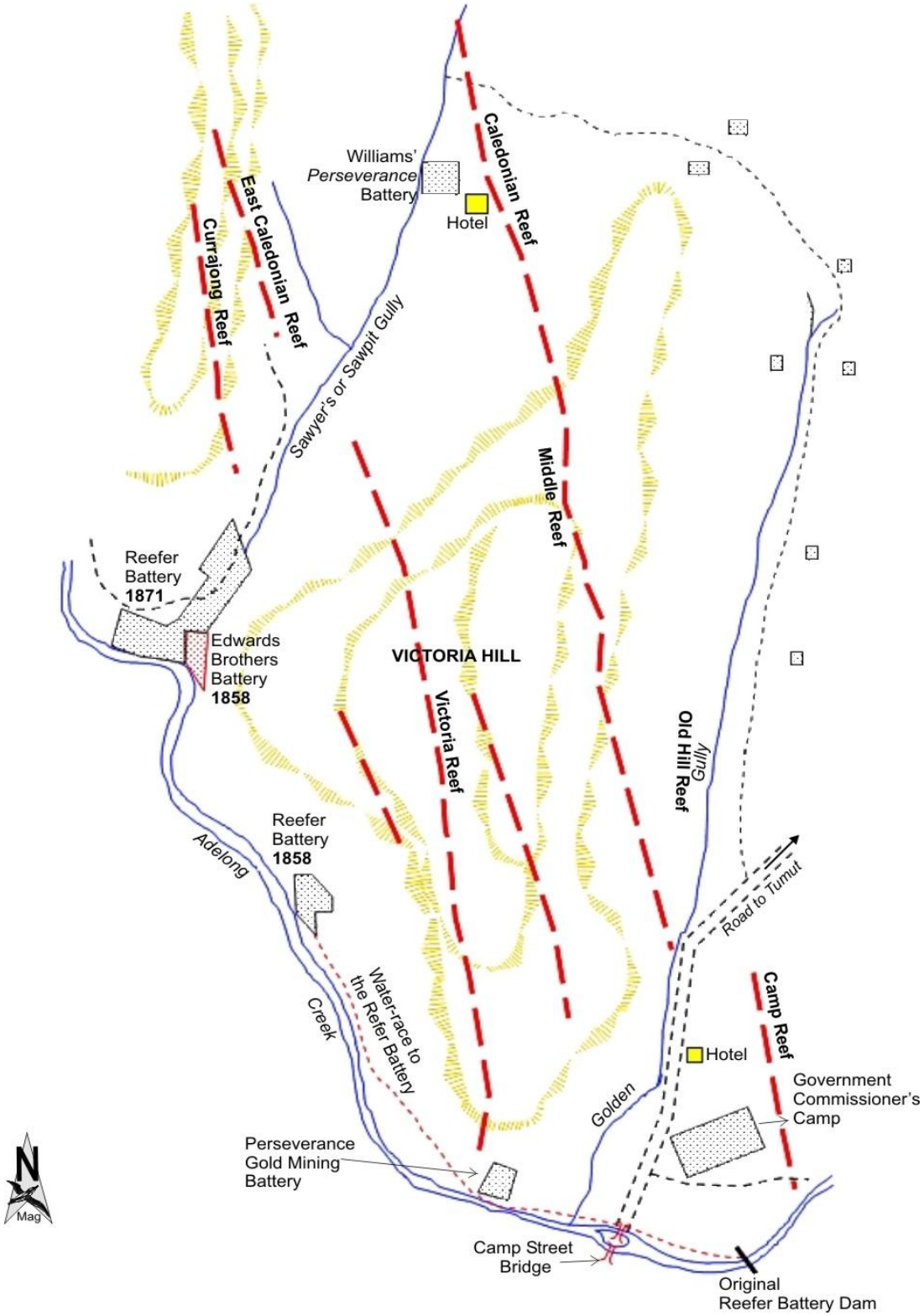
1. *The name of the mill complex **The Reefer Battery** is believed to have come from the nickname of the initial manager of the battery at its 1858 site John 'the Reefer' Carmichael.*
   *In its original site it was known as The Reefer**s** Battery. Even when the mill was relocated to a new downstream site in 1870, and grew through the addition of further processing stages, it was named the Reefer Battery and remained so throughout its life.*
   On occasions, it was also referred to by the names of its owners - Wilson Battery, Wilson & Co [Ref 7 p7] Wilson and Ritchie Battery, Wilson & Ritchie Quartz Crushing Mill and later the Ritchie Battery.
   The name of the proprietary company was The Reefer Quartz Crushing Company.

2. *The Inspector of Mines of the newly established NSW Department of Mines W. H. Slee [later Chief Inspector] states on p 12 of his 1876 report "My practical experience of gold-mining during twenty-two years on the principal gold-fields of the Australian Colonies has led me to form these opinions, and I have no other object in view in writing this report than to place our gold mines on a sound and legitimate footing"*

4. *Throughout the document the author has used the name **Reefers Battery** for the original 1858 mill and **Reefer Battery** for the 1870 mill.*



Aerial Photograph showing the location of Adelong and Surrounding Townships



Sketch map showing Reefer Battery and Victoria Hill the gold bearing reefs and other historical features.

Source Ref 3 p 49

Plan of Reefer Battery post 1882 Ref 5 p 106

Basic History

Pre European History

The Adelong district is situated near the boundary of the traditional lands of the Wiradjuri Aboriginal People to the west and the Nungunawal Aboriginal People to the east
To them, Adelong Creek was a movement corridor to and from the nearby Australian Alps for the summer feasting on Bogong moths.
The area is believed to be of traditional and contemporary significance - offering rock pools, food resources and materials, views over "Country" and sheltered sites.

History of the Adelong Goldfield

The only detailed descriptions of the Adelong Gold Field is that by Harper (1916) and Slee (1876) Ref 7 which is based largely on the study of those underground workings accessible at the time of their surveys and informed newspaper reports of the day. The history of mining operations at Adelong from 1875 to the present is outlined in successive Annual Reports of the then NSW Department of Mines.

Alluvial gold was first discovered on Adelong Creek in late December 1852 and this triggered a "rush" to what was to become the rich alluvial diggings at Upper Adelong near Batlow. The government of the day control of mining by the diggers was by the NSW Gold Fields Management Act, 1852 [16 Vic. No 43]. Many diggers en route from central NSW to the newly discovered Victorian goldfields detoured to these new finds to "try their luck" and in the process made discoveries on Adelong Creek working downstream to take up the first claims close to the present township of Adelong. By 1853, prospectors had worked down as afar as *Curran's* boundary – *Rimmers Crossing* [the site of the present town bridge]. Finds of rich alluvial gold in *Golden Gully* in late 1854 began a rush of miners of many nationalities to this area. Claims along the creek and its tributaries were quickly staked and a rough hut and tent settlements were established.
Ethnic identity became a feature of this landscape with the unofficial segregation of these camps. These camps were known via the nationalities of their residents as *Yankeeland*, *Chinkey Town*, *Irish Point,* and *Germantown.* [Ref 3 p21]
The Adelong Goldfield was officially proclaimed on 15 February 1855 by which time "over 2000 diggers" [2] were working Adelong Creek for "thirty miles along its course with shallow sinkings and surfacing [broad but shallow exploratory pits] on the hill-slopes" [2]. Evidence of the alluvial mining from the first two years after the proclamation of the Adelong Goldfield has long-since vanished under successive waves of activity.

It was not until May 1857 that the major reefs of the area were discovered by William Williams on the south-eastern side of Victoria Hill – *Victoria*, *Middle* and *Old Hill* Reefs.
By 1859 a number of prominent lines of mineralisation were being actively exploited.
It was at this time that alluvial deposits were discovered near Adelong Falls [TW].

In July 1859, *Colonial Mining* reported that in just two years after reef gold was discovered, there were 53 claims at work on these lines. Of these 32 had been and were being worked with good results. The returns from the 32 claims were, 7,953 tons which, when crushed, produced 54,238oz, an exceptional yield of nearly 7oz/ton.

The discovery of reef gold created a need for ore crushing facilities. Several portable crushers - limited capacity Berdan pans, were brought to the field but were unsuccessful in crushing the hard ore.
The township of Adelong was proclaimed on 5th March 1858.

2. It was reported in July 1858 there were over 3600 miners [and growing] on the Adelong field – Goulburn Chronicle 28 July

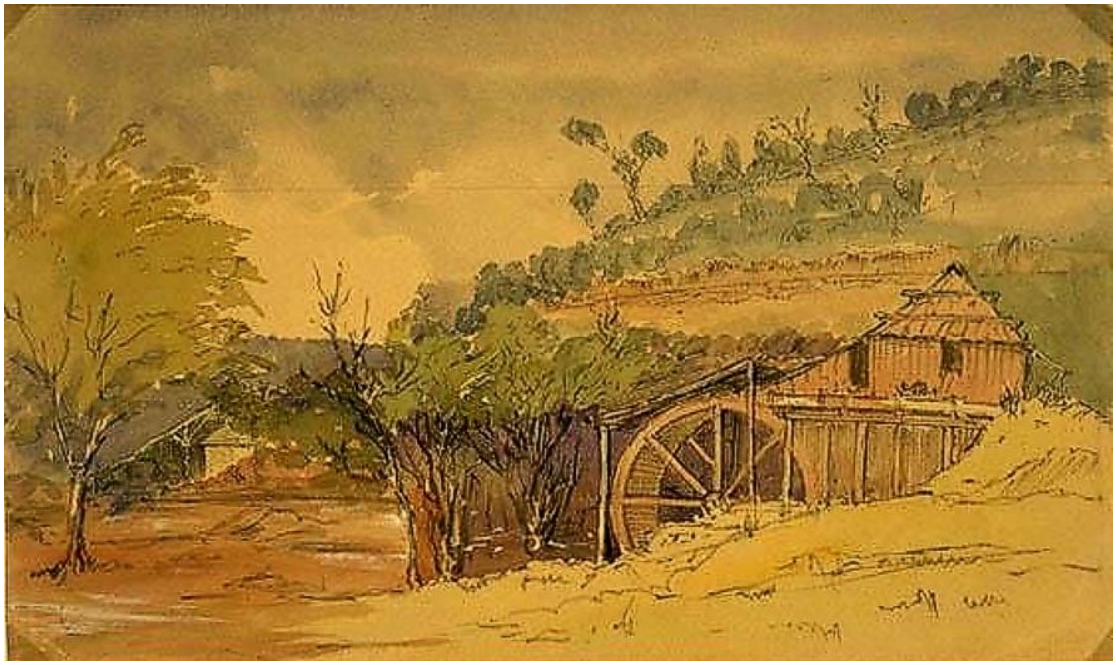
The first successful quartz crushing mill on the Adelong field was the *Pioneer* built for Samuel Emanuel[3] which commenced operation on the eastern side of Adelong Creek – on the right-hand side of Adelong Creek near to and down from the present bridge, in early 1858.

This steam-powered mill operated on the dry-crushing process and secondary crushing/ grinding was done using Chilean mills.
Comment: The first recognised mill in Australia commenced operation at Clunes Vic in May 1857 Ref 19 p103

David Wilson, who was to later be a longstanding owner of the Reefer Battery, came down from Sydney – as an agent of P N Russell & Co who were the manufacturers of the machinery [TCJ 31 08 1904 p 32-35], to superintend the erection of this battery.

Edwards Bros and Turner and Company in 1859, erected the second mill - variously called the "*Edwards Mill*" and later the "*Great Western Battery*"[4] – near the mouth of Sawyers/ Sawpit Gully and to ensure a reliable water supply constructed a dam upstream of the mill site across Adelong Creek and brought water via a water race [and possibly a section of flume] to the 18ft {5.5m] diameter overshot waterwheel which powered the mill machinery.
The mill had a six head stamper battery and operated on the dry-crushing process with secondary crushing of the pulp carried out by Chilean mills.

The incised 'granite' stream bed and its reliable torrent in the stretch of the stream bank upstream of the cascades, made it an ideal location to take advantage of the "free power" [so referred to by the mill owners of the day as neither boilers, fuel or engines were needed to produce power for the operation of the mills] that could be provided by the fast flowing stream to power the mills.



1870 painting by Edward Coombes {1830-1895] of Edwards mill. The building in the background housed Edwards' Denny pulveriser which was driven by a separate water wheel which was probably undershot. [Source NLA pic-an5945028-v]

The third mill to be erected was the water powered Walters Battery[4] - a water-powered 6-head stamper battery mill using a dry crushing process with Berdan pans.

Erected by the Reefer Quartz Crushing Company [RQCCo] and commencing operation on 18 May 1858 [Adelong Mining Journal May 27], the "*Reefer's Battery"* was the fourth mill to come into operation on the Adelong Goldfield.

3. The battery was shortly sold to the Mandelson brothers and George Wells
4. This sequence is taken from Ritchie's 1910 ledger No 7. Newspapers of the day give a different sequence of establishment of the mills.

It was owned by the Mandelson brothers [the major shareholders], John [*The Reefer*] Carmichael [Manager], Andrew Lemons, George Wells and later, David Wilson [the mill builder and engineer]. This mill was located a quarter of a mile [1.6km] below the present town on the right hand bank of Adelong Creek.

Beside Adelong Creek - off the southern end of Victoria Hill, William Williams [known later as *Old Gold Dust and* who discovered the *Old Hill Reef]*, followed with the next mill, the steam-powered *Perseverance Battery* on the upper reaches of Sawyers [also know as Sawpit] Gully at Williamstown. The mill also worked on the dry-crushing process and also used Chilean mills for secondary crushing

By the end of 1859, only 29 months after the discovery of reef gold, there were five mills worked by steam and four driven by water power; with one powerful steam machine and three additional water mills in various stages of progress [SMH 4 Oct 1859 p8] crushing the reef auriferous quartz that came from the nearby Adelong mines.

The principal geological formations in the field are granite and the auriferous lodes and ore deposits that was mined were mainly sulphide ores and while rich in gold was difficult to process. [Detailed descriptions of the physiography, geology and tectonics of the area are given in Ref 7]

Even at this early life of the Adelong field, the "*mundic stone*" – ore containing significant amounts of pyrites, when shaft depths of 40 to 50 feet [TCJ 7 Dec 1895] brought them to the refractory ores where the quartz, being unweathered, suddenly changed from a free-milling ore [the ore above this depth was weathered and allowed the gold to be easily recovered resulting in excellent early returns] to one that presented great difficulties in processing. The pyrites content below this level typically ranged from 8 to 16% [The Daily Telegraph 15 Aug 1896].

The first recorded encounter of mundic on the field was in May 1858 in the Reefers Battery.
E Ward Deputy Master of the Mint and Professor Smith of Sydney University commented in their Royal Commission Report: Ref 13

Their machine consisted of a battery of stampers and a Chilian mill. They put fifteen tons of the quartz through the machine in one continuous operation, and during the process eighty pounds of quicksilver was put into the basin of the Chilian mill. On "washing up' the product at the close of operation, they obtained only forty pounds of amalgam, which yielded sixty ounces of gold, while nearly forty-five pounds of mercury had "disappeared" altogether.
[At the time mercury was selling for around £25 [$50]/ 70.1lb flask] Argus 22 March 1884 p10]

Considering the trouble which the mundic gave the battery managers of the time, it is surprising that so much gold was produced by the original crushing equipment. The chances were for every ounce that was won another was washed into the creek as tailings.

The SMH 4 October 1859 p8 stated:
"The operation of crushing is now carried out to great perfection…. But the process of amalgamation has not been so successful. …. The result of the loss of quick-silver is, that mining operations are retarded in the district, as the cost of crushing and amalgamation is of necessity high, so that hundreds of tons of auriferous quartz are thrown aside that would be sent to the mills if the [loss] rate were lower.

Towards the end of 1859 as a result of the main source of gold being the mundic ore, gold yields on the Adelong field began to decline and as ore crushing expensive became prohibitive *refer Appendix 5*, for the individual miners, many miners moved on to new finds such as Kiandra and Lambing Flat goldfields. In 1870 there were an estimated 400 miners left on the Adelong goldfield [T&CJ 5 March 1870].

The "mundic' difficulty had a more serious effect on the interests of Adelong than people at the time understood – it was reported in The Daily Telegraph August 15 1896.

Comment: based on Ref 19

1. The minimum loss of mercury at Adelong is probably ½ lb to every ton of mundic quartz crushed. Mercury is capable of adsorbing nearly half its own weight of gold. Assuming however, that an average of 1 lb of mercury adsorbs 1 to 2 ounces of gold; the average loss/ton would be £3

2. For an ore that did not contain as much pyrites the loss of mercury one 70 lb flask would last a month or more

Because of the loss to the Crown [all gold recovered from Crown Lands was owned by the Crown], the NSW government, in 1860, set up a Royal Commission to investigate the 'mundic' problem.

The Royal Commission commissioners were Captain Ward, then Deputy-Master of the Mint, and Professor Smith of the University of Sydney. The object of the commission was to "ascertain the difficulties experienced in extracting gold from the auriferous quartz, and the character of the machinery employed for that purpose" and at Adelong the commissioners' attention "was specially directed" to these points.

The Royal Commission reported [Ref 14] and SMH 1September 1860
"At present it appears that the richness of quartz veins is estimated not by the gold they contain but by which imperfect means they have been able to extract, and our analyses of some tailings of the reefs leaves little doubt that two or three ounces per ton are frequently lost in tailings that are thrown away"

Comment:

1. *The processing of the alluvial gold required little machinery as did the processing of the more easily won decomposed ore veins – often down to around 50 feet below surface level. Refer Annexure 6*

2. Ref 13 reports on a crushing at Mandelson's Pioneer battery 15 ton of stone crushed in the stamper with the addition of 80lbs of mercury. The result from the amalgamation barrel was 40lb of amalgam from which 60oz of gold were recovered and 45lb of mercury had 'disappeared'.

3. *In the early days, the mills carried out the primary crushing of the ore with stamper batteries of the "Cornish" type - a multi-head stamper, usually vertical square non-rotating timber shafts – stems, with iron shod stamps of ~ 300+ pounds. The crushed ore then passed down slides into Berdan pans or Chilean mills for secondary crushing with the addition of mercury to amalgamate with the free gold. The slurry then passed over amalgamation tables – shaker tables / shotting tables to retain some of the amalgam and then to amalgamation tubs which also contained mercury. The amalgam was recovered and the gold and mercury were separated using a retorting furnace.*

4. *Much of the trouble was due to poorly dressed copper plates. If the copper plate was not thoroughly "dressed" the mercury would not adhere to it, let alone penetrate the surface. Even when thoroughly coated, it required several tons of crushed ore to pass over it before it was in a good working condition with a liberal coating of gold amalgam. Some operators coated the copper plate with silver, as it adhered more easily than mercury, before applying the mercury.*

While the first batteries worked on a dry- stamping principle, after only a year or so of operation, most stamper batteries had converted to wet stamping [Empire 19 July 1859].

By 1869 there were only two public stamper batteries in operation – the *Reefer Battery* and Edward Brothers and Channon's "*Great Western Battery*" regularly available for crushing private miner's ore. A third stamper was a company crusher operated by Wellington and Company and occasionally may have crushed ore for the "public".
Most of the early reef mining operations were undertaken on the *Victoria* and the *Old Hill* Reefs, which returned high gold yields from their upper strata during the 1860s and saw up to 18 claims being worked along these lines. The smaller *Currajong* and *Caledonian Reefs* also produced some high yields- including a local record yield - 17 ounces of gold won from one ton of ore from the Currajong Mine in 1877. Further north, the *Donkey Hill*, *Middle and Fletcher's Reefs* were also worked. The rich *Gibraltar Reef* also discovered in 1857, which was only initially worked to shallow depths for 5 years, was located approximately 2.5 kilometres north of the main Adelong reefs. Due to the peculiarities of the area's geology, the Adelong Goldfield was subject to boom and bust cycles and many mines were abandoned after the initial high yields declined.

Some of the first batteries that operated on the Adelong Goldfields allowed large quantities of gold – because there were no local processing alternatives, to escape as part of the tailings, usually into nearby waterways. Quartz ore that was expected to produce 10 ounces of gold to the ton only produced 4 ounces. In some instances no less than 6 pounds [2.7kg] of mercury and attached gold were lost for each ton of ore treated. The Reefers Battery in 1859 overcame this problem through the introduction clean sand/gravel in the ratio of three times to the amount of ore. This new method of processing – a first for the field and independently of other fields where mundic ore was encountered, restored the mercury to its clean fluid state in the Chilean mills and no further loss was experienced. Ref 13
However, the addition of the quartz, while saving on loss of mercury, required more processing time through the mill and it was only cost-effective for processing high grade ore.

Comment:

1. *In Victoria, where mundic was encountered deep in the leads, in locations such as Maldon, Stawell, Bendigo and Ballarat, large roasting works were constructed to treat the pyritical concentrates*

2. *Mines in Bendigo and Ballarat had reached 750ft by1871 and by ~1880 reached 1000ft at Ballarat.*

3. *Mundic was noted to still be a problem in 1904 [T&CJ 31 Aug 1904 p31]*

4. *The advantages of wet crushing over dry crushing were:*
   - *It yielded more gold and silver recovery in subsequent amalgamation processes*
   - *Wet crushing gave larger capacity with the same stamp mill – as much as double the tonnage of ore milled*
   - *It was less injurious to the machinery*
   - *It eliminated the associated dust health hazard*

Because the Reefers Battery incorporated this and other gold-saving devices, and because its two owners demonstrated they could cope with the difficulties arising from the refractory nature of the ore obtained from the lower levels in the mines, the Reefers Battery attracted ore for treatment from far afield [30 -50km] and enabled it to survive all other batteries that had been erected in the Adelong Falls area. [Ref 9]

Towards the end of the 1860s, large returns in the main Adelong Field were becoming more sporadic; yields from the Gibraltar Hill area were becoming more substantial. After an initial period of alluvial and shallow mining in the 1860s, the area was largely unworked and it was not until the 1880s another rich body of ore was discovered by the Gibraltar Syndicate.

In 1872 a group of miners had put down a test shaft downstream from the main Adelong Field, and returned payable alluvial gold. The *Adelong United Goldmining Company* later established a highly mechanised large alluvial mining operation. The mine initially strip-mined and hydraulic sluiced the alluvial deposits and later sunk shafts to recover the gold-bearing alluvium in bulk for processing on the surface. In the early 1870s an average of 1000 skips of' 'wash-dirt' was moved and sluiced every 24 hours. Power for the operation came from both steam engines and waterwheels with races cut alongside the creek to bring water from off-takes constructed below the Adelong Falls.

Geological surveys by the fledgling NSW Department of Mines in the late 1870s greatly aided mining companies in the development and operation of the mines. As a result, using this official information, many company mines profitably extended mining activity on the Victoria Reef to depths of 500 or 600 feet and in 1877 the Great Victoria Mine won a NSW government award of £1,000, to stimulate deep prospecting, for the first mine in to return payable gold from a depth over 800 feet and later in 1883, a further £500 for being the first mine in Australia to reach a gold-bearing lode at a depth of 1,000 feet. [Ref 7 Letter of Transmittal]

Another "first" on the field among gold mines in NSW; in 1881 the *Perseverance Goldmining Company*, working the *Old Hill Reef,* was among the first to use compressed air powered rock-boring machinery. The installed compressors, apart from powering the drills, supplied fresh air to the mine workings.

In the 1890s, the focus of mining activity extended further down Adelong Creek past Gibraltar Hill.

Established in 1891, Gibraltar Gold Mine [Limited], became the largest reef mining company to operate on the Adelong Field. In its first years of operation it was obtaining yields of around 10 ounces per ton. Over the following years, the mine became an increasingly mechanised underground operation requiring a substantial workforce which later rose to 350 men. The operation was sold in 1895. Its new English owners, with the advice of internationally leading mining engineers of the day, invested over £300,000 of new capital to erect new plant. The intent being to compete on a level playing field with other technological advanced mines of the day elsewhere in the Australia and elsewhere in the world [the mine could never be the equal of the great mines and processing plants on the Rand South Africa Ref 17]. The rebuilt ore processing train included a new 30-head stamper, large chlorination and cyanide works, air compressors to work 20 rock drills, steam driven hoisting machinery for four shafts. The shafts were connected to the battery by self-acting incline tramways. [Ref 7 p 37]

To power the air compressor and the battery; two Lefell water driven turbines were installed. The turbines' demand for water led to construction of a water race which drew water from Adelong Creek from just below the main falls site within the gorge.

Between 1897 and 1899 the operation's gold returns exceeded 43,000 [troy] ounces.
Yields began to decline after 1900. The company was restructured in 1900 and a further £150,000 was invested and in an attempt to make the mine profitable - new leases were bought and considerable prospecting and development work was carried out in the following years.
All to no avail as the cost of production continued to exceed the returns. The mine outlasted others on the main Adelong field operating until 1915 which effectively marked the cessation of active reef mining in the area, [although sporadic attempts were made between 1928 and 1931 to open the Kurrajong line of mineralisation and a small production from the Gibraltar mine was maintained during the period 1928-1942]. The mine produced nearly 4 tonnes of gold during its entire life but only declared the one dividend to its shareholders. [Ref 12]

The gold reserves of the alluvial flats were even more comprehensively exploited following the introduction of the NSW *Mineral and Gold Dredging Act* in 1899. Dredging operations on the lower reaches of Adelong Creek began in 1900 [Jennings' pump dredge] and in 1901 when Grahamstown Estates – later Davies and Kershaw, bought Jennings out they introduced two large suction-pump dredges later reworking most of the previously mined alluvium. In 1911 two large bucket dredges were in use and by 1915 up to five dredges were operating [SMH 20 July 1929 p11]. Dredging operations were carried out intermittently until the Second World War. From 1900 to 1941 nearly 6 tonnes of gold of the Adelong was won from the extended Adelong goldfields – *see Appendix 6*, most from dredging activity downstream of Adelong Gorge.

In 1916, Harper [Ref 7 p 6] wrote:
… when one realises the enormous quantities of gold won from within the limited area of the Adelong field proper, it is hard to believe that the comparatively limited amount of reef mining carried out has exhausted Nature's store.
It has been estimated that nearly 25 tonnes [800,000 troy ounces] [5,6,7] of gold was won from the Adelong Goldfield as a whole, from 1857 to 1941 – however, this is an underestimate as no official government reef mine records were available prior to 1884 [Ref 7 p36] and not all of the recovered gold was sold to the Crown [8]. [The NSW Mines Dept came into existence in 1875].

Comment:

1. Other records- often incomplete, that were available to estimate the quantity of gold won from the Field were those of the mills, the banks that purchased the gold and the Royal Mint in Sydney.

5. NSW Department of Primary Industry Fact Sheet Feb 2007 estimates 21.234 tonnes was won from the Adelong Field.

6. `Miners often smuggled their gold over the Victorian border where the offered price was higher NSW offered £1:17:00 per troy ounce and Victoria £1:17:06 /troy ounce and Chinese miners took their gold home cashing only to meet their living needs.

7. The estimated value of the gold won from the Adelong Goldfield to the present day is 25 tonnes at $1500/oz is $1.2B.

More than the monetary return [7], the Adelong Goldfield is demonstrative of the major methods of gold mining as utilized, and evolving, during the 19th and early 20th centuries – from the early days of panning and working the alluvial deposits saw every variety of process. The reef mining showed the same span from the days of horse and whim and bucket on. The alluvial mining passed through the stage of framing and slabbing with pumps that threw up tons of alluvium a second, through extensive underground mining of the deposits and a period of experimentation with high-power hydraulic nozzles and pump machinery to the broad-scale dredging which dominated the first decade and a half of the 20thC before the First World War. Ref 12

It is perhaps unique in Australia that all these mining technologies are encapsulated in a single, relatively compact – 3 square miles, goldfield.

Not to be forgotten and importantly from a social aspect, over the several rushes that occurred, the camps made up of widely differing nationalities that were established and the towns that developed because of the economic viability of gold production had a significant impact on the communities of the Australia yet to come.

Since the price of gold has risen in recent times, understandably exploration and mining companies have again become interested in the gold resources of the Adelong area with test drilling occurring in several locations including the sites of the former mines.

The Reefer[s] Battery / Mill

The first "*Reefer's Battery*" [8] was erected/ built in 1858 by the Reefer Quartz Crushing Company [RQCCo]; a limited liability company, which was owned by the Mandelson brothers [the major shareholders], John [*The Reefer*] Carmichael [manager] Andrew Lemons, George Wills and David Wilson [the mill builder and engineer]. The mill machinery was ordered from P N Russell & Co Sydney, the premier NSW Colony foundry and engineering firm of the day.

This mill was located above the eastern bank of Adelong Creek off the western side of Victoria Hill, about halfway between Adelong Township and the falls within the gorge.

The mill – Reefers Battery, commenced operation June 1858 and started life as a 4-head iron-shod wooden-stem stamp battery. An additional 4-stamp battery was added shortly after to meet the demands of miners. [TW]

With the performance of the initial batteries proving unsatisfactory and seeking to overcome the mundic problem and so obtain a better recovery of gold from the ore than its competitors, in 1859 Wilson and the other owners brought in a quite different stamper battery – a *King and Howland* patent battery, manufactured by P N Russell & Co, "*one of the most perfect crushing machines yet erected on the Adelong. In California it was said to supersede all others*" [SMH 4 October 1859] - *details of the machine and its operation are given in Appendix 5*, from the 'Cornish' batteries that had been installed in the three earlier mills.

The other components of this mill were "a ripple board, 2 tub amalgamators, a Chilean 'basin' followed by an amalgamating tub". [a more complete description is given in SMH 4 Oct 1859 p 8*]*

The mill machinery was driven by an overshot water wheel 18 feet in diameter – similar to the Edwards wheel, estimated to produce 18 horse-power [13.5kW] - one third more than was needed [SMH 4 Oct 1859 p8]. The water was supplied by a race four feet wide and two feet deep [0.6m x 1.2m], and one mile [1.6km] in length from further up Adelong Creek.

It would appear that the *King and Howland* battery was not up to the task, most probably because of the hard "stone" and was replaced in 1865 with a set of three 4-head 'Californian' stamper batteries that, based on the knowledge that Wilson and later Wilson and Ritchie designed their machinery, would have been manufactured to a modified design by P N Russell & Co Engineering.

A small 8 horsepower [6kW] steam engine was part of the mill machinery as insurance in the event there was insufficient water to power the mill.

William Ritchie, who was to play a significant role in the Reefer Battery's history, bought into the *Reefer Quartz Crushing Company* in 1860 when Mandelson withdrew from the partnership, [Carmichael and Lemons withdrew in 1864 after successful financial investments in gold mines on the nearby Kiandra Goldfield and the Old Hill Reef.

By 1869 the "Reefers Battery" as operated by the *Reefer Quartz Crushing Company* was one of only two public stamper batteries working on the main Adelong Goldfield. As well as being used by the smaller local mining companies and independent miners, the *Reefers Battery* because of its increasing reputation that it was able obtain higher yields from the difficult refractory ores, was also serving gold miners from far afield.

8. The mill's location shown on the Dept of Mines NSW *1874 Plan of Adelong and Environs* corresponds with this location.

Reefer Battery / Mill

In 1869, the *Reefer Quartz Crushing Company* [which was now owned by Wilson, Ritchie and Wills. Wills sold out of the partnership in October 1874 Ref 15 No 2 p34] made the decision to move the Reefers Battery downstream to the Adelong Falls cascades, where it would be less susceptible to flooding and strategically better located relative to the nearby mines on Victoria Hill from where most of its business came from.
[The site for the new mill was granted by the Crown on 3 February 1871. Additional adjoining lands were purchased from the Crown on 5 September 1878]

The new mill was to be a "wet processing operation" using most of the machinery from the original *Reefers Battery* and was to remain a privately owned facility and continue to operate as a public mill, crushing ore for individuals and small mining companies. From time to time it would take in ore from the larger mines for processing.

The sloping site chosen also allowed the company to rebuild the battery with greater crushing capabilities and intentionally, because of the steep fall of the site [9], all the mill processes would be gravity fed i.e. eliminating the need for mechanical feeders.

In March 1869 approval was sought for the construction of a 3ft [0.9m] dam across Adelong Creek [Ref 15 No 2]. At this time a contract was awarded for the construction of the necessary retaining walls and mill foundations at the site using won 'granite' won. The creek bank excavation needed to accommodate a 24-foot water wheel. The contract included the cutting a headrace through the parent rock above the eastern bank of Adelong Creek from below Sawyers/Sawpit Creek to bring water to the mill. [Gundagai Times 19 June 1869]

It was decided to dispense with the steam engine as a source of power and rely solely on water power for the operation of the mill using the much larger waterwheel.

The foundations for the building were on rock [which had to be blasted]. The machinery was set on baulks of timber to cushion the impact of the stampers. The open sided building under which the mill machines stood was about eighty feet long and thirty feet wide, [25m x 9m] framed with of well-seasoned hardwood, and covered with a galvanised iron roof.
One side was built up of stone, on the top of which, and under the same roof, was a place set apart for those men who had to watch the mill at night and control the flow of water to the water-wheel.

The relocated mill initially opened with two 4-revolving-head stamper batteries, amalgamation tables, two Chilean mills and amalgamation barrels that were relocated from the Reefers Battery. A trial run crushing granite using only 4 stamps was carried out on 7 July 1870 [Empire 16 July 1870 p3]

The nature of the Adelong Field ore was not an easy one to process [Ref 7 p7] and hence the process train adopted by the mill owner/ designers was of necessity unique to ensure the best recovery rate of gold from the difficult ore. Mines Department Inspector Slee in his 1876 report wrote:

> The quartz on the Adelong field is so strongly impregnated with pyrites and mundic that extraordinary skill is required to treat this mundic stone, Ref 7 p14

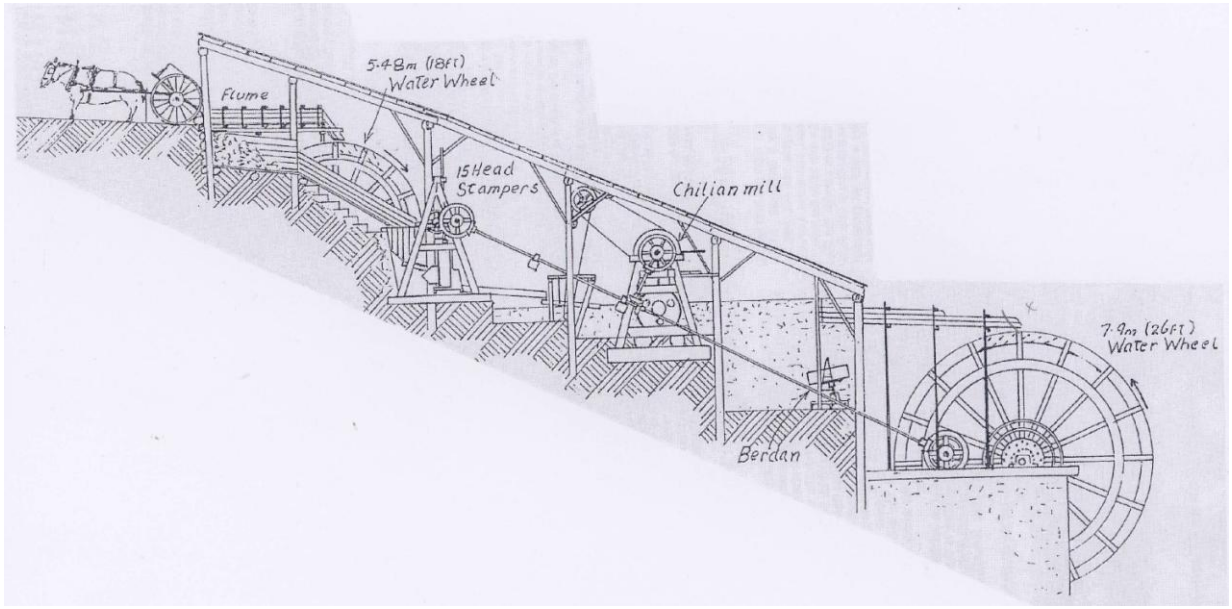
The mill process and machinery were designed by David Wilson and William Ritchie to take the special requirements of this ore into account and the machinery was manufactured by P N Russell & Co of Sydney. [T&CJ 16 July 1870 p15].

9. It was standard practice to construct gold mills on a gradient so they were self-feeding, even to the extent where no natural slope was available, the foundations for the earlier machinery in the process train were elevated.

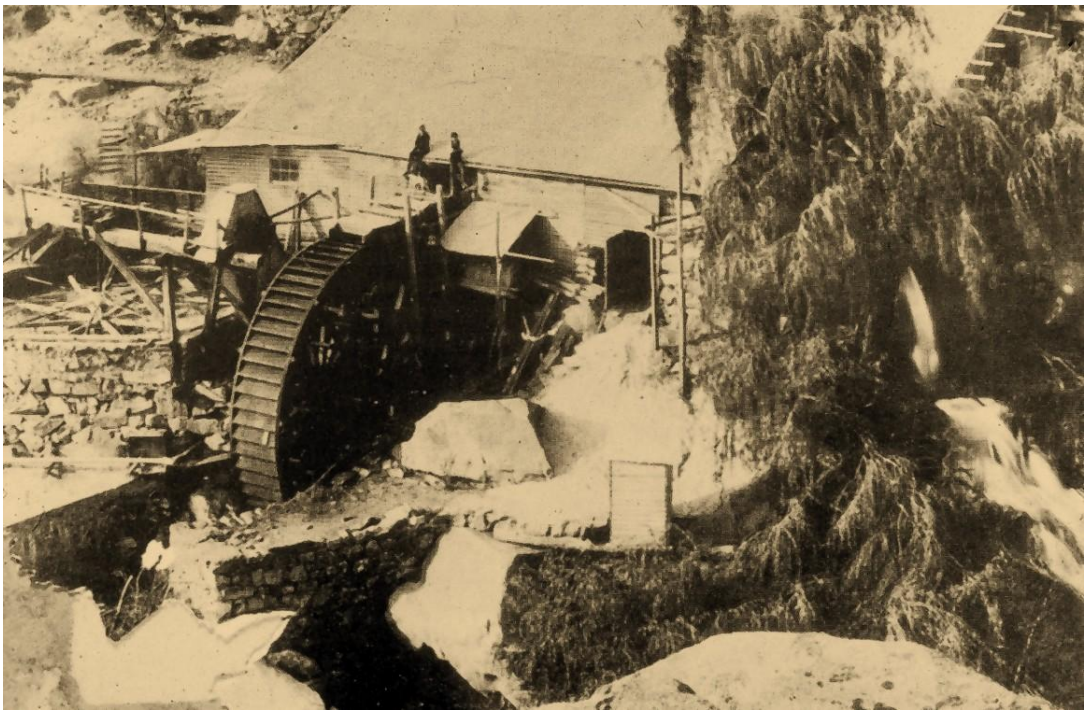
The stages down the slope and under the corrugated iron roof were sequentially as follows:

Stage 1	ore bins
Stage 2	ore chutes / shoots [*the stepped wall*]
Stage 3	stamper batteries [*below the transverse wall]*
Stage 4	amalgamation [mercury] tables]
Stage 5	Chilean mills
Stage 6	blanket tables and later Berdan pans

Outside, and below the Stage 6 level, were: the lower water-wheel and the later buddle and reverberatory furnace [1876].



Overview of the layout of the Reefer Battery – *amalgam and blanket tables not shown* [Tom Wiles]



The Reefer Battery - 26ft diameter lower waterwheel with mill men and buddle on its left c1915 R C Strangman NLA

The mill was powered by a 26 feet [7.92m] diameter backshot waterwheel – purported, at the time [10] to be the largest in Australia, which was located in a housing excavated into rock at the lower end of the complex above the creek. However, delays in construction of the new water race meant that water for the mill, which was still drawn from the Company's dam upstream of the present town site, was delivered via an extension of the existing water race to the initial Reefers' Battery site. This extension crossed the Adelong Creek twice via a [sawn timber, iron lined flume elevated on round timber trestles, between the original *Reefers Battery* site and the Williams' Goldmining Company Dam, continued in a race along the creek's western side, before crossing Adelong Creek again just upstream of its junction with Sawyers/ Sawpit Creek. This convoluted route – especially the elevated creek crossings was to prove susceptible to flood damage.

The wheel could generate 50 hp. [37.25kW] but usually, it was operated at 35 hp.[26kW] Ref 7 p15

The new mill with an assured water supply could now crush as much as 24 to 30 tons of quartz in a 24 hour day.

Of particular interest is the manner that power was transmitted from the water wheel to the several machines. The gearing arrangement was on a new principle to that generally used. This system of driving adopted by Wilson and Ritchie dispensed with the use of all belts and pulleys and allowed power to be taken off at any point along the main drive shaft via bevel gears without clutches [except for the buddle, which was added in 1876, which was driven from a pulley mounted on the main shaft via a belt arrangement] where required and also allowed individual machines to be off-line as required. The mill starting and stopping process was controlled by one man by adjusting the water race flow and a brake.

The mill, under normal operations, would be managed by a mill-man and two or three men on each shift; the owners from time to time assisting its operations. Additional men would be called on during down-times. [It was not unusual for tributors to work in the mill while their ore was being crushed – usually washing the blankets and skimming the wells.] Later when more "machines" were added to the process line, [buddle, Berdan pans, reverberatory furnace, chlorinator and cyanide plant], additional men would have been permanently employed.

The relocated mill was opened on 29 June 1870 and commenced operation on 14 July 1870. Dependent on ore supplies, the mill was to work twenty-four hours a day six days a week.

When the mill was in operation, an unknown source commented:

"*Richie's" Battery, on the side of the hill opposite Cornishtown was kept busy crushing ore to extract the gold from it. The noise was deafening while it was "crushing".*

Particulars of the machinery of the Reefer Battery reveal how its two enterprising builders ensured an efficient mill are detailed in Appendix 5

The new battery was described as follows: [The Australian Town and Country Journal 16 July 1870 p 15 and 16 March 1872 p13]
… The principal machinery at Adelong …. is about three-quarters of a mile from the town. It is known as Messrs. D Wilson and Co.'s Reefer Quartz Crushing Co. … The machine works eight head of stampers … there are two pair of Chilian mills … gold is caught in the stamper box and nearly all the rest on tables with copper plates and ripples. The refuse is then subjected to the action of the Chilian mills which secures the finer gold … The main wheel is … 26 feet in diameter. There is a shaft or axel [sic] sixty feet in length taken from the wheel at right angles … at a cost of upwards of £*3000.*

Closure of the original *Reefers Battery* upstream saw the remaining four-head stamper and Chilean Mill relocated to the new site.

10. The largest waterwheel in Australia was the Garfield Wheel 21m diameter that was brought into service in 1887 at Chewton Victoria to operate a 23-head quartz crushing battery. It only remained in service for 15 years.

Ore was brought to the *Reefer Battery* by horse and dray, along newly constructed ore roads from the reef mines above on Victoria and Currajong Hills, and the ore dumped into bins at the edge of the bench/ apron immediately above the battery. A tally was kept for each miner or company [at this time it is believed the mill charged for processing 'by the hour'], with a small stone-walled mill office located on-site slightly above and to the north-east of the Central Processing Area.

The ore [stone] had to be knapped down to fist-size to be acceptable to be shovelled into the battery mortar. Oversize stone had to be reduced in size by its owner.

The sized ore was then dumped into an ore shoot that fed into log-lined bins which had adjustable partitions. The ore was shovelled into the chutes and then moved by gravity from the bins to hoppers located on the back of the stamper battery mortar frames.

The staged processing of the auriferous ore was as follows:

Each ore shoot introduced the ore into a stamper battery via an integral hopper – the start of each process line. [Separate process lines allowed the mill to treat three separate ore loads simultaneously.]

After the ore was crushed by the stampers – water was added to assist the crushing operation and reduce dust and mercury was also added during crushing operations to amalgamate with the gold, the pulp passed out through fine screens.
[Water for the crushing operation was supplied from a tank which was fed by a hydraulic ram that was situated near the blacksmith's forge. Power for the ram was taken of a battery drive shaft]

The finely crushed ore – pulp ~1-2mm size, was then washed over the gently sloping and riffled mercury amalgamation tables, and then troughs. It then passed, in slurry form, for secondary crushing [grinding] to the Chilean mills to be finely ground [~ 100 microns, depending on the time it remained in the mill].

Below each Chilean mill was a heavy sacking/ corduroy blanket table on which the heavy concentrates were retained. The lighter tailings were washed off, and the concentrates were given a final grinding in the Berdan pans where separated gold was reclaimed by mercury amalgamation. All the tailings were then further treated in the amalgamation barrels then the amalgam recovered and the waste dumped into the tailing pits. However, this final process was abandoned soon after the mill opened as being ineffective, and it is believed following its decommissioning that the lighter tailings were sent down to the buddle [after it was added in 1876] or tailing pits while the heavier concentrates were ground in the Berdan pans together with concentrates from a "concentrating shoot".

A sandstock brick retorting furnace was built next to the blacksmith's forge, believed to have been located in the complex's upper area, was used to heat the won amalgam from the stamper, tables, machines, troughs and barrels to evaporate off the mercury [which was condensed for re-use] and leave the molten gold. The gold, in the form of ingots, was stored in a small sandstock brick strong room.

Recognition of the mill was quick in coming. The NSW Mines Department Inspector Slee in his 1876 report wrote:
"[The Reefer Battery is] one of the best, if not the very best, on the goldfields of New South Wales." Ref 7 p 11

and in the Mines Department 1878 Annual Report Slee, now as Chief Inspector states:

"The quartz crushing and gold-saving machinery is a credit to New South Wales, and ranks foremost of any in Australia."

Wilson and Ritchie throughout the life of the mill sought to improve its performance and witness to this is borne out in Ritchie's ledgers and press reports.

The TCJ of 5 March 1870 extols the simplicity of design of the mortar boxes –"Simplicity is Wilson & Co.'s motto" and that of many improvements not seen before by the journal's mining reporter and goes on to say … as long experience and mechanical skills have caused some special alterations to be made in the ordinary construction of crushing mills , and goes on to say; During the last three years that Messers. Wilson & Co. have been crushing at Adelong they have perseveringly endeavoured to

meet the difficulties that the peculiar nature of the Adelong stone presented to the mill. Almost every invention heard of has been here tried without regard to cost and removed and in turn to make room for the next, and, after all for an abundance of disguised metal and very fine gold. [TCJ 5 March 1870]

In 1872 the TJC stated "Many of the details are quite original and of Mr Wilson's sole invention. [the mill] is considered superior to anything previously attempted in quartz crushing in this part of the Colony" TCJ 16 March 1872 p13

Richie was also proud of their achievements stating in a drawing of his mortar box – after 14 years in service:

Plan
of
A stamper Box designed by Wilson & Ritchie of the Reefer Battery Adelong N.S.Wales
This stile[sic] was adopted after 15 years trial with other forms and found to answer best. We have used it for 14 years and do not see where we can improve on it.

Wilson & Ritchie Quartz Crushing Company Adelong 24/ 5 / 88

Two residences for the owners completed the Reefer Battery complex – *Campsie* and *Ferndale*.
Details of these two residences and their history and current physical condition are given in Ref 1

David Wilson built his residence called *Campsie* – a comparatively 'grand residence' on the high cliff top opposite the Reefer Battery around 1882. Prior to this Wilson had lived "near the Great Victoria Mine".
Ferndale was a stone cottage built for - and it is believed partially by, William Ritchie around 1870 and at times referred to as the "Overseers House".

In 1874 the flumes across Adelong Creek delivering water to the mill were washed away on three occasions in three months and to prevent this disruption, a lower water race, on the down slope or creek side of the battery to replace the old race was completed at this time. It drew water from Adelong Creek immediately above the mill and delivered it directly to the lower waterwheel. The old race was done away with. This lower water race comprised a stone headwall with sluice gate fed by headwaters from a complex configuration of two weirs and a log dam [and by-pass channels] built on natural rock bars across Adelong Creek at the upper cascades, with the weirs/ dams anchored to these outcrops by large iron spikes which are still evident today. The flow of water into the race was controlled by a sluice gate that fed the water into a timber-lined race that extended over 40 metres along the battery's lower side. A spillway was also located at the start of the race just behind the sluice gate. At the western end of the lower race, control gates were used to direct the water through a northern race to the interior of the mill building to the [lower] waterwheel, or discharge unwanted/ excess flows back to Adelong Creek. There was also an offshoot race or "underground conduit" that, at times of high flow, delivered excess water to the waterwheel at about mid-height [breast] to boost the power output.
In 1874, the existing three 4-head stamper batteries were replaced with three new 5–head stamper batteries - each stamp weighing 7 cwt; length of mortar boxes 5 feet 4 inches [1.6m] [using the same A frames] – but this necessitated moving the position of each stamper battery approximately 2 feet [0.6m] forward [down hill] and now being driven by a countershaft, and a rock-breaker - similar in design to a Blake Rockbreaker, with an integral grizzly was installed before one of the stamper batteries for those people who did not wish to break down the ore to an acceptable size for the batteries.

Adjoining stone-walled open containment areas for the mill's tailings [tanks] were erected along the edge of Adelong Creek north-west of the main processing area, [and below the future buddle site] between 1874 and 1876.

Tailings were piped into these "tanks" for later processing. Originally there were seven in total – four large and three small, which were mortared dry-stone walls built on top of rock outcrops of the creek margin to which they were anchored by large logs that were prevented from moving by iron spikes secured into the parent rock. The "tanks" were serviced by a tramline along which filled skips delivered tailings back to the mill for reprocessing.

The Reefer Battery was considerably expanded in 1876 to improve the efficiency in winning gold from the field's pyritic ore. A 24 feet diameter Lewis and Munday's Patent Buddle, [11,12] - a grading machine with a distinctive gently sloped and riffled circular base with rotating rake arms mounted on a central column was installed immediately north of the lower waterwheel off the bottom of the *Central Processing Area* to extract gold-bearing pyritic material from the tailings. The buddle at the Reefer Battery was a combination of features from the "Munday's Patent Buddle" and the" Lewis and Munday Patent Buddle". The unit's rotating arms and paddles were powered by a take-off shaft driven by a belt from the main drive shaft from the lower waterwheel.
In association with the buddle and at the same time of its construction [1876], a reverberatory furnace – based on the principle of the New North Clunes Co.'s mine in Victoria furnace [Ref 7 p 15], was constructed in a small building some 12 metres away to the north of the buddle and used to roast the dried pyrites from the buddle burning off the sulphur and releasing the gold. The roasting pyrites was raked almost constantly to enable the burning off of the sulphur and to ensure it did not "cake". The flue from the furnace intelligently ran uphill, underground, for 25 metres to a sandstock-brick chimney stack [the only substantial brick structure on the site] which used the slope of the hill to increase the chimney's draft and effectiveness of the furnace. The calcined pyrites from the furnace was taken back to the Chilean mills to ground up prior to chlorine treatment

A small Clyde? chlorination treatment plant - consisting of a chlorine generator and treatment vat – is believed to have been installed somewhere on the site at this time [possibly in a shed adjacent to the later cyanide works or a small hut located above the centre of the mill, as visible in some historic images of the site.
It was reported the roasting, grinding and subsequent chlorination [Ref 20] that this process was unsuccessful and was abandoned. The pyrites would again have been sent to Harden or Dapto to recover the gold by chlorination]

The weighbridge above the mill was added to an extended apron area at this time, with an area quarried level to accommodate it, and the mill's fee for service changed from an "hourly" [13] or "bulk" rate to one based on "weight".

In the Mines Department Annual Reports [Ref 7] Mr W H J Slee [later Chief] Inspector of Mines stated in his opinion of the improved mill:

1876 P11 Wilson & Co [Reefer Battery mill] had improvements for gold saving purposes and is certainly one of the best, if not the very best, on the goldfields of New South Wales.
1882 P103 The quartz crushing and gold saving machinery is a credit to NSW and ranks foremost of any in Australia

At this time the water delivery system to the stamper batteries was upgraded from the previous hydraulic ram to a new 6 inch force pump.

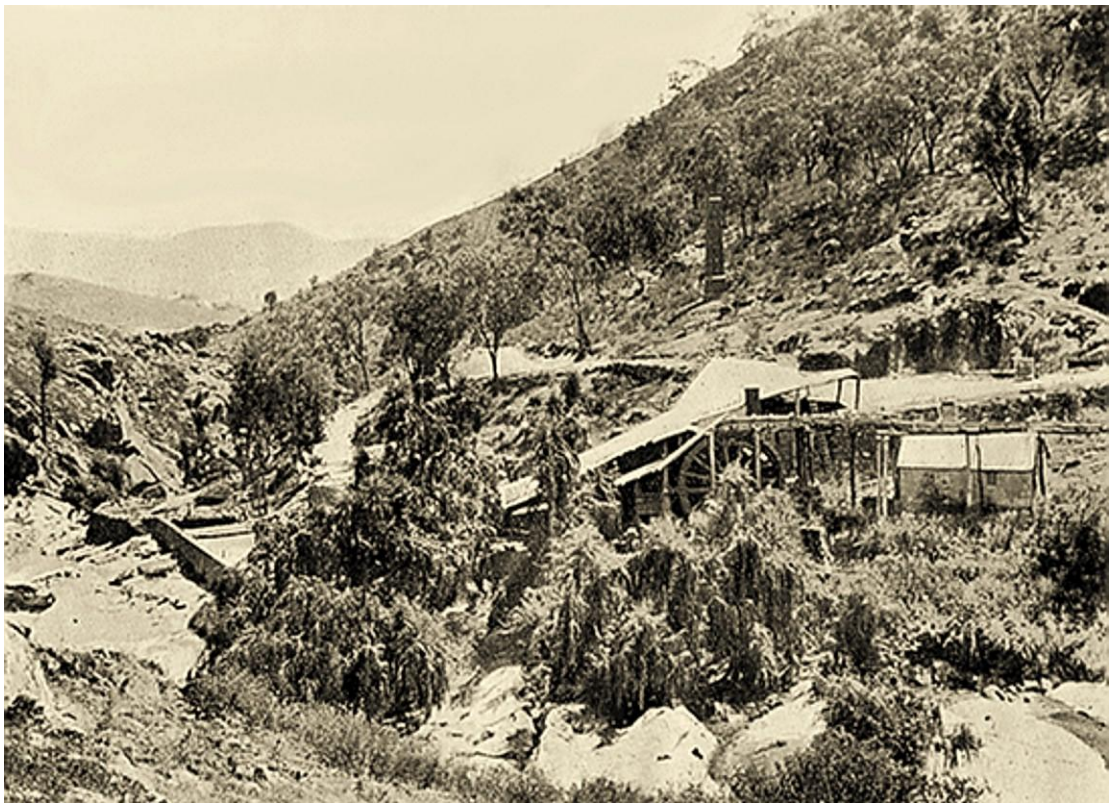
As reported by Slee in 1876 [Ref 7 p14], inside each box there were four temporary liners or iron plates for the double purpose of saving the boxes from wearing too fast, and for forming recesses or catches to retain the added amalgam in the boxes; the iron plates are taken out every time a crushing is finished.

11. Ref 7 Slee's1876 Annual Report p 15

12. Details of the operation of the Buddle are given in Annexure 5

13. Around this time - 1876, the public could have their ore crushed for 8d per hour for each stamp or 10/8d for the whole of the machinery. The parties crushing pay for all loss of quicksilver Ref 7 p14

The Reefer Battery showing the upper water wheel, flume, office, reverbatory furnace stack c 1915 R C Strangman, NLA.



Reefer Battery showing upper water wheel, flume, dam, office, ore road, weighbridge, lower water race - circa 1915

In 1881, having purchased the *William's Goldmining Company Co Great Western Mill* including the dam and water rights on 15 June 1881, the partners sought approval to construct a 6 ft [1.8m] high dam across Adelong Creek – on the site of the old Edwards Bros dam and a race to provide more water power for an intended significant additions and improvements to the *Reefer Battery.*

The new 510 yard [460m] race crossed Sawyers/Sawpit Creek in a short flume, then entered a rock cut race, before the water was carried across the steep side-slope in a metal lined wooden flume supported on high timber trestles that continued over the top of the work's office building and was brought down to power a newly installed 18 feet [5.5m] diameter 'overshot water wheel. This new waterwheel was located in an elevated housing near the upper terrace or entrance to the battery immediately down-slope of the office building. The new wheel is believed to have assisted in powering of the stampers, as well as a rock breaker installed around this time in the nearest ore bin. Installation of the "upper" waterwheel also required relocation of the retorting furnace, to near the mill's south-west corner. Water from the new "upper" wheel discharged into the lower race, and so, once it had served its initial purpose, was used to power the "lower" waterwheel. The potential motive power was now 60hp [44.7kW]. At this time provision was made for the installation of an additional five stamps.

It was commented on in 1885, that the *Reefer Battery* had quite a name as a gold saver, and many samples of "stone" were brought here over great distances from such places as Kiandra, Tumbarumba, Clarendon, Tarcutta, Coolac etc. to be crushed. [TCJ 13 06 1885]

In 1892 two patent concentrators were added to the mill [SMH 11 Aug 1892 p7].

The final major improvement to the *Reefer Battery* was in 1900 when a cyanide plant[16] was installed to treat the graded tailings from the buddle. The cyanide process, developed in 1887, was a widely used method of extracting gold by dissolving finely crushed gold ore in a solution of sodium or potassium cyanide before reclaiming it by chemical precipitation and evaporation and then retorting to recover the molten gold. It offered increased yields plus the ability to economically win gold from lower grade ores. The cyanide plant is believed to have been located 66 metres north of the reverberatory furnace on a bench above the creek.

William Ritchie kept careful records in ledgers of the new mill's operation giving details of each crushing and yield and the result of experiments he carried out. There are – at times, mentions of past history of the Adelong Field and technical information on the mill [Ref 14]

These ledgers showed the mill's busiest decades were the 1870s and 1880s, coinciding with the greatest activity on the Adelong Goldfield. The *Reefer Battery* was more efficient than competing mills at extracting the maximum amounts of gold from the treated ore, and increasingly so with the ongoing progressive additions and modifications to the mill machinery and process improvements, and so was well patronized by local miners as well as attracting ore from mines further afield. As a result the Reefer Battery survived all other mills on the Adelong Goldfield above the falls [at one time there may have been up to 16 working stampers on the field]. Ritchie's records showed the mill did little work towards the end of its operating period. David Wilson died in 1897 and ownership of the *Reefer Battery* passed to William Richie, but the mill effectively ceased operation in 1910 and finally closed in 1915 [the last reported crushing was in 1915 SMH 12 June 1915 p15]
William Ritchie died during the intervening period.

Between 1871 and 1907 the *Reefer Battery* extracted over 93,000 troy ounces of gold. [Ref 15 records]

The site remained unused from World War 1 onwards, and would have been damaged by severe flood events in the 1930s when structural remains of other stamper batteries along Adelong Creek were destroyed. The site was very extensively damaged in the1930s Depression, when it was partially demolished - including being dynamited, to be cannibalised for the iron and steel scrap and other raw materials that the *Reefer Battery* contained. It is likely during the Depression parts of the mill may have also seen some attempt to rework the residual tailings at the site using

leftover materials from the cyanide plant. The Depression also saw damage to the buddle by attempts to recover residual mercury-gold amalgam that may have seeped into the structure's concrete base.
This period also saw remaining mill associated features in Adelong Creek demolished in attempts to free any gold-bearing deposits and recover these by panning.

The site was further disturbed in the late 1930s again for scrap recovery. Machinery scrap was believed to have been stockpiled in a temporary "dump" above the battery ruins, on the ore road and apron, which explains some of the larger items remaining in this area today divorced from their original locations. Scrap recovery would have caused further damage to the mill's stone infrastructure.

From the 1940s, Adelong Creek including the mill ruins and the Adelong Creek gorge attracted growing numbers of picnic and leisure users – including recreational fossicking/ prospecting, bottle collectors and souvenir hunters further impacting the site's remains and integrity. Active management of the site was absent during this time.

Associated Infrastructure Adjoining the Reserve

Several items that were part of the history or infrastructure of the Reefer Battery are located just outside the current 61.2Ha Reserve boundary:

- The possible remains of the original *Reefers Battery* on the eastern side of Adelong Creek – immediately south of the *Creek-walk* Bridge [approximately 1.75 kilometres upstream of the *Reefer Battery* site]. There are substantial remains stepped up the creek bank on a number of partially overgrown terraces. Recognisable remains include the foundations of a boiler, a stamper shaft, the remains of a waterwheel hub, structural timbers and metal and other debris.

  Four distinct terraces approximately 5 metres in length and 2 metres in width have been cut into the slope of the hill, together with these artefacts indicate that the site is that of an ore crushing battery worked on the gravity ore feeding principle.

- Sections of the water race that ran from the Williams dam site to the mill. The race has been severely eroded and overgrown, it is still discernable on site and aerial photos discernable

The *Reefer Battery* Site Management

To ensure that the Reefer Battery site remained in public hands, the Adelong Falls Reserve was created by the forfeiture of an existing Special Lease to the Crown and Reserve 88410 was notified on 26th November 1971. The size of the Reserve has been augmented over the years and today has an area of over 60 hectares.

Four years later, in 1975, Tumut Shire Council – as Trustee and responsible for on-the-ground management for the area commenced clearing the ruins of vegetation, improving access and parking, constructed walking tracks and footbridges and providing visitor facilities and information panels heralding the sites next era as a historic site and recreation area. This work was completed over 1987-1992 with monies from a Bicentennial grant.

A viewing platform of the site on the high side of the creek - down-hill from *Campsie* was built in 2010 funded by a Federal Government Stimulus Package Program funding.

The ruins of the mill and associated structures have not had a happy life over the past years. Time has taken its toll. Natural disasters – an uncontrolled bushfire in 2002 burnt much of the remaining structural timber and floods in 1985 severely damaged the tailings tanks and floods in 2011 and 2012 saw the complete loss of all the tailings tanks.

14. Sections of the site were destroyed as a result of ill-advised "conservation" work between 1987 and 1992 for the construction of a picnic area - in particular where the cyanide plant was located.

Uncontrolled run-off has further damaged the site and allowed sediment, rubble and debris to accumulate in unwanted locations – retaining moisture, blocking drains and encouraging salt attack and vegetation growth.

Root damage from trees and vegetation springing up within the ruins is also a problem. Vandalism and theft of materials- often causing instability of structures, is also a concern.

Extensive but uncontrolled conservation works were carried out at the site between 1987 and 1992 and this resulted in unintentional damage to parts of the site.

eg. A lot of evidence was destroyed when the underfloor conduit to the water wheel was rebuilt – the retaining wall of the Chilean mill terrace was obviously horizontal logs, as it is thought all the internal walls were, and in-filled with clay, which was crumbling away. Instead of restoring the wall, even partially, it was cleared right away.[T Wiles]

Restoration of flood damage was carried out in 2011 – 2012 [15], and happily, this time, the work has been carried out in conjunction with and under the purview of NSW Heritage, as will all future work of this nature.
Over the years, a number of archaeological studies, Conservation Management Plans, Conservation Management Strategies and Plans of Management for the Reserve ruins have been commissioned by Tumut Shire Council – 1983, 1985, 1993, 2008 and 2010.

Comment:
It comes as a matter of regret that none of these documents were critically reviewed by qualified and experienced mining engineers whose expertise covered 19th C gold mining and processing practices. If this had been done errors of fact and interpretation might have been avoided.

It is acknowledged that the heritage management, especially at a site as large and complex as the Reefer Battery remains, is a long term undertaking and progress varies with available budgets, the availability of conservation and craft-persons skills, evolving knowledge of the mill and conservation techniques, the commitment of key players/ agencies, contingency or emergency repair/ protection needs, and a range of other factors.

There is still a pressing need for more research on the history and elements of the mill and its technology to be conducted by people who have a practical in-depth knowledge of 19th century gold mill construction, operation and processes.

A survey of the site - in sufficient detail to allow the construction of a virtual three-dimensional computer generated model of the site with ‘working’ components such as water flowing, waterwheel turning, stamper working and the like [This is now common practice for important heritage sites such as the *Reefer Battery*] is considered to be necessary for the purpose of record, education and appreciation of what was at the site.

In the interests of visitor safety and the preservation of the ruins, consideration must be given to the provision of an elevated walkway with handrails for visitors to traverse the site.

On a positive note, Council is committed to ensuring this important heritage site is not lost to the local community and over the years has demonstrated this commitment through the ongoing restoration and stabilisation work carried out under its auspices at the site.

The Tumut Falls Committee is to be commended for their ongoing dedication and impressive track record in raising money to help support their efforts and defray expenses. Their enthusiasm and endeavour continue to add value to the local community through its work associated with the stabilisation of the fabric of the Reefer Battery ruins.

15. Full details of the work Council has carried out over the past 30 years are documented in Ref 1

Heritage Award Nomination Form

The Administrator
Engineering Heritage Australia
Engineers Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Attention: Engineering Heritage Recognition Committee

Name of Work: **Adelong Falls Gold Mill Ruins of the Reefer Battery and Associated Infrastructure**

The above mentioned work is nominated to be recognised underthe Engineering Heritage Recognition Program of Engineers Australia for the award of an **Engineering Heritage Marker**

Location: Grahamstown Road 1km north of **Adelong** on Adelong Creek.

Owner: NSW Government Department of Finance and Services – State Property Authority
[*previously Department of Lands, later Land and Property Management Authority]*

The Owner has been advised of this nomination, and a letter of agreement from the Trustee of the site - Tumut Shire Council, consenting to the plaquing is attached *Appendix 1*

Access to Site: The site can be accessed from several points by foot – one starting at the viewing platform and others along the bank of Adelong Creek.

Nominating Body: **Engineers Australia, Sydney Engineering Heritage Committee**

Simon Wiltshier

Chair Sydney Engineering Heritage Committee

Date ……

ENGINEERING HERITAGE AWARD NOMINATION ASSESSMENT FORM

BASIC DATA

Item Name: Adelong Falls Gold Mill Ruins of the *Reefer Battery* and associated Infrastructure

Other Former Names:
Mill: Reefers Quartz Crushing Machine, D Wilson & Co Battery, Reefing Battery

Proprietary Name: D Wilson & Co, Wilson, Ritchie & Co, Reefer Quartz Crushing Company

Location: Latitude 35^0 15' 30" S Longitude 148^0 03" E

Address: Grahamstown Road Adelong

Nearest Main Town: Adelong [originally referred to as The Reef]
425km south-west of Sydney [originally 288 miles by unmade road]

State: NSW

Local Government Area: Tumut Parish of Adelong County of Wynyard

Owner: NSW Department of Finance and Services – State Property Authority
Trustee Tumut Shire Council

Current Use: Tourist and heritage site

Former Use: Gold ore processing and recovered gold refining.

Designers: 1858 Reefers Battery
thought to be original owners who purchased proprietary equipment from P N Russell & Co Sydney

1870 Reefer Battery and subsequent improvements
David Williams and William Ritchie

Comment:
During the life of the mill Williams and Ritchie were much involved in the selection of new equipment and processes and improvements to existing equipment
It is highly likely given their experience with P N Russell - refer Appendix 5, their designs would have been turned into reality at Russell & Co Engineering Works in Sydney - refer Ref 15

Builder: *1857 Reefers Battery*
Machinery manufactured, in part, by P N Russell & Co
Erection and construction by local contract and day labour

1870 Reefer Battery
Machinery manufactured, in part, by P N Russell & Co
Erection and Construction by local contract and day labour

Year Started: *Initial site Reefers Battery* 1858
Year Finished: 1858

Year Started *Current Adelong Falls Site* 1869

Year Finished 1870

Comment:
Improvements to / upgrading of / replacement of the processing machinery and the treatment technology were actively advanced by the owners during the life of the mill until it eventual closure some time after 1915

Physical Description: A full listing of the machinery, buildings and other infrastructure that made up the mill including relics of the mill that remain on site is given in Ref 1 and a description of the machines and processes is given in Appendix 5
Photographs – historic and current are included in Appendix 3

Physical Condition: *the remaining physical evidence*

The remaining built elements of the *Reefer Battery* include stone building ruins, equipment housings, water races and extensive dry-stone retaining walls and roads and pathways constructed to provide vehicle and pedestrian access around the site. Many of these features have undergone varying degrees of conservation and preservation works, or modifications to protect heritage fabric or facilitate visitor access and understanding. Unhappily, as a result of the ravages of time, theft and in some cases ill-advised restoration works, some of the elements are now lost forever.

eg. The north wall of the main works area is rapidly deteriorating and will eventually fall down, it is a ballast wall and while unprotected from moisture, it will keep swelling. [T Wiles]

Contemporary elements have also been introduced to the site - principally access paths, bridges, signage which has been constructed to allow visitors to inspect the mill ruins as well as service and access tracks.

Current conservation work conducted over 2011- 2012 on the site is being carried out based on strategies approved by the NSW Office of Environment and Heritage.

The following descriptions of the Reefer Battery's remaining heritage evidence, for each component of the site are taken from the 2011 Conservation Management Plan Ref 1 Rev D4 April 2010 [that has now been signed off by the NSW State Property Authority and adopted by Tumut Shire Council - advised by Louise Halsey] which in turn was taken from earlier CMPs.

Lower Water Race.

The lower water race running approximately 40 metres along the mill's lower flank comprises a mortared stone retaining wall on the lower side and a dry stone retaining wall to the upper side. The race [which unfortunately had been dug out below its original level] has been in-filled and now serves as the main visitor route to the entire complex. Conservation works and clearing were carried out on the lower race between 1987 and 1992 – with flood and demolition debris removed, the floodwall repaired and underpinned with new timbers, capping stones re-grouted and intrusive regrowth removed. It is possible that the race may have been inadvertently deepened at this time. However, the original level of the lower race is still a debated issue in the mill's history and functioning. The sluice gate in the headwall was reconstructed at this time – however, the depiction of the function of this item, and to a degree the race overall, has been compromised by the amount of infill and level modification undertaken. Timber and stone steps have been constructed over the northern end of the headwall and the lower race is now part of the main walking track access to/ through the battery site, further confusing visitors about its original function.

Upper Water Race and Aqueduct

The main or upper race proceeds in a series of doglegs, cut into the in-situ rock with some infill stone walling in places. The race appears to have been unlined and originally varied in depth up

to 2 metres, but gravel has been laid along its course to ease visitor access. However the feature's original function is still clearly apparent. The original aqueduct over Sawyers/ Sawpit Creek, feeding into the upper race , has been re-established as a pedestrian bridge – with the original dry-stone abutments repaired and old bridge timbers laid to fit the original abutment stonework [lime mortared granite].
The only remaining evidence of the 64 metre timber flume off the upper race feeding the upper waterwheel are the footings and cuttings for the flume's supporting timber trestles, which are evident on careful inspection.

Site Office

The site office remains are adjacent to the upper waterwheel, below the ore road level. Only the mortared stone walls of this small one-room gable-roofed building are extant. The site has undergone considerable conservation works.
Between 1987 and 1992 the wall tops were capped and vegetation/ rubble cleared from around the structure [especially on the upslope side]. A "Bicentennial brick" was inserted in the front wall at this time and crudely outlined in white paint, but the brick has eroded to such an extent where its meaning is now barely discernable. Subsequent conservation works have improved drainage around the structure and shored the upper bank to better ventilate the structure's upper wall as part of the desalination efforts, as well as modifications to the mortars used in previous conservation works. The ground levels around the office are believed to have been stabilised at historically correct levels, by both walking track construction and the installation of a stone drain across/ below the entrance to the building.

Upper Wheelhouse

The upper wheelhouse is made up of four mortared stone walls, with a gap at the south-west corner. There is no remnant machinery in place.
Conservation works between 1987 and 1992 cleared the area of rubble [allowing visitor entry and inspection] as well as minor re-pointing, patching of a settlement crack inside the structures north-west corner and relaying several stones in the floor.

The relative levels of the upper wheelhouse and the nearby lower water race remain issues of some conjecture in the *Reefer Battery's* history and operation - with the lower water race possibly functioning as both a water delivery and "head" storage system [so enabling the waterwheel to be slowed and allow the operators to engage/ disengage the pinion wheels from the main shaft to start/ stop individual items of machinery]. The crack from the top to the bottom of the north-west inside corner has reopened [believed to be due to further settlement] and a large boulder at the base of the front "entry" is dislodged – possibly due to deepening of the lower race or by its subsequent use as a walking track. The walking track itself is sheeted with visually intrusive blue metal at this point. Recent works have included the removal of decayed mortar and fixing fine wire "tell-tales" to monitor movement in the north-western wall crack.

Central Processing Area [CPA] and Stone Walls

The CPA is the stepped and roofed area which housed much of the heavy ore processing machinery of the mill, and was the working heart of the Reefer Battery. The east, west and southern margins of the area are defined by low stone retaining walls while the large northern wall forms one of the major visible structural elements of the site. Remains of the stone walls between the various stages of the mill are still evident, but collapsed or covered for the most part [especially the lower platforms/ Stages].Most of the Central Processing Area has been left as is, and remains a ruin and is dominated by a jumble of stones and rubble with stone wall sections or remnants. Minor conservation works between 1987 and 1992 reconstructed one subfloor wall to prevent slumping of the rubble. There also remain some extant large timber members, both in the stone walls as debris, and evocative items of larger broken machinery and processing equipment.
[There are no remains of the 60ft drive shaft, power take-off shafts, tables, Chilean mills or Berdan pans.]

Lower Wheelhouse

Located immediately below the central processing area, the lower wheelhouse remains as a mortared [and pointed] stone walled niche capped with large timbers. It retains a portion of its wheel – the axle, resting precariously on the rotting timber beams.
Conservation works between 1987 and 1992 removed rubble from the base of the wheelhouse which was used to construct the protective upstream buttresses [a dry stone wall] that had been damaged by flood. Stone work linking the wheelhouse to the underside of the buddle and incorporating the buddle outlet has been re-laid to ensure stability and aqueduct drainage. Public access to the wheelhouse is not provided for, with visitors viewing the feature from a short timber bridge above it of from adjacent walking tracks. Slow infill of the wheelhouse floor with sediment and rubble and vegetation is ongoing.

The Buddle

The Buddle is located below and slightly to the west of the central processing area, separated from the lower wheelhouse to the south by the tailings shoot/chute. The buddle machinery has been removed, leaving the circular concrete base which is finished on the inside with a smooth concrete face.
Conservation works between 1987 and 1992 reconstructed the buddle outlet drain, re-pointed loose capping stones and patched a damaged section of the buddle base. However, an area of the base has broken away [possibly due to the root impacts of now removed nearby trees]. The buddle support walls were also repaired - however, as the structure is set into the side of the hill and built on stone walling with large supporting timber members. The continued rotting and ultimate failure of these timbers could cause major destabilisation of the structure. Substantial carbonate deposits on much of the stonework of the high supporting wall below the buddle has leached from the structure's concrete and may present problems in the longer term.
The growth of trees, mainly cypress pines, close to the Buddle causes observable cracking of the structure and has in the past threatened the buddle's longer-term condition and stability. Most of these trees have recently been removed; however, vegetation growth and root-fracturing will present on-going problems at this site.

Holding Tanks [Tailing Pits]

Originally seven holding tanks were constructed along the banks of Adelong Creek. Four were well constructed "reservoirs" and three were rough dry stone walled structures.
Seven tanks were recorded in 1983 but severe flood damage to these items occurred in 1985, just prior to the commencement of major site conservation works, the following year resulted in the loss of 4 of the tanks. The floods of 2010 and 2012 removed the last traces of the remaining tanks.
Knowing the certainty of comparative flood events, a decision has been taken not to replace these structures.
Other more makeshift tanks are also believed to have possibly extended downstream as far as beneath the cyanide plant.
The outer and dividing walls of the tanks, as constructed were of mortared granite freestone, while the natural rock outcrops formed the base and rear of the tanks. The outer walls of the tanks were retained on the sloping rock outcrops adjacent to the creek by forged iron spikes inserted into the bedrock. Most protruding spikes from the destroyed tanks were cut off at the base during the 1990s conservation works; however, the former lines of the tank walls are still visible in places and some twisted spikes remain in-situ.
The tanks also included some minor timber elements, as part of their low side drains/ openings.
It would seem that on regular occasions when the creek rose it came someway up the rock walls and it is expected that, as has been noticed in the past, sections of the walls that had collapsed during the flood event would have had to be rebuilt.

Reverberatory Furnace and Chimney

Believed to be originally a small shed with a gable roof, the reverberatory furnace now comprises only the east wall and flue at the rear of the furnace of brick [below] and mortared granite [above] remain. The northern stone wall has collapsed and the south face is believed to have always been open. The furnace was extensively repaired and reconstructed, to its present state, during the conservation works from 1987 to 1992 prior to which it was a heap of stone rubble. One dry-stone wall was constructed accurately to about waist height, the flue mouth was re-pointed, several bricks replaced, and a grille set across the flue opening [which has since become a repository for visitor's rubbish]. A replacement grille was installed in early 2009.
Dry-stone retaining walls remain in the furnace vicinity.
The condition of the entire 26 metre underground flue from the furnace to the chimney is unknown; however, a hole in this structure was capped with a flat stone to match the original design, grouted and concealed as part of the earlier conservation works. The red sandstock brick stack, with rendered bands and a stone base was extensively repaired during the earlier conservation works – in addition to earlier, 1986, repairs when the structure was in danger of collapsing due to the removal of bricks. In these later works the stack was extensively re-pointed, damaged bricks were turned and missing bricks replaced. Today all the bricks below the first band of render have graffiti scratched into them, as does the render itself.

Chlorinator

No traces of this plant remain.

Cyanide Plant

No traces of this plant remain.

Retaining Walls

Rough built retaining walls, predominately dry-stone walls, are a feature of the site and make up a significant proportion of the extant remains – although a full archaeological survey of their extent and nature has not yet been undertaken. Many are incorporated as part of the features described above, while others occur across the site. Most are roughly built of unshaped stone – local granite without defined courses. Footings, where they occur, are minimal, and usually the walls rely on a pronounced batter for stability.
Conservation works between 1987 and 1992 undertook extensive minor repairs to the retaining walls, closely following the detailed character of each stone or masonry section – however, in some instances the mortar used is visually intrusive and/ or has a high salt content [salt attack is also evident due to moisture and soil build-up]. Some retaining walls are showing signs of minor slumping, bulging or other instability – such as the dry-stone wall along the high side of the lower water race. However, given their initial bulk and batters, as well as the earlier work undertaken where there was obvious evidence of damage or weakness, most of the walls appear stable at present.

Ore Road

The roadway through the site, from the present Reserve's eastern boundary to and past the Reefer Battery, was and is known as the Ore Road. It was originally described in some accounts as a "metalled roadway".
The 1987 to 1992 conservation works removed the vegetation regrowth on the road and its stone wall margins and resurfaced much of the route with crushed granite. Drainage was also improved in several places, but with unsympathetic concrete dish drains used and road/ ground levels altered at a number of locations. Erosion and sedimentation are continuing maintenance problems, albeit minor, along sections of the route, as well as visitor safety issues where stone walls and/ or steep drops line the road margins.

Machinery Remains

All that remains of the machinery that once formed part of the mill are the hubs of the two waterwheels, one of the five-stamp mortar boxes, one of the bases of a four-stamp mortar and the cast iron rim of one of the Chilian mill wheels. [The author believes that the mortar boxes and wheel rims should be recovered and displayed, perhaps at the old weighbridge site.]

Owners' Houses *Campsie and Ferndale*

Details of the physical condition and photos of these houses are given in Ref 1.

Use of Lime Mortar

Very little mortar was used in the construction and maintenance of the Reefer Battery. Hydraulic lime mortar was used in the construction of the walls of the tailings pits, the water wheel structures, sealing the water-race near the headwall of the lower water-race and building up the low points of the water race [TCJ 5 March 1870]. Builders lime mortar [that includes some clay] was used in the construction of the houses, office and non structural walls.
Apart from some of the repair work of the 1980s, only lime mortar has been used in the restoration work eg lower water-race and smoot [drain in a dry stone wall].

Modifications to the Reefer Battery and Dates:

Refer to Basic History section of this submission and Appendix 2 for dates and details of modifications to the Battery.

Historical Notes: *Refer to Basic History section and Appendix 2 of this submission for dates and details.*

Heritage Listings:

Statutory:

Name:	**Register of National Estate**
	not formally listed
Title	Adelong Falls Reefer Battery
Place ID	17214
Place File No.	1/06/322/0015
Category	Indicative Place

Name:	**NSW Heritage Council**
	NSW Heritage Register
Title	Adelong Falls Gold Workings/ Reserve
Number	00072
Category	Mineral discovery site
Date	02 April 1999 updated 11 July 2008

Name:	Permanent Conservation Order
Title	Adelong Falls Gold Workings/ Reserve
Number	00072
Category	Mineral discovery site
Date	15 March 1985

Name:	Interim Conservation Order *lapsed*
Title	Adelong Falls Gold Workings/ Reserve
Date	02 09 May 1980

Name:	Tumut Shire Council Local Environmental Plan 2012
Title	Adelong Falls gold processing site
	[Adelong Falls Gold Workings/ reserve]
Date	07 December 1990

Non-Statutory:

Name:	**National Trust of Australia (NSW)**
Title:	Adelong Falls Goldmining Remains
Listing Category	Classified
Number:	485
Date	28 March 1983

ASSESSMENT OF SIGNIFICANCE

Historical significance

Adelong Falls Gold Mill Ruins – *Reefer Battery* has historical significance because:

(a) The mill was constructed at its first site in 1858 at the time of the genesis of gold ore processing in Australia. [The first recognised mill at Clunes Victoria, the Port Phillip & Colonial commenced operation in May 1857 Ref 19 p103. It was among the first of the mills erected on the notable Adelong Goldfield and the Reefer Battery was the last in 1915 to shut down.

(b) It is thought to be the only substantial remains of a water-powered gold mill in NSW [and possibly Australia].

(c) It is one of the few gold mills that incorporated such an extended series of treatment processes to extract the gold from the pyritic ore.
In most cases it is only the foundations of stampers and engine beds that remain.
Although only the mill's stonework fabric remains with little of the machinery, it is possible, with the information given on the panels at the viewing platform, to appreciate the mills construction and process train.

Historic individuals or Association *Refer Appendix 6*

Adelong Falls Gold Mill Ruins – Reefer battery, showed a high level of technical achievement In the following areas:

(a) David Williams and William Ritchie distinguished themselves in the design and operation of the gold-mill. They took out several patents and passed their successful technology on to other mill operators in the area. *refer Annexure 5*

(b) Because of their practical training and demonstrable skills, both Ritchie and Wilson were, in their day, regarded as engineers.

(c) P N Russell & Co the leading Australian engineering company, worked with Williams and Ritchie on the design and modification of the mill processing machinery. This resulted in the recovery rate of gold from the 'difficult' ore being among the best in its time, in NSW.

Technical Achievement

(a) The quartz crushing and gold-saving machinery was ranked foremost in Australia by NSW Department of Mines reflecting the view of the Chief Inspector.

(b) The TJC noted that many of the mills details are quite original and of Mr Wilson's sole invention. And the mill is considered superior to anything previously attempted in quartz crushing in this part of the Colony. TJC 16 March 1872 p 13

(c) The thought that was put in to ensuring the economy of effort in building and operation of the mill, as are the other technical features such as the use of a large water wheel with an integrated ring gear to power the mill and the introduction of the drive shaft power train were an innovative solution to avoid the use of the traditional belt and pulley system that was used elsewhere.

(d) Williams and Ritchie through a thorough understanding of the most suitable treatment processes for this difficult ore and an understanding what their machinery was capable of, were able to optimise the recovery of the gold from the ore that was brought to their mill. As

a result of achieving higher levels of recovery, especially from difficult ores, miners were prepared to travel large distances to have their ore processed by the *Reefer Battery*.

(d) The treatment processes devised for the difficult ore enabled the recovery of gold from the ore to be optimised

(e) The mill was credited as being the first mill to incorporate, as a result of Ritchie's and Wilson's designs:

(i) slim tapered wedges to hold stamper tappets in place in lieu of set screws as well as other innovative features, a feature later widely adopted by other stampers.

(ii) a device that prevented the battery boxes [mortars] from getting choked, which ensured the battery could not be overfed [T&CJ 13 April 1895 p20].

(iii) Ritchie's patented side-action tables [TCJ 31 Aug 1904 pp32-32] a percussion table – concave table ending in a sharp point, to retain the incoming pyrites whilst allowing the light material to be washed over the side [said to be as effective and much cheaper than frue vanners] [T&CJ 13 April 1895 p26].

(g) The mill owners found, ahead of other mills, by slowing the stamp rate per minute from 90 to 60 and adding clean gravel to reduce the frothing of the crushed pyritic ore largely overcame the mundic problem and significantly improved the recovery rate of gold and mercury.

Creative/ Aesthetic Significance

(a) The site provides an evocative 19th century landscape mining ruins. It shows a considerable degree of unity in materials, form and scale with the structures being built from local material and conforming to the morphology of the land.

Research Potential:

Adelong Falls Gold Mill Ruins – *Reefers Battery* and surrounding sites provide an opportunity for research and learning in relation to:

(a) the incremental changes over time in the philosophy, design, construction and technology of wet process gold ore milling and recovery over a period of 60 years in an Australian context.

(b) the historical elements remaining at Adelong Falls Gold Mill – *Reefers Battery* ruins and other nearby sites may all be interpreted for both educational and scientific purposes and comparative purposes with other mills in Australia – some exist as ruins, some exist as only foundations and others only known from photographs and documentation.

(c) The Adelong Goldfield of which the mill was part, demonstrates the major methods of gold mining as they evolved, during the 19th and early 20th centuries – from small scale alluvial mining, to reef mining, large scale alluvial operations and finally to broad-area dredging.

(d) The logistics involved in servicing a productive 19th century goldfield. Refer Ref 7 re transport logistics

(e) The successful reclamation of the mill site from overgrowth and conservation of the ruins while maintaining the integrity of its construction; the result being an interesting tourist site.

(f) Examination of the social context of the Adelong Goldfield to reveal the influence and obvious effects that mining and mining methods had on communities and the interrelation of different ethnic groups.

Social:

Adelong Falls Gold Mill Ruins – *Reefer[s] Battery* is significant from a social and cultural perspective in the following ways:

(a) During its 60 years of operation, the *Reefer Battery* as a public mill was an important facility for independent miners and small mining companies who otherwise would have had to take their ore over long distances to be crushed and processed.

(b) The ruins are a focal point for visitors to the area and are a popular subject for artists and photographers.

(c) Tumut Shire Council has shown enlightened stewardship of the site by carrying out remediation, preservation and partial restoration of the ruins, much of the work being carried out by voluntary community labour.

Rarity

(a) It is thought to be the only substantial remains of a water-powered gold mill in NSW, and possibly Australia.

Representativeness

While the *Reefer Battery* had many features that made it superior to other 19th century wet processing gold mills in Australia- as noted by Slee [Ref 7], it was in most aspects similar to other mills of the day that included processes to win gold from the pyrites and tailings

Integrity/ Intactness:

Overall

The Adelong Falls Gold Mill Ruins – *Reefer Battery* is today a ruin and will not be reinstated, but sufficient parts of the fabric - structures and some equipment, remain to allow an appreciation of its construction, the purpose of its components and the processes involved. Active scholarship and photos together with excellent interpretive panels and walking and viewing access assist the layman to gain an understanding of what was there in its “glory days” and its importance to the Colony of New South Wales.

There is an excellent model of the mill in the Adelong Museum as well as models of individual items of the mill’s machinery.

Statement of Significance:

The Adelong Falls Gold Mill Ruins – The Reefer Battery, is historically significant in the processing of gold ore; its development and operation were associated with important individuals and a leading engineering company; and it was technically superior to others in Australia in the crushing of ore, the extraction of gold, and in the machinery it utilised.

Erected in 1858, the Battery was one of the first on the Adelong Goldfield and was the last to close in 1915. Its owners, David Wilson and William Ritchie were innovative and exhibited technological excellence in developing processes and machinery to extract gold from the difficult mundic ore. Their quartz-crushing and gold-saving machinery was ranked foremost in Australia by the NSW Department of Mines. And in the design and manufacture of the equipment, they were assisted by P N Russell & Co, the leading Australian engineering company. As efficient and effective facility, the battery was socially significant in enabling ore to be processed locally instead of it having to be transported to distant facilities.

The mill closed when reef mining effectively ceased and the machinery and building superstructure were subsequently removed. However, the fabric of the Battery and some of the

machinery elements substantially remain. Accordingly the mill has significant research potential in relation to the development of gold mining ore processing and extraction processes as they evolved during the 19th and early 20th century.

The Battery is most likely the only remaining – substantially intact, water-powered gold mill in NSW and perhaps Australia, and was one of the few privily owned mills that incorporated an extended treatment process to extract gold from pyritic ore.

While it had many features that made it superior to other 19th century gold mills in Australia, it is representative of them as it was similar in most aspects.

Assessed Significance: State

Cited References and Internet Linkages:

Ref	Author	Title	Publisher	Repository/ Location	Year
1	Gondwana Consulting Alan Ginns	Signed off Plan of Management – Adelong Falls Adelong Falls Gold Mill Ruins Vers. D.4	n/a	Tumut Shire Council	2010
2	Tom Wiles	A tour of the Reefer Battery – a guide to the workings of the Reefer Battery	Adelong Alive Museum	Adelong Alive Museum	~ 2003
3	Heritage Archaeology M Tracey and J Lambert Tracey	Conservation Management Plan Adelong Falls Reserve NSW	n/a	Tumut Shire Council	2003
4	Crown Lands Office Dept Lands NSW	Plan of Management Adelong Falls	n/a	Tumut Shire Council	1985
5	J H Winston-Gregson	Adelong Falls Reserve Archaeological Report *Part of Ref 4*	n/a	Tumut Shire Council	1983
6	J Lambert- Tracey	Gold on the Adelong – an Historical Archaeological Landscape Study of the Adelong Goldfield 1853-1916 ISBN 0 646 34346 7		Internet	1996
7	NSW Department of Mines Geological Survey L F Harper	The Adelong Goldfield this document includes a report of the Inspector of Mines Upon the Mines of Adelong J Slee in 1876	NSW Government Printer	Tumut Shire Council Library	1916
8	Rosalyn Bird	Adelong Glimpses of the Past ISBN 0 9597435 0 2	Stewart Press Hornsby	Tumut Shire Council Library	1976
9	W Roy Ritchie	Early Adelong and its Gold ISBN 0 7316 0745	Wilkie Watson Publications Tumut	Tumut Shire Council Library	1987
10	Crown	Goldfields Act 10 Vic No 29	NSW Government Printer	Mitchell Library	
11	Department of Mines	Annual Reports of the NSW Department of Mines	Government Printer	Mitchell Library	various
12	Sybil Jack	Report on the Adelong Goldfield *Aust Soc. For Historical Archaeology*	Newsletter Vol 11 No 1 March 1981	internet	1980
13	Deputy- Head of Sydney Mint and Professor of Geology Sydney University	Royal Commission Report on the Southern Goldfields to Colonial Secretary	SMH 1 Sept 1860	National Library of Australia – *Trove* data base	1860
14	William Ritchie	Ledgers of the Refer Battery	n/a	Adelong Museum	1871 to 1910
15	Wilson and Ritchie	Drawings of their 1874 5-head stamper battery	n/a	Adelong Museum	1888
16	P McCarthy, C Davey	The Development of Victorian Mining Technology			
17	Peter McCarthy and Sandra Close	Discussions with these AIMM people well versed in 19thC goldmining practices	n/a		
18	T K Rose, W T Merloc	The Metallurgy of Gold 6th ed	Wexford Press		2008
19	Anonymous [T A Rickard]	The Stamp Milling of Gold Ores	Hill Publishing Co		1906
20	Perkins	Perkins Papers	Tumut Family History Group	Adelong Museum Tumut Shire Library	

Source Material & Research Comments

The research on Adelong Falls Gold Mill Ruins of the *Reefer Battery* and associated infrastructure has been protracted because primary source documents relating to the years following the proclamation of the Adelong Goldfield are scarce, most official records having been destroyed in the Garden Palace Exhibition Building at the Domain in Sydney 22 September 1882 where they had been stored.

In addition to the official reports from the then NSW Department of Mines, there were quite a number of newspaper and magazine articles of the day describing the mining activities on the Adelong Goldfield and Ritchie's ledgers.

However, the author's understanding of the site and of the technology and processes involved has been immeasurably assisted by local historian Tom Wiles – a fount of knowledge who first saw the site in 1954, and with others who took the time and trouble to talk to those who worked at the mill and investigated their stories on the site, testing their information even to the extent of carrying out surveys, recording what was there and making models of the components of the mill. It is imperative for anyone wishing to gain an understanding of the mill that any reading of the above references must be tempered with the helpful comments of Tom Wiles - but not necessarily adopted by the authors.

Others who greatly assisted the writing of this document were Louise Halsey Tumut Shire Council Conservation Coordinator, Peter McCarthy and other professionals who are well versed in the history and practices of 19thC goldmining and processing.

It must also be said that each successive Plan of Management built on the work that the preceding ones. Unfortunately none of their authors sought the advice or comment of practical mining engineers who were well versed in 19thC auriferous mining practices and processing and treatment of auriferous quartz.

The document the author took as my basis for this document, often verbatim, was Ref 1 which was the evolution of earlier Plans of Management as well as newspaper articles of the day, Ritchie's ledgers and limited number of drawings.

Appendix 1 Letter of Approval from Tumut Shire Council

Tumut Shire COUNCIL

16 January, 2012

Engineering Heritage Committee
Engineers Australia
10 Noel Street
NORTH WOLLONGONG NSW 2500

Dear Mr Boleyn

Engineering Heritage Recognition of Adelong Falls Reefer Battery Site

I refer to your letter dated 11 January, 2012 and advise that Council happily agrees to Engineers Australia recognising the engineering heritage value of the Adelong Falls Reefer Battery site under its Engineering Heritage Recognition Program. Such recognition is a real honour that will increase public awareness in the heritage significance of the site and the important role that engineering played in its development. It is also hoped that this recognition will increase community visitation to the site and encourage on-going conservation works.

In agreeing to the recognition, Council acknowledges that it will be responsible for organising an unveiling ceremony.

Council's contact person in this matter is Louise Halsey, Adelong Falls Conservation Co-Ordinator.

Council also agrees to provide copies of relevant material at its libraries, without charge.

Yours faithfully

Paul Mullins
Director Development & Environment

Cc Land and Property Management Authority
Grant Marsden
P O Box 60
Wagga Wagga NSW 2650

76 Capper St Tumut NSW 2720
ne 02 6941 2555
...ail admin@tum...nsw.gov.au
website www.tumut.nsw.gov.au
ABN 82970406169

Administration/Assets & Design (Engineering)
fax 02 6941 2676

Finance/Development & Environment
fax 02 6941 2679

THE Bluett AWARD

Appendix 2 History Time Line of the Reefers Battery

Date	Occurrence	Ref	References
03 05 1800	William Williams born		
1824	Hume and Hovel expedition passed through area		
1829	David Wilson born at Campsie Scotland	1	
1834	William Ritchie born in Paisley Scotland	1	
1839	Geologist Strzelecki found auriferous pyrites near Hartley. Governor Gipps requested he not reveal his findings		
1841	William Ritchie emigrated to Australia with his parents	1	
1849	Reported a Charles McArthur found gold at Nackie Nackie near Adelong		
1849	Aged 19, William Ritchie was apprenticed to George Russell's foundry in Sussex St Sydney		
1851	Governor Gipps allowed the discovery of gold to be made public		R Bird Adelong Glimpses 1976 ISBN 0 9597435 0 2
1851	Sofala gold finds		
Late Dec 1852	Alluvial gold discovered on Hindmarsh Ck in the Upper Adelong Creek – near Batlow		
1853	Reported a diggers camp set up Upper Adelong near Batlow	3	
1 Feb 1853	Goldfields Management Act came into force		
Sept 1853	William Williams arrives at Adelong from the Ophir goldfield		
1855	Payable alluvial gold discovered in the bed of Golden Gully		
1855	Rush began to the Adelong main field reported over 2000 diggers	3	
15 02 1855	Adelong Goldfield officially proclaimed		
1855	A Commissioners camp was set up		
1855	Adelong Creek being worked 'thirty miles along its course with very shallow sinkings and surfacing on hill slopes		*The Goulburn Herald 10 March*
June 1857	Reef gold discovered on Donkey Hill by Bullock and party		
1857	Reef gold discovered by William Williams in winter at Victoria Hill Old Hill Reef	3	
1857	Goldfields Act 10 Vic No 29		
1857/ 58	Portable crushing machine brought to Adelong by A S Jones	3	
1858	Town of Adelong proclaimed		
early 1858	*Pioneer Battery* off southern end of Victoria Hill erected by David Wilson for Mr Emanual opened	1,14	
May 1858	Mundic first encountered	7	
1858	*Edwards Mill/ Great Western Battery* with dam on Adelong Creek and connecting water race	14	
1858	Perseverance Battery opened for William Williams on upper reaches of Sawpit Gully	14	
18 May 1858	*Reefers Battery* for Reefer Quartz Crushing Company opened for business	14	Adelong Mining Journal May 27
Aug 1858	Reported population of 2500 on goldfield – expected by some to		Empire 2 August p2
January 1859	Ritchie came to Adelong to supervise the nightshift at the *Pioneer Battery*		Ritchie's memoirs
	Returns from June 1857 to September 1859 give a return of 60,000 oz from 12,000 tonnes of quartz – 50oz/ ton from the Old Reef Crushing costs £14,000 other expenses £20,000	2	
1859	Production falling and miners being lured to new diggings at Kiandra	2	
1859	Ritchie dispensed with the amalgamation barrels		Old Adelong 1926
1860	David Williams bought into ownership of *Reefers Battery* when Carmichael and Lemons withdrew from partnership		
1860s	Influx of fortune hunters from all over the world ,Chinese, Germans, Cornishmen when reef mining started		

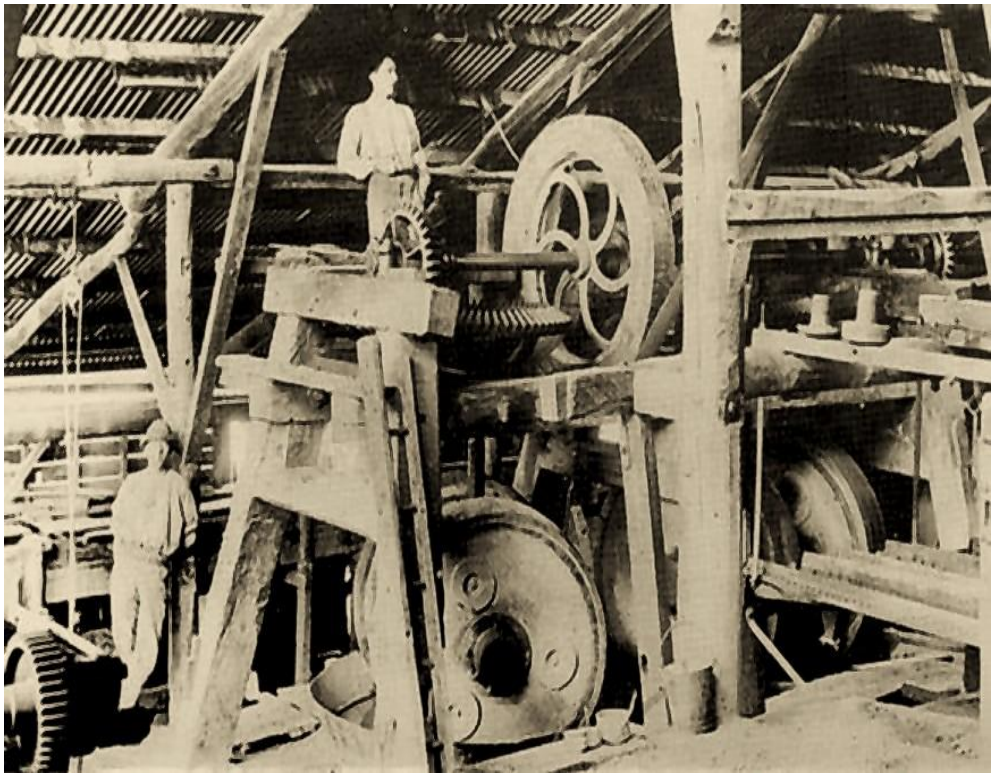
Date	Occurrence	Ref	Comment
1860	Kiandra gold discoveries	1	
1861	Lambing Flat [Young] gold discoveries. Many miners left the Adelong for this new field.	1	
1860s	Upper strata of Victoria and Old Hill Reefs being worked – up to 18 claims, Other reefs being worked – Currajong, Caledonian, Donkey Hill, Middle and Fletchers Reefs Gibraltar being worked but only to shallow depths	7	and newspapers of the day
1864	Mandelson withdrew from the partnership leaving Williams, Ritchie and Wills as owners of RQCCo [Reefer Quartz Crushing Company]	TW	
1868	Significant new gold discoveries in Adelong field by William Williams	1, 7, 8	
1869	Only two public stamper batteries regularly available for crushing private miners' ore along Adelong Creek Reefers and Edwards and Channon Great Western Battery	1	
26 March 1869	Mining Registrar gives right for Wilson, Ritchie and Wells to build a3ft high dam across Adelong Creek and take off water in a race 12 cu ft/ sec		
1869	Decision to relocate Reefers Battery downstream to present site	1	
1869	Contracts let by RQCCo for construction of a race to bring water to new *Reefer Battery* site from dam constructed for original Reefers Battery		Newspapers of the day
17 07 1870	Construction of *Reefer Battery* completed and mill did a trial run with granite		
1870	Estimated 400 miners on the Adelong Goldfield	1	
1870	Introduction of *The Goldfields Regulations*		
187o	Goldfields Royal Commission C S Wilkinson		
1870	Watercolour titled *Edwards Mill Adelong* Edward Combes along with other paintings of the area		
1870	*Ferndale* residence of Ritchie believed to have been built	1	
1871	Goldfields Royal Commission, 1871 into the present gold fields act resulted in Report 1881 Parliamentary Papers NSW 1871-2 Vol 2		
1871	Census of NSW recorded Adelong population 864	3	
1871 - 1885	Land granted or acquired progressively over this period to Williams and Ritchie for gold mill site	4	
1872	Miners put down a test shaft on Adelong Creek downstream of the main field and returned payable alluvial gold	1	
1872	Adelong United Goldmining Company formed to establish a highly mechanised large alluvial mining operation		
1872	"A mining mania broke out and Adelong was besieged with speculators and brokers intent on floating anything and everything mania"	8	
March 1874	*Plan of the Town of Adelong and Environs* issued by NSW Surveyor Generals' Department		
Oct 1874	Mining Registrar approves transfer of interest of Weeels to Ritchie and Wildon	2	
1874	The flume above the Great Western dam was washed away on 3 occasions in 3 months, so the lower water race with headwall was completed and a weir and log dam built for the water supply and the old race done away with.	1	
~ 1874	Holding tanks for mill's tailings erected along Adelong Creek	1	
1874	Original three 4 head stamper batteries replaced with three 5 head stamper batteries which were relocated 600mm downhill still utilizing the original A frames	2	
1874	Hydraulic ram replaced with 6 inch force pump	2	
1875	Crown Lands Alienation Act allowed miners to settle with their families on 2-acre blocks within a proclaimed goldfield, was being considerably misused	3	
1875	NSW Department of Mines brought into being Geological survey by NSW Department of Mines conducted	1	

Date	**Occurrence**	**Ref**	**References**
1876	*Reefer Battery* mill considerably expanded with construction of a buddle and reverberatory furnace with a rising underground flue and chimney, chlorine plant and weighbridge	1	
1876	Great Victoria Mine secured the £1,000 award offered by NSW Government for reaching a gold bearing lode at a depth greater than 800 feet	7	Letter of Transmittal
1876	First official comments on *Reefer Battery* J Slee Inspector of Mines *Report of the Inspector of Mines upon the Mines of Adelong*	7	
1876	Thought the Weighbridge was installed around this time	TW	
Early 1880s	Gibraltar Syndicate found rich ore at depth after several years of effort	1	
15 June 1881	RQCCo purchased water rights, 4ft high dam and mill equipment of Williams Gold Mining Company confirmed July 1881 – 20 ground sluice heads [20 cusecs – 0.56cu m/sec]	1	
July 1881	Water right, dam and race registered to S Emanual transferred to Wilson and Ritchie – 16 hp of water		
Aug 1881	Mining Registrar approves construction of 6ft high dam across Adelong Ck to supply Reefer Battery		
1882	Land grant Portion 102 to David Wilson	4	
15 June 1881	Auction of Williams Amalgamated Gold Mine Company Limited machinery, plant and leases		
1882	Wilson's house Campsie built Block 704		
1882	New upper water race from site of *Williams' Mill* to *Reefer Battery* constructed	1	
1882	New overshot 18 feet diameter waterwheel installed at Reefer Battery	1	
1882	Rockbreaker installed at *Reefer Battery*	TW	
20 Jan1883	*Great Victoria Mine* received a government award of £500 for showing payable gold at 1,000ft	7	
29 July 1885	Adelong Population Area proclaimed	4	
1891	Gibraltar Hill Gold-mining Company obtaining yields of around 10 oz to the ton and becoming an increasingly mechanised operation	1	
1893	Patent amalgamators and concentrators were erected at *Reefer Battery*		[T&CJ 28 Oct 1895]
1895	*Gibraltar Hill Mine* sold - led to new capital injection – 30 head stamper, chlorination, cyanide works, air compressors and steam-driven hoisting machinery for 4 shafts and a water race	7	P37
1897	David Wilson died and William Ritchie became the sole owner of Reefer Quartz Crushing Company and moved into *Campsie*	14	
1897-1899	*Gibraltar Mine* production >43,000oz	7	
1899	*Mineral and Gold Dredging Act* introduced		
1900	Cyanide plant installed at *Reefer Battery*		
1900	Mining Partnership Act proclaimed 22 September 1900		
1901	Dredging operations began on lower Adelong Creek with Davie and Kershaw operating 2 large suction dredges	1, 7	
1902	William Williams died	1	
1908	Areas downstream of the Falls had been leased by other dredging companies	1	
3 March1909	*Adelong Urban Area proclaimed*		
1910	*Reefer Battery* effectively ceased operation		
24 April 1911	William Ritchie died		
1911	Two large bucket dredges were in use on the lower Adelong Creek	1	
1914	After experiencing declining Gibraltar Mine closed having produced ~ 4 tonnes of gold during its life		

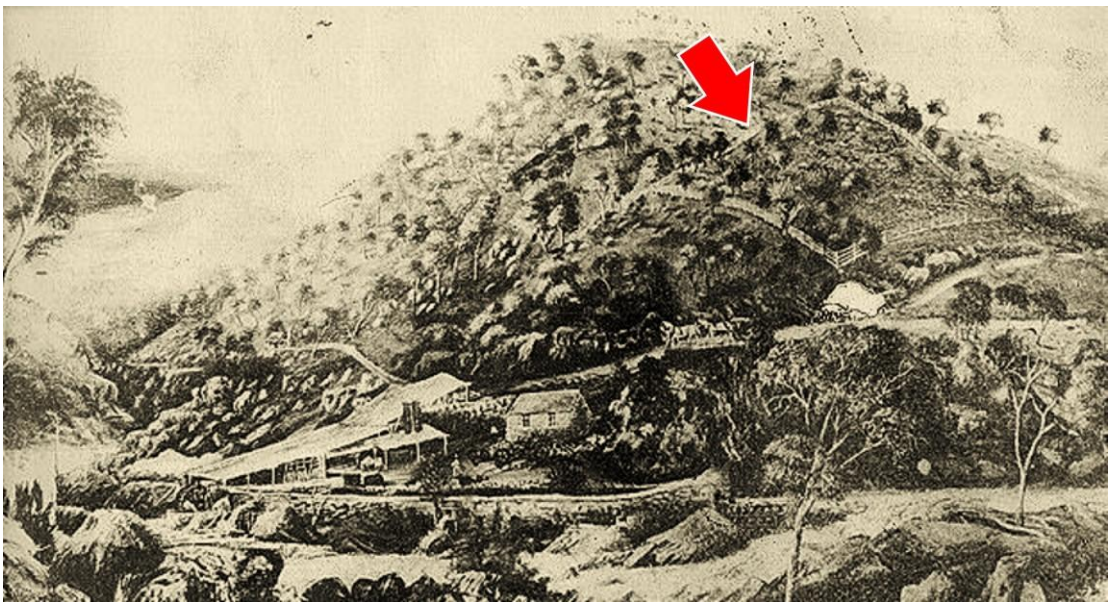
Date	Occurrence	Ref	References
1915	*Reefer Battery* finally closed	1	Last reported crushing
1915	Five dredges were in use on lower Adelong Creek	1	
1916	NSW Department of Mines Geological Survey *The Adelong Goldfield* L F Harper		
1930s	Site scavenged for scrap iron and steel and much damage done to the fabric of the Reefer Battery	TW	
1930s	Severe flood events caused the structural remains of stamper batteries that were erected on the banks of Adelong Creek to be destroyed including sections of the Reefer Battery along the creek.	3	
1938	Williams' house *Campsie* burnt down when explosives stored on the ceiling exploded	TW	
1857-1941	Estimated nearly 25 tonnes of gold won from the Adelong Goldfields	1	
1900-1941	Nearly 9 tonnes of gold had been won from the extended Adelong Goldfields	1	
26 11 1971	Gazettal of Reserve No 88410 for Public Recreation approx 17.8 hectares	4	
Mid 1975	Development of the Reserve began with Federal Government grant under the RED Scheme	4	
03 09 1976	Fossicking Area No 32 over Adelong Creek passing through the Reserve declared	4	
12 09 1876	Commenced to treat or save mundic with a new improved buddle	14 No 7	
1980	Adelong Falls Reserve given interim heritage protection	1	
February 1980	Tumut S C application for funding to restore "The Adelong Falls Gold Workings"		
12 12 1980	Additional 9 hectares added to the Reserve	1	
> mid 80s	Test drilling carried out in several locations of Adelong Goldfield	1	
1983	NSW Department of Lands began researching a Plan of Management for the Adelong Falls Reserve	4	
1983	Archaeological study - Adelong Falls Reserve Archaeological Report completed J H Winston-Gregson	4	
28 03 1983	Ruins classified by the National Trust of Australia NSW	1	
15 03 1985	Gazettal of Permanent Conservation Order No. 72 for the Reserve	4	
1985	Plan of Management for Adelong Falls Reserve completed by Crown Lands Office – NSW Department of Lands	4	
1987	Australian Bicentennial Fund grant of $120K and additional funding by Tumut Shire Council $60K enabled significant conservation works to be undertaken on the ruins		Louise Halsey
05 06 1987	Further significant addition of lands - 30.47 hectares to the Reserve		
1987	BiceLouise halseyntennial grant of $120,00 supplemented with TSC $60K to carry out restoration work		
1987 - 1992	Substantial vegetation clearing, stabilisation and conservation works of the *Reefer Battery* ruins took place in two main periods of activity.		
02 01 1988	Official opening of Adelong Falls Reserve	4	
1990	Investigation of structures and stability of retaining walls completed - Structural Engineers Report	1	
1993	Adelong Falls Battery Conservation Report completed	1	
02 04 1999	Ruins listed on NSW State Heritage Register		NSW Heritage website
2003	Conservation Management Plan – Adelong Falls Reserve	3	
13 10 2005	Tumut Shire Council resolved to set up an Adelong Falls Committee		
28 02 2006	Tumut Shire Council Resolution No. 69 adopted Terms of Reference for Committee		
Sept 2007	Adelong Falls Gold Working Reserve – Schedule of Works prepared for Council		Noel Thompson and Louise Halsey
2008	Conservation Management Strategy prepared for Council		
2011	Adelong Falls Reserve Plan of Management signed off by all parties		
2012	Significant flooding and loss of the remains of the tailing pits		Louise Halsey

Appendix 3 Photos of Adelong Falls Gold Mill Ruins and Adelong Goldfield

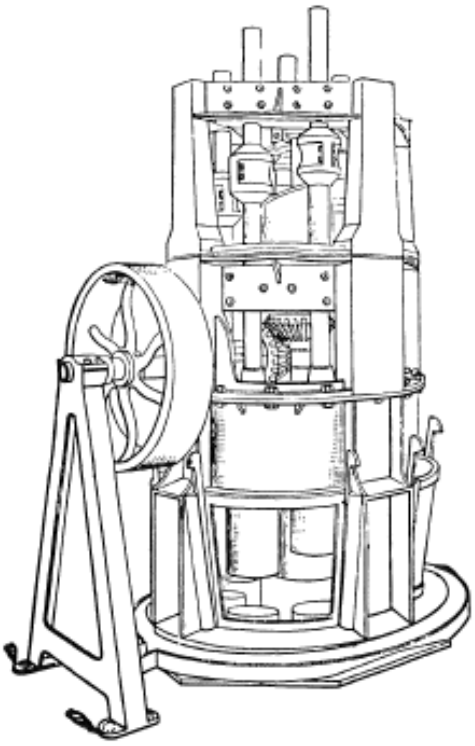
2 stands of 5-head stamper batteries Harrietville Museum



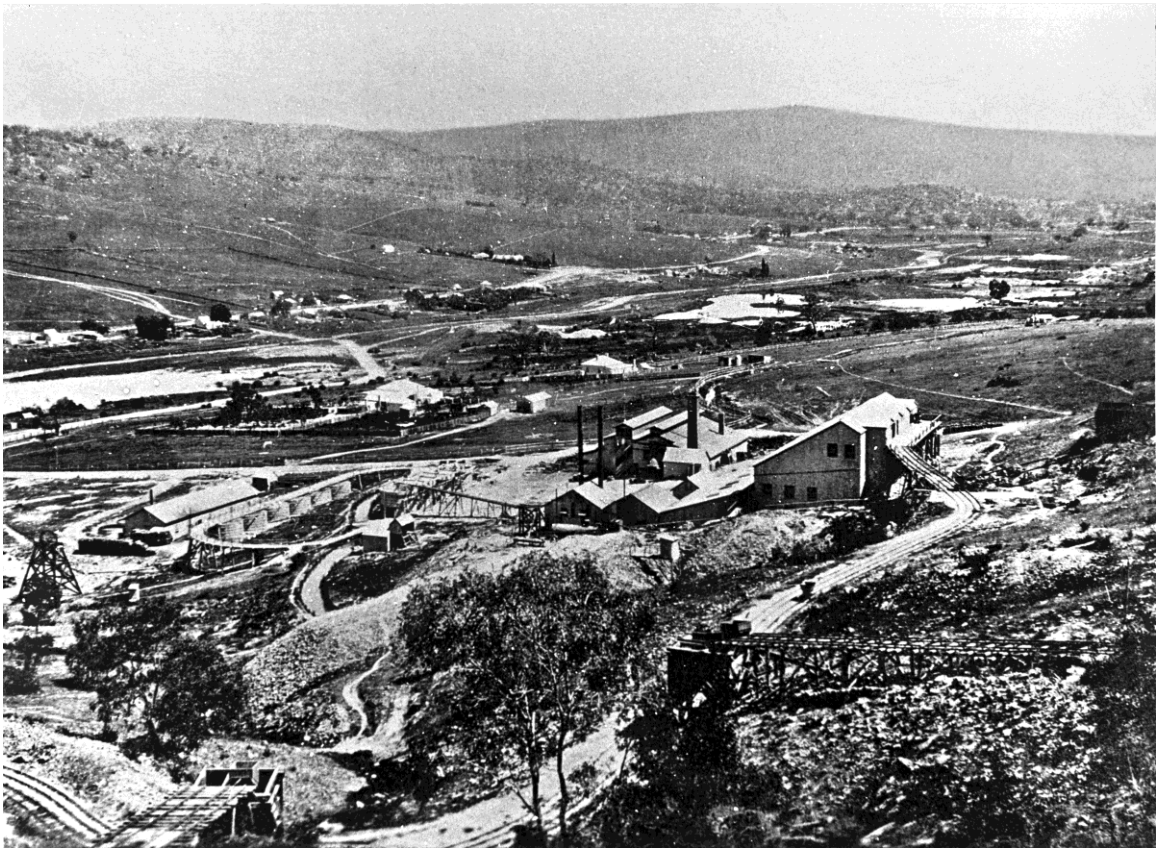
Ore-crushing machinery in the Reefer Battery - Chilean Mills. [Mineral Resources NSW].



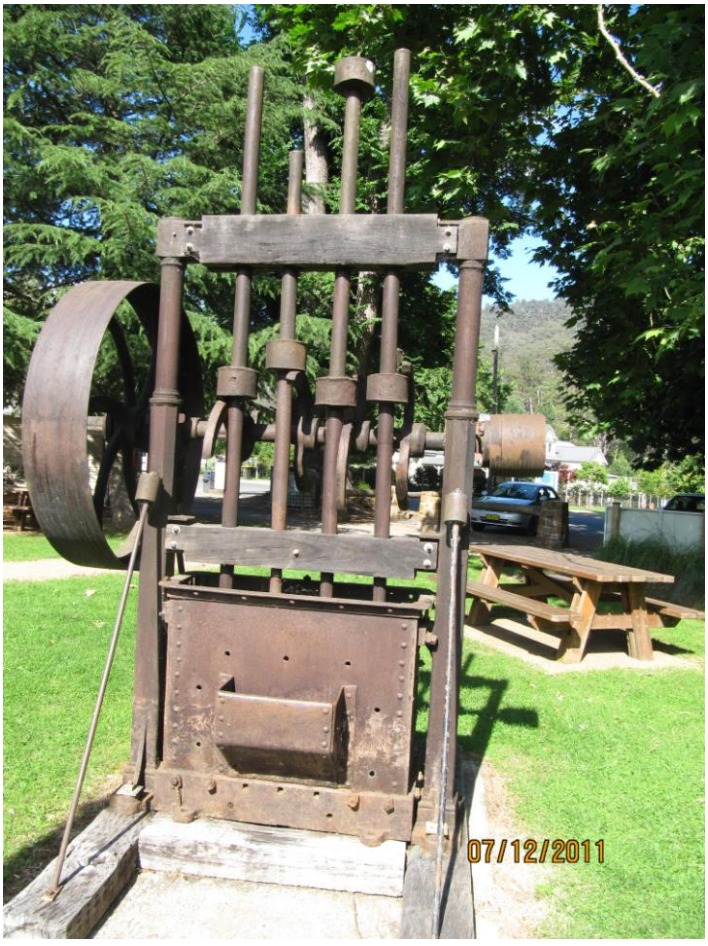
Reefer Battery around 1875. The photo also shows fencing of auriferous land on Currajong Hill



Howland's rotary 6-head stamp battery
from R W Raymond, "Mining Statistics West of the Rock Mountains", 1870 p666



Mount Gibraltar Mine NSW Department of Minerals



Old 4-head stamper Harrietville Museum

Berdan Pan with cast iron ball Harrietville Museum

Hub of 26ft [7.9m] lower water wheel

Note Additional photographs are included in the accompanying CD and DVD
refer list of contents in Appendix 4

Appendix 4 Drawings of the Reefer Battery Processing Machinery

1. No drawings of either the site or of the machinery other than the two drawings of 1874 5-head stamper battery mortar box included here are known to exist

2. Tom Wiles has completed a set of drawings of the mill's machinery and layout based on discussions with old mill workers, significant research and extensive on-site investigation over a period of 50 years where he gained an thorough appreciation of the mill machinery and processes.
   As part of this understanding process he constructed a model of the mill – now in the Adelong Museum and models of the individual items of machinery.

Contents of Disc 1

Submission to EA Engineering Heritage Heritage Recognition Committee
Adelong Falls Information Panels
Tumut Shire Council letter 26 November 2012

Contents of Disc 2

Folders

Adelong and Adelong Falls General Information
Adelong Falls Information Panels
Adelong Falls Information Panels photos
Adelong Falls Reefer Battery
Adelong Reefers Battery 2
Department of Mines NSW
Legislation
Mining Technology
Newspaper Articles
Photos and Drawings
Ritchie Ledgers
Tom Wiles Information

Files

Adelong Falls labelled map
Adelong Falls Reserve Plan of Management 1981
Adelong Australia Map 2 txt
Adelong Australia Map 2 jpg
Conservation Chronology Adelong Falls Gold Mill Ruins
Conservation Management Plan Adelong Falls Reserve November 2003
Development of Washoe and Reese River Silver Process
Development of the Stamp Battery
Map indication surrounding mines
Mining Technology paper
Notes from the web
Notes on a visit to Mitchell Library 1 August 2012
Notes on a visit to Adelong 16 March 2012 Tom Wiles
NSW Gold Mining Statistics
P & N Russell information
Plan showing the position of Mines at Adelong
Report on Goldfields Commission 1871
Report on Southern Goldfields to Colonial Secretary August 1860
Tom Wiles comments on 1st Drat
Tumut Shire Council letter of Approval
Will Carters writings
William Ritchie story
Wilson Family History

Appendix 5 Reefer Battery Machinery and Processing of Ore Explained

The principal adopted by Messers. Wilson and Ritchie's mill is to collect the free gold initially in the stamper batteries and amalgamation tables by amalgamation with mercury, and then further the grind the pyritical ore in Chilian mills and Berdan pans to release the free gold which is collected as an amalgam or free gold on the blanket strakes. The tailings which contained sufficient gold to warrant processing them were then taken to the Munday buddle where the pyrites was separated from the waste material. This pyrites was calcined in the reverbatory furnace and returned to the processing stream at the Chilean mills.

The effect of the process of triturating the "mundic" in Chilean mills and Berdan pans is to reduce it to an almost impalpable slime, and it is inevitable that, despite the blankets and the buddle, a large quantity of the mineral must be carried away in the tail-race.

It is only in recent years that the concentrates from the field have been subjected to any other than the grinding process for free gold. Some years ago, Messers. Wilson and Ritchie erected a roasting furnace and treated the calcined pyrites by amalgamation, but the process is reported to have been unsuccessful, and it was abandoned.
It is certain that an enormous quantity of gold has been lost through the lack of perfect concentrators, because Adelong pyrites are far richer than the average. The Daily Telegraph 15 August 1896

It was only when first a chlorination process - later replaced by cyanidation process that a significant portion of the "lost gold" was recovered.

The below descriptions of the mill machinery are of the mill as it was after the installation of the Cyanide Plant in 1900 and were taken mostly verbatim from Ref 2 and from Ref 7 and 18.

General

The mill had three separate lines where ore from three separate parcels could be processed independently and simultaneously.

Refer the elevation drawing of the mill on p 19 ?

Delivery of Ore to the Mill

The auriferous ore was brought to the Reefer Battery by horse and dray or bullock carts in approximately 1 ton loads along ore roads that ran from the reef mines above on the Victoria and Currajong Hills.
[When the weighbridge was installed in 1876, the ore was first weighed]

Ore Bins

Acceptable sized ore was dumped/ shovelled into three log-lined bins - 4 feet [1.2m] deep. The partitions between the bins were moveable gates so that the bins could be made larger or smaller according to the amount of ore delivered.

Ore Shoots [Chutes]

Each bin had its individual ore shoot mounted on the back of the battery A frames [that braced the stamper batteries] that led to the stamper battery directly below it. The shoots were operated from one of the stampers, to automatically feed the ore into the stamper battery mortar below.

Later, in 1882, a crusher with a grizzly screen was installed before one of the bins to allow toll charge processing of oversize stone.

Stamper Batteries dimensions of the post 1874 stampers are given in the two drawings shown in Appendix 4

Comment: the stamp boxes were designed by the owners to suit the particular kind of quartz that was found on the Adelong. TCJ 5 March 1870 p12

The three 5-head batteries stood below the ore shoots in between A frames, [4 in number]. The back ends of the A frames were built into the stone wall, helping to stabilise the machines. The A frames were cross braced and tied to two stout purlins notched on the back and supported a close lined feeder box extending the whole width. The mortars [cast iron boxes] sat on large hard-wood bed logs and were wedged down firmly from the A frames. Dies 9 inches diameter and 3 inches high , upon which the ore was crushed, were cemented onto the indented bottom of the mortar with a mixture of sand and clay.
The stamp boxes were designed and constructed so as to allow the hard Adelong "mundic stone" to be processed without damage. The internal length of the boxes 4 ft 9 in [1.44m] and width – without liners 16 inches [0.4m]. Inside each box there were four liners - cast iron plates for the double purpose of saving the boxes from wearing too fast, and for forming recesses or catches to retain the amalgam in the boxes; these iron plates were taken out every time a crushing was finished to provide access to the trapped free gold and gold amalgam.

Each stamp weighing 7 hundredweights [356kg], rotated and rose and fell 60 times a minute. The order of fall – beat, was 5-2-3-1-4 and the fall was about 9 inches [229mm].
Mercury – 2lbs initially and 1 ½ oz every half hour the crushing continued was placed in the mortar to amalgamate with the free gold.
On the front of the mortar was a screen [gratings] with small holes - of the order of 195 or 169 holes per square inch [1/13 or 1/14 of an inch -1.9 or 1.8mm] wide through which the crushed ore – pulp, had to pass down the process line. [the preferred screen size was 160 Ref 11 1878 p116]
Water for the wet-process was supplied by a hydraulic ram to a wooden trench in the stamper boxes. The water flowed down the shanks of the stems on to the stamp heads without splashing. The supply tank was next to the chimney of the blacksmith's forge. [TW]
Around 1880, a 6 inch force pump replaced the hydraulic ram. The pump was driven from the cam shaft of the batteries.
From the stampers the pulp passed down a trough that had blankets lining the sides [to ensure that any amalgam splashes did not escape] to the amalgamation tables.
The mortars were cleaned out of amalgam at the completion of each crushing and the amalgam processed to obtain the gold.

Amalgamation Tables *- recovery of free gold contained in the pulp by step ripples and amalgamation*

Comment: The tables were prepared to suit the pyritical quartz. TCJ 5 March 1870 p12

The three cedar tables were actually shallow troughs. Each table was 12 feet long and 4 feet wide [3.6m x 1.2m] with 6 inch sides and a fall of approximately 1¼ in per foot [~1 in 10]. Three 1 ft x 4 ft x ¼ in thick copper plates "silvered" with mercury [quicksilver] - the last one having a shallow riffle were placed on the upper section of the table. The remaining 9 feet of the table that was not covered with copper plates had a series of transverse 1 inch high timber riffles spaced ??ft apart.
Reports of the day [TCJ 5 March 1870] also stated that from time to time blankets/ strakes were placed on the table to trap the free gold that had escaped the mortar box
At the end of each table there was a shallow 6 inch wide by 6 inch deep timber well to catch any of the free gold or amalgamated gold that may have escaped the copper plate , riffles and blankets on the table.
The plates were cleaned of amalgam at the end of each crushing run and the amalgam processed to obtain the gold. The contents of the well - sand, mercury and amalgam were usually collected and placed in the stamper box.
If there was a considerable build up of amalgam on the plates they would be scraped off and more mercury sprinkled on.
At a later date the tables were converted to shaker tables to a design that was patented by Ritchie.

and made up in two sections divided by 3 mercury wells. The top section had a 4 feet x 3 feet x ¼ inch [1.2m x 0.9m x 6mm] plate then three 1 foot [0.3m] wide plates. At the end of the tables there were three shallow timber wells containing mercury to catch any of the gold that may have escaped the copper plates on the table.

Leaving the tables, the slurry passed onto the Chilean mills.

Often before the tailings were allowed to pass into the secondary crushing process the tailings were assayed to check the gold content to see if it was economically worthwhile to process the ore further.

Chilean Mill *releasing free gold from the pyrites*

There were three low-speed Chilean mills, one for each process line. Each mill consisted of an iron hemi-toroid pan – semi circular cross section - 5 ft in diameter and 1 ft wide [1.5m x 0.3m]. In this annular pan ran two connected rotating large heavy crushing wheels. The pair of wheels rotated at a speed of about 12 rpm giving a grinding surface of around 400 ft/ minute. Each of the wheels was 4 feet 10 inches [1.8m] in diameter x 1 foot [0.3m] wide. The rim of the wheel was cast iron and the centre of each wheel [drum] was filled with concrete and the total weight of each wheel was 30cwt [1.5 tonnes]. The wheels were 2ft 9in [0.88m] apart from each other.
This secondary crushing of the pulp further reduced the ore to a slurry.
Two of the Chilean mills had built in cone clutches but these were only used when that machine was disengaged and all machinery had to be stopped while the clutch bolts were loosened [Ref 12].
At the completion of each crushing run, the amalgam in the pan went to the retorting furnace for recovery of the gold.

Leaving the Chilean mills, the slurry then passed over a copper plated 4 ft [1.2m] wide board to catch any quicksilver that may have passed the mill and then passes on to the three blanketing tables.

Blanket[ing] Tables [Strakes] to catch the fine free gold

Below each Chilean mill was a blanket table. Each table was 12 feet long and 3 feet wide [3.65m x 0.9m] and had a dividing strip down the middle. The slope of the table was 1½ inches/ foot [1:8]. In each divided section were placed 4 overlapping long piled corduroy blankets 16 inches x 3 feet [0.4 x 1.2m. The light tailings were washed off into a tub while the heavy ore, the concentrates, were retained on the blanket.
[The blankets were washed every 2 hours on average . Ref 19 p136.
The rough surface of the blankets was particularly efficacious in catching and holding the plates and spangles of free gold or pyrites.
The tables were a cheap alternative to high-priced concentrators.
Before 1876, the amalgam went to the retorting furnace and the tailings went to the tailing pits. After the installation of the buddle in 1876 these tailings went to the buddle.
After 1892, the tailings passed through concentrating shoots, where the heaviest material was gathered, brought back and reground with the blanketings in the Berdan pans. The tailings that were not trapped in the concentrators went to the buddle.

Berdan pans

The Berdan pans, were rotating flat bottomed cast iron tubs – internal diameter 4 ft ½ inch and 2 feet deep [1.2m x 0.6m]. Each tub had a heavy cast iron false bottom plate – 3 ½ inches [80mm] thick cemented in. The axis of the tub was inclined – 1:3. The tub rotated at a speed of 28 – 30 rpm, and the ore was ground between the wall and bottom of the tub by one [Ritchie preferred one drag to the usual two] fixed heavy [3 cwt - 150kg] cast-steel drag that was secured by chains. The pulp was ground between the rotating bottom plate and the drag and front edge of the drag was turned up to assist the sand to pass under the drag.

After the blanketings and tailings passed through the whole process of grinding they were directed into the Munday's patent buddle.

Retorting Furnace.

When the mill was opened in 1870, the retorting furnace the retorting furnace was a new addition to the process line. It was originally built next to the blacksmith's forge but was shifted to near the south-west corner of the mill when the upper wheel structure was erected.
The amalgam from the tables, machines, troughs and barrels was placed in a retort and heated in the retorting furnace. The mercury evaporated and passed through a tube from the lid of the retort into a tub of water where it condensed and was reclaimed. The gold, when molten, was poured into ingot moulds and the ingots were stored in the strong room until they were sent, under police escort, to the Royal Mint in Sydney.

The [Mudays Cornish] Buddle

The 24 ft diameter buddle, incorporating Munday's patented Archimedean scrapers, was initially used to separate [grade] the pyrites from the tailings and later to grade the tailings before treating them at the cyanide plant.
The bottom of the buddle was concave and when in use had a baffle about 50 centimetres high around the sump in the middle. The 3 circular riffles on the bottom were to catch mercury or amalgam that had escaped during the grinding process.
There were 8 spreader pipes radiating from the spreader head on the upright shaft and below that were 8 rake arms, each arm carrying 3 rakes/ scrapers angled to sweep the tailings to the outside. The spreader pipes and rake arms turned at 8 revolutions per minute. After the ore had passed through the two or three stages of crushing [stamper, Chilian mill and Berdan pans] and most of the gold extracted, the tailings [the fine residue] were piped, as slurry, into the buddle near the rim. The fine material ran to the centre and the coarser and heavier material, the pyrites, was swept back to the outside.
When the buddle was full, the centre 40% or so, which were free of pyrites - the light tailings, were flushed into the tailing pits. The middle 40% or so which still contained some pyrites was put aside to be treated again. The outer 9 or 10 inches [about 25cm] of ore which was all pyrites was spread to dry [on the raised area above the buddle] then barrowed to the reverbatory furnace to be roasted to burn off the sulphur.
The pyrites could contain up to 2 or 3 percent gold [and by assays made in Sydney contained from 9 to 14oz per ton].

Comment: Buddles were introduced in to Victoria early 1860 [DMR Nov 1863 p241]

Tailing Pits and Tramline

The Tailing Pits were built after the lower water race [1874] but certainly before the buddle [1876]. The ramp above the pits carried a tramline for a skip to carry the tailings back to the buddle for further treatment.
After two or three crushings, all the tailings were placed in the pits. When transferring the tailings to the buddle, a special frame consisting of a head rail and two legs was used to lower the skip into the pit and when filled, lifted it back onto the tramlines to be pulled up to the buddle by winding gear. The frame was moveable and could be used in any of the four main pits.

The tailing pits were filled through a pipe [4 inch diam ? 100mm] from the Central Processing Area or the buddle as a slurry. The water drained away through a perforated wooden tube.

Reverberatory Furnace to calcine the recovered pyrites

After the pyrites had been extracted from the tailings, they were dried and barrowed to the furnace and fed into it through a hole at the top. The furnace nominally held about 20 cubic feet [0.56 cu m.] of ore – about 1/5th of the amount that would normally be obtained from one operation of the buddle.

The furnace, with its chimney, was built in 1876, at the same time as the buddle and the Chlorine Plant, to treat the pyritic ores.

Some details of the furnace: *W Ritchie circa 1910 Ref 14*

Slope of hearth	1 ¼ inches per foot
Furnace hearth construction	bricks on edge lengthways of hearth
Height of bridge at end of hearth	9 inches
Opening	5 inches
Roof of furnace	all bricks built on end [soldiers]
Side of furnace wall	all bricks on end sideways [headers on edge]
Sides of furnace	1 foot 3 inches thick
Outside walls	in usual manner

For hearth, walls and roof of furnace, good tempered clay was used instead of the usual mortar on account of the intense heat.
The outside construction of the furnace a usual [refractory] mortar was used

The ore was spread evenly over the hearth and the furnace fired up. When the ore became hot enough, the sulphur in the ore would start to burn. From then on the ore would have to be continuously raked to ensure that all of it was exposed to the flames and to prevent caking. When the fireman was satisfied that all the sulphur was burnt off, the furnace was shut down and the ore allowed to cool. Care had to be taken that the ore did not become too hot as then the gold would sublimate – that is, it would turn from a solid to a gas and thus be lost. If caking did occur, the ore was broken up in the Chilean mill before being sent to the Chlorine Plant for further treatment.

Chlorinator/ Chlorine Plant. To recover the gold from the calcined pyrites

Little is know about the Chlorine Plant except after 1878 the mill had one - *where who knows*? [TW]
The plant was thought to have been based on the patented chlorinator developed at The NSW Government Metallurgical Works at Clyde.
The treatment process entailed taking the roasted pyrites from the reverberatory furnace, moistening it and placing the pyrites in the chlorine vat. The generator was charged with manganese peroxide; common salt; sulphuric acid and water and the generated gas – chlorine, was delivered to the vat to percolate through the pyrites and dissolve the gold.
After several hours, when the operator was satisfied all the gold had been dissolved, water was passed through the pyrites to wash out the gold solution into a precipitation vat. Iron sulphate was then added to the vat which caused the gold, after 12 hours or so, to precipitate out of solution. After that time the water was drained off and the resultant sludge dried. At this stage, the gold was of molecular size. Borax, saltpetre and salt were added as fluxes and the sludge heated in clay crucibles to melt the gold.
Eissler The Metallurgy of Gold 1896
[Although employed at Grass valley California as early as 1857, it has taken 40 years to bring the knowledge of the best methods of its application to such a stage as to render its use technically successful and economically safe Ref 19 p237]

Cyanide Plant to recover the gold from the calcined pyrites

The cyanide plant was built in 1900 to extract the remaining free gold in the tailings. Gold in very fine particles will remain suspended in water and may take several days to settle in calm conditions. The tailings may contain 8 or 9 dwt. [pennyweights] per ton, a quantity well worth saving as was said that 2 dwt would cover the cost of treatment leaving 6 or 8 dwt of gold as profit.
The plant consisted of two wooden filter vats that stood on stone footings. The vats were approximately 12 feet [3.6m] in diameter and 6 feet [1.8m] high. There were four tanks- one for water, others for an alkaline solution; a weak cyanide solution and a strong cyanide solution. A small shed below the filter vats contained the precipitation boxes and settling vat. There were also delivery and return pipes and a pump.

In the bottom of the filter vat was a filter bed consisting of timber slats overlaid with coconut fibre matting then sacking. In the centre was an iron standard stayed to the top of the vat and upon which was a rotating spreader. The spreader consisted of a conical hopper to receive the tailings as slurry

and eight [or more] spreader pipes of differing lengths and turned at right angles at the discharge end. This was to spread the ore [a fine sand] evenly in the vat.
When the cyanide plant was built the tramline was extended to it and the buddle was used to grade the tailings before cyaniding.
Cyanidation was developed by McArthur in Glasgow, and was reported in Australia from 1889 [Janin 20 Dec 1888] Ref *Eissler The Metallurgy of Gold 1896*

The Cyanide Process to recover the gold from the calcined pyrites

The vat was filled with water then the ore [a fine sand] was pumped as a slurry to the hopper of the spreader which rotated as the ore issued from the end of the pipes spreading the ore evenly in the vat. When the vat was full, the water was drained off and a weak solution of cyanide containing an alkali was run in to neutralise the acids in the ore and neutralise any organic matter. After a suitable time the weak cyanide was drained off back to its tank. A strong cyanide solution was then introduced.
The strong cyanide solution was allowed to remain in the vat for several hours then the liquid was slowly drained off. The damp ore was allowed to stand for a few more hours to allow air to penetrate the damp ore – this helped the gold dissolve.
The dissolved gold [gold cyanide] was then flushed out with a weak cyanide solution. All solutions carrying gold passed through the precipitation boxes. These boxes contained zinc shavings upon which the gold precipitated as a black slime.
Here the gold cyanide reacted with the zinc and the product of the reaction was gold and zinc cyanide.
When the leaching process was completed, the zinc [in cages] was washed in the settling vat, the boxes thoroughly cleaned out and the sludge put in the settling vat where it was left for a few days to settle. The water was carefully drained off, the sludge taken out and dried and placed in a retort with fluxes and heated in the retorting furnace to melt the gold. During the process the cyanide solution was kept up to strength by adding more potassium cyanide.
The corrugated tanks at the cyanide plant site were used during the Depression in the 1930s to cyanide the tailings after the mill closed in 1914.
taken from Eissler *The Cyanide Process for the Extraction of Gold*

The Use of Mercury for Amalgamation

After Ritchie and Wilson overcame the mundic problem Ritchie wrote later in his Ledger 2:
At the start of a crushing 2 lbs of mercury was placed in a mortar box and then 1 ½ oz every ½ hour
Mercury would have also been used to dress the copper plates on the amalgamation table and some placed in the Chilean Mills and Berdans.

Lower Water-wheel

Until 1872 this wheel drove all the mill machinery. It was a backshot wheel rated at 35 [nominal horsepower [26kW]. The wheel was 26 feet [7.9m] in diameter, constructed of hardwood spokes with an iron centre hub and axle. It incorporated 64 buckets 4 feet 6ins [1.35m] wide and 1ft 3in deep requiring about 1250 cubic feet [35.4 cubic metres 35 tons] of water per minute to produce 35hp [26kW].

[Other reports state this wheel had 165 buckets, each of which contained four cubic feet of water, or 240 tons. There were only sixty-five of the chambers full at one time, so that at each revolution there is 15,600lb of water carried down. [T&CJ 16 July 1870 p15]]

According to Ritchie, the wheel rotated at 3.5rpm.

Mounted on the wheel – bolted to the spokes – refer Annexure 3, was an eight segment ring gear

This gear was replaced in 1881 with another segmented ring gear. The pitch circle diameter [PCD] was 18 feet 6 ¾ ins [5.51m], the pitch 3 ½ ins [70mm], number of teeth 200 in each segment and width of the teeth was 7 ½ inches [190mm].

From Ritchie's ledgers [Ref 14], the ring gear was replaced a number of times, each time with a differing PCD.

Mill Drive Train

It was noted in T&CJ 16 July 1870 p15, that the "gearing arrangements are on a new principle to that generally used".

The "free power" for the mill is generated by the water-wheel by a large eight segment internal ring gear – pitch circle diameter 18 feet 1 3/8 inches [5.51m], that was bolted to the water-wheel spokes, engaging a short horizontal shaft ; a pinion at one end and a spur gear at the other. Power is then transferred to the main drive shaft that delivered power to the various machines was made from wrought iron, three pieces - each ~20 feet, 60 feet long and 3 ¾ inches in diameter. The shaft rose up through the building at a 1:2 grade and was supported at 5? [every 10 feet TCJ 5 March 1870 p12] locations by intermediate plumber blocks mounted on solid carrier timbers that were housed in the north.

Transfer of power to the individual machines was through bevel gears- crown wheel mounted on the shaft and a spur gear take off, without clutches [except for the buddle, which was added in 1876, which was driven from a pulley mounted on the main shaft via a belt arrangement].
This allowed each machine to be connected/ disconnected "without the least interference' Ref 7 p15.

[Williams and Ritchie had a preference for bevel gears as opposed to belt drives because they gave positive power without slippage.]

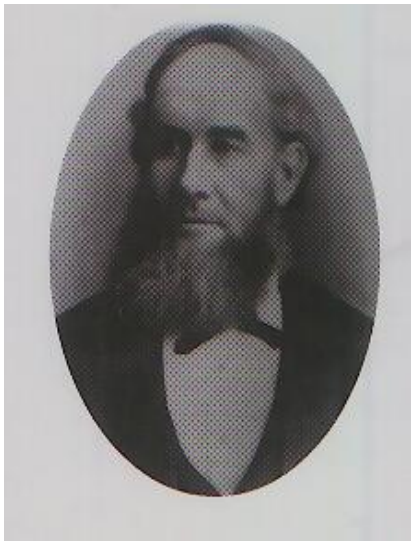
[Because there were no clutches in the drive train, when starting and stopping the machinery, the waterwheel had to be turning very slowly – the counter-shaft and gear wheel of each machine was moved to engage/ disengage the pinion on the main shaft. The flow of water to the waterwheel was controlled by a gate at the south-west corner where the operator could be signalled when the machine was required to be engaged/ disengaged.]

Upper Water-Wheel

In 1882 the capacity of the mill was significantly increased and the required additional power was derived from an 18 feet [5.5m] diameter overshot water wheel. The wheel was 6 feet [1.8m] wide and had 48 buckets. It is estimated that the wheel would have rotated at approximately 5rpm. Water from this wheel discharged into the lower race and so once it had served its initial purpose, was used to power the "lower" water-wheel. The addition of the upper wheel increased the potential power output to in excess of 60hp [44kW]. [Mines Dept Annual Report 1882 p103]
This wheel was used to power the stamper batteries and crusher.

Appendix 6 Biographies of David Wilson, William Ritchie, P & N Russell & Co.

David Wilson *Ref Wilson Family Memoirs Adelong Museum*



David Wilson was born at Lochcraig of Eaglesham – near Glasgow, on 23 November 1828 into a large family of nine children.

It is said that although they were reared on the land, there was a strong inclination towards engineering in some of the children, and this inclination appears to have been inherited by some of their descendents.

A number of the family eventually settled in Australia – David arrived on 18th June, 1853

David worked in the Paisley's cotton mills and when he was required to regulate the speed of his spinning machine by the pendulum movement of a clock in order to ensure an even thickness of the thread, he decided to leave the mill.

For some reason he decided that this was *the last straw* and decided to migrate to Australia.

Unfortunately his ship ran aground on a reef near Barwon Heads near the entrance to Port Phillip Bay and he swam to the shore.
Family legend has it that he shipped some machinery with him from Scotland and sold it at a good profit.

From Geelong he went to the Bendigo goldfields which had recently been discovered.
The next we know of him is he obtained employment as a pattern maker at P N Russell & Co Engineering in Sydney. There it is believed that he worked on the first railway engine that ran in NSW.

David moved to Adelong in 1858 with his wife and 2 children to erect the first quartz-crushing battery that had been manufactured by P N Russell & Co, to crush gold ore, either independently or more likely as a representative of P N Russell.
It was the steam powered *Pioneer Battery.*

Two years later with William Ritchie, he designed the *Reefer Battery* that incorporated many of their ideas that overcame operating problems of earlier batteries.

David entered into a partnership with Ritchie in 1861 and later became the senior partner in the firm when just the two of them owned the firm

He was the architect and builder of many buildings, including schools and churches, in Tumut and Adelong, and he erected a large flour mill at Adelong Crossing for William Williams.

His obituary following his death 3:30pm 19th July 1897 in part, said of him

Shrewd, skilful, industrious and possessing a vast store of practical knowledge on a wide range of subjects, it was little wonder he succeeded in life ….. his busy life has been identified with the history of the Adelong goldfield almost from its opening ……It was just 38 years ago that he and Mr Ritchie went into partnership and laid down the nucleus of what afterwards became the renowned "Reefer" battery, which is now, with all its special works and appliances, a monument of the deceased's engineering skill.

William Ritchie *Ref Ritchie Memoirs – Adelong Museum and Ref 9*

William Ritchie was born in Paisley, Scotland in 14 February, 1834 and as a child travelled to Australia with his parents in 1841.
Aged 15 in 1849, he was apprenticed at George Russell's foundry in Sussex St Sydney
His working hours were 6am to 6pm and earned 5 shillings/ week which he spent on board and lodging.

When William was 17 in 1851, he was sent to assist other of George Russell & Co to install flour milling machinery at West Maitland and, in the following year had to perform similar work at Clear Creek Bathurst.

William remained with the George Russell engineering firm until a friend in Adelong sent him a letter urging him to take a job there operating a crushing battery.

As a result, in early 1859, he came to Adelong to supervise the nightshift at the steam-powered "*Pioneer Battery*".

"I Wlm Ritchie of A(d)along in January 1859 I was working at my trade with P N Russell & Co of Sydny I was offered an appointment to come to Adelong at one Pound Pr Day [£1/ day] to run the Old Pioneer Battery. I excepted this appointment and left Sydney and started to work crushing Quartz about the latter Part of January 1859" *Ref 14 Ledger No 4 page 119*

After a successful trip to the Kiandra goldfields and a fruitful venture on Victoria Hill in 1860, he had enough money to by a share in the Reefers Battery.
When news came of a strike at nearby Kiandra, William left Adelong, registered a claim and worked the mine with some success. Following heavy snow at Kiandra he returned to Adelong and worked a mine on the Victoria Reef and for a while obtained 7 ounces of gold to the ton.

With the capital he had accumulated he purchased a share in the original *Reefers Battery* whose erection had been superintended by David Wilson in 1860. The other owners with the exception of David Williams and George Wills sold their interest in Reefer Quartz Crushing Company.

William married one of William [Old Gold Dust] Williams' – the wealthy scion of Adelong who had many financial interests particularly in goldmining enterprises, daughters – Maria on 15 December 1864, which would have – no doubt, been of advantage to him and David Williams in procuring capital needed for the improvements to the mill.

William's knowledge of foundry work no doubt was a great asset when replacing machinery as much of it was designed by Wilson and Ritchie themselves and much of it cast/ manufactured- where it could not be made locally, at P N Russell & Co's foundry.
Ritchie was also successful as a builder in and around Adelong.

William Ritchie died in 24 April 1911

P N Russell & Co Engineering

From a small family business Peter Nicol Russell went on to become a major played in 19th Century industrial Sydney.
In 1841 Russell left Russell Bros. foundry to take over the late James Blanche's foundry in George St Sydney. The foundry was believed to be the first foundry establishment in Australia producing both iron and brass castings.
Russell built up the business of the Sydney Foundry – manufacturing stoves, kitchen ranges; balcony stair and tomb railings, architectural building columns, as well as bells, bolts, nails and steam engine parts.
With business booming he established a branch works in Sussex St. It became known as the Sussex Street Engine works.
In 1855, Peter Nichol Russell founded P N Russell & Co in partnership with his brothers John and George, and James Wilkie Dunlop, the works' foreman.
The company prospered and in 1859 expanded to yet another site in Barker St with wharf access at the head of Darling Harbour. This became the main works.

P N Russell & Co became one of the largest engineering works in Australia, manufacturing engines, boilers, tanks, bridges, wool-washing machinery, wool presses, hay presses, quartz crushing machines [stamper batteries], ships, railway rolling stock and "every other description of machinery' that was required for the mining and pastoral development of Australia.
It was one of the first engineering works in Australia to introduce standard engine design and manufacturing.
Apart from designing machinery, by all account, P N Russell was also a major importer of machinery and had several warehouses to store the machinery.

Peter retired as an active member of the firm in 1860 and returned to London to act as overseas representative and purchasing agent.

Because of simmering industrial disputes, P N Russell abruptly closed in 1875 with a dramatic "lock-out". Over 600 men lost their jobs.

Russell was instrumental in the establishment of the Engineering Association of NSW in 1870 which was to be one of the twelve Australian engineering association societies that amalgamated to found the Institution of Engineers Australia – now Engineers Australia in 1919.

The Peter Nicol Russell Memorial Medal is the most prestigious award made by Engineers Australia. It perpetuates the memory of Sir Peter Nicol Russell, who made major donations to the cause of engineering in Australia. The award is presented annually to a Fellow of The Institution of Engineers Australia who has a minimum of 20 years experience in the practice of professional engineering and has made a notable contribution to the science and/or practice of engineering in this country.

Appendix 7 Adelong Goldfield – Statistics and Other Information

Returns of gold received by the Sydney Mint by the Gold Escort for the year 1879

	Ounces		**£**	**s.**	**d.**
Hill End	17,299.00	*Value*	68,042	17	0
Parkes	17,342.98		66,120	02	3
Adelong	16,432.54		62,580	11	9
Gulgong	16,236.78		62,985	08	6

Yields from the Adelong Goldfields

Based on records of NSW Department of Mineral Resources [Ref 9]

Period	**Reef Gold**	**Alluvial Gold**		**Total Gold**
	kg	*Dredging - kg*	*Other Alluvial - kg*	kg
1857-1874	5,648.98	-	5,291.69	10,940.67
1875-1920	6,043.25	4,226.89	2,302.08	12,572.22
1920-1941	66.96	1216.65	102.37	1385.98
1857-1941	11,759.16	5,443.54	7,696.14	24,898.87

From official records of Mineral Resources NSW, a total of almost 145,000 ounces of gold were extracted between 1876 and 1914. There is a noticeable reduction in the gold yield in 1878 and the years 1895 to 1897 due to drought. When gold dredging commenced on the field in 1901, the alluvial gold yields increased steadily, reaching an annual peak of 13,000 ounces in 1908. No official returns for the quantity of reef gold extracted are extant prior to 1884. From 1884 to 1914 the returns indicate that 182,261 ounces of gold were obtained through reefing claims. However, Harper estimates that the figure would be more likely around 250,000 ounces of gold, valued in 1914 at around £1,000,000.
The gold was extracted from an area of around 3 square miles [*Ref 3 p 50*]

The discoverers opened small longitudinal claims on the Reef. Gold was obtained by washing the rotten particles of rock and earth because of the stone at the top [of the reef] being in a state of disintegration. Before the quartz being worked became too hard, fortunately, a reef was discovered on the eastern slope [of Mt Victoria]. At this stage nobody understood quartz mining which later involved machinery for crushing ore. Using machinery, production naturally soared.
The returns from June of 1857 to September 1859 showed the incredible amount of 60,000 ounces of gold from 12,000 tons of quartz, an average of 50 ounces of gold to the ton, from the Old Hill Reef
However, the crushing costs were £14,000 and other expenses were £20,000 leaving £2 per week per man. Ref 8

Mr Dalton, Gold Commissioner interviewed by the Sydney Morning Herald said:

"…. Of eighty companies who worked the Great Reef between June 1857 and September 1859, thought 39 cleared nothing and twenty hardly paid expenses yet twenty one did well – some retiring with wealth and independence' Wilson ***[Ref 8 p11]***

Gold from the Adelong was then worth £3:12:06 per ounce. That from nearby Batlow to Laurel Hill was worth £3 :10s :0p - per ounce. The latter was a deep golden bronze yellow compared with the Adelong gold which was of a lighter, buttercup yellow shade.**[*Ref 8 p23*]**

Typical recovery rates of gold in the mills of the Adelong Goldfield were: TCJ 16 March 1872 p13

Mortar box	75%
Amalgamation tables and wells	20%
Blanket tables/ strakes	5%

Appendix 8 Contents of Accompanying Computer Disk

Documents:

Adelong Falls Gold Mill Ruins of the *Reefer Battery* and associated infrastructure should be recognised under the Engineers Australia's Engineering Heritage Recognition Program

Historic and current photos of the *Reefer Battery* and Adelong

Background information

Other selected pieces

Appendix 9 Author's Assessment of Significance of Adelong Falls Gold Mill Ruins

[taken from the EA Guide to Engineering Heritage Recognition Program]

Historical Significance	Indicate "Agree" or leave blank		
	National significance	State significance	Other than National or State
Guidelines for inclusion			
Shows evidence of a significant human activity			Agree
Is associated with a significant activity of historical phase		Agree	
Maintains or shows the continuity of a historical process or activity	Agree		
Guidelines for exclusion			
Has incidental or unsubstantiated connections with historically important activities or processes			
Provides evidence of activities or processes that are of dubious importance			
Has been so altered that it can no longer provide evidence of a particular association			

Association with important person or group	Indicate "Agree" or leave blank		
	National significance	State significance	Other than National or State
Guidelines for inclusion			
Shows evidence of a significant human occupation		Agree	
Is associated with a significant event, person or group of persons		Agree	
Guidelines for exclusion			
Has incidental or unsubstantiated connections with historically important people of events			
Provides evidence of people or events that are of dubious historical importance			
Has been so altered that it can no longer provide evidence of a particular association			

Creative or Technical Achievement	Indicate "Agree" or leave blank		
	National significance	State significance	Other than National or State
Guidelines for inclusion			
Shows or is associated with, creative or technical innovation or achievement		Agree	
Is aesthetically distinctive		Agree	
Has landmark qualities		Agree	
Exemplifies a particular taste, style or technology		Agree	
Guidelines for exclusion			
Is not a major work by an important designer or artist			
Has lost its design or technical integrity			
Its visual or sensory appeal or landmark qualities have been more than temporarily downgraded			
Has only a loose association with a creative or technical achievement			

Research Potential	Indicate "Agree" or leave blank		
	National significance	State significance	Other than National or State
Guidelines for inclusion			
Has the potential to yield new or further substantial scientific and/ or archaeological information		Agree	Agree
Is an important benchmark or reference site or type		Agree	
Provides evidence of past human cultures that is unavailable		Agree?	
Guidelines for exclusion			
Has little archaeological or research potential			
Only contains information that is readily available from other resources or archaeological sites			
The knowledge gained would be irrelevant to research, human history or culture			

Social / Cultural	Indicate "Agree" or leave blank		
	National significance	State significance	Other than National or State
Guidelines for inclusion			
Is important for its association with an identifiable group		Agree	
Is important to a community sense of place		Agree	
Guidelines for exclusion			
Is only important to the community for amenity reasons			
Is retained only in preference to a proposed alternative			

Rarity	Indicate "Agree" or leave blank		
	National significance	State significance	Other than National or State
Guidelines for inclusion			
Provides evidence of a defunct custom, way of life or process		Agree	
Demonstrates a process, custom or other human activity that is in danger of being lost		Agree	
Shows unusually accurate evidence of a significant human activity	Agree		
Is the only extant example of its type	possibly	Agree	
Demonstrates designs or techniques of exceptional interest	possibly	Agree	
Shows rare evidence of a significant human activity			
Guidelines for exclusion			
Is not rare			
Is numerous but under threat			

Representativeness	Indicate "Agree" or leave blank		
	National significance	State significance	Other than National or State
Guidelines for inclusion			
Is a fine example of its type		Agree	
Has the principal characteristics of an important class or group of items		Agree	
Has attributes typical of a particular way of life, philosophy, custom, significant process, design, technique or activity		Agree	
Is a significant variation to a class of item		Agree	
Is part of a group which collectively illustrates a representative type		Agree	
Is outstanding because of its setting, condition or size		Agree	
Is outstanding because of its integrity or the esteem in which it is held		Agree	
Guidelines for exclusion			
Is a poor example of its type			
Does not include or has lost the range of characteristics of its type			
Does not represent well the characteristics that make up a significant variation of its type			

Appendix 10 Interpretation Plan

Refer Tumut Shire Council letter of 26 November 2012 on the accompanying disc

Interpretation Strategy

Strategy for interpretation of the site is as per the draft EHA Guide to Engineering Heritage Recognition Program [2012].

The interpretation for the site will be by:

- Marking the site with an **Engineering Heritage Marker**, supplied by Engineers Australia Engineering Heritage Committee.
- A public ceremony to unveil the marker

The interpretation of the site is adequately covered by existing information panels located at the viewing platform site – 9 in number. These panels detail in words, photos and drawings the heritage and identify significant features for the public to understand the importance, those involved, rationale and history of both the Reefer Battery and other mining activities that took place on the Adelong Goldfield. *Photographs of the information panels are on the accompanying disc*

1.	Conserving Adelong Falls Gold Mill Ruins	*interpretive photos and text*
2.	Partners in Ore Crushing & Gold 'Saving"	*interpretive photos, aerial of Adelong, Ritchie and Wilson photos*
3.	Crushing Machine 'Saves' Gold	*interpretive photos, aerial, history of field and text*
4.	In the Footsteps of the Ore Crushers	photos, text and walks diagram
5.	The Last Gold Ruins Standing	photos and text

1.	Great Victoria Gold Mine & upstream alluvial diggings	*interpretive photos, map of Adelong inc leases and text*
2.	Gibraltar Gold Mine & downstream dredging	*interpretive photos, aerial and text*
3.	Reefer Battery Crushing Mill ~ one waterwheel 1870s	*interpretive photos, cross-section drg and text of mill before 1882*
4.	Reefer Crushing Machine ~ two waterwheels 1882	*interpretive photos and text of mill with 2 wheels*

In addition to the interpretive signage the following is in place:

1. Access paths to the sites from the viewing platform area and along the creek banks. These paths and small bridge across the creek were damaged in the 2011 and 2012 floods are in the process of restoration.
   There is some older unsuitable interpretive signage at the site but this will be replaced in due course.

2. The Adelong Alive Museum has a large model of the site with information and a booklet – *A Guide to the Layout and Workings of the Reefer Battery* written by Tom Wiles for sale. The museum also has explanatory models of the main items of machinery and holds the original Richie ledgers together with other information relating to the mill.

3. Copies of the submission will be printed by Council and placed in the branches of the Tumut Shire libraries, the local historical society, the local high schools, NSW Heritage and National Trust of Australia.

4. As part of the current upgrade work the following will be undertaken:

   a) Directional signage at the start of the two walks.
   b) An interpretation panel mounted on a structure similar to that detailed in draft 2012 Guide
   c) At each location where the major items of equipment once stood signage with a photo or outline drawing of the machinery together with details of its purpose.

5. A twin stand 5-head stamper battery at the entrance to the viewing platform road.

The Tumut Shire Council Adelong Falls Gold Mill Ruins Committee through its Manager Development and Environment Paul Mullins and the Committee's Conservation Coordinator Louise Halsey is considering providing the following additional interpretive information for the mill ruins site, subject to funding:

1. Information booklet based on this submission.

2. Web based downloadable MP3 Self Guided Tour of the ruins.
3. Open days where the interested public will be taken through the ruins.
4. A computer generated working model of the mill as at the turn of the 20th century.

To minimise potential damage to the site and give a better overview, consideration is also being given to the provision of elevated walkways through the site.

Design Process for the Panel Content

The basis panel content will be proposed and an initial layout developed by Engineering Heritage Australia [Sydney] will be developed by the Conservation Coordinator with input from specialist mining and engineering heritage technologists.
The panel content and layout will be submitted for approval to Tumut Shire Council and Engineering Heritage Australia.
Once joint approval is forthcoming, if Tumut Shire Council does not wish to undertake sourcing the panel, the approved design will be forwarded to EA's Marketing Manager in the Canberra office, who will finalise the graphical content and prepare an .eps [vector graphics] file required by the surface coating manufacturer.

Content of the Interpretation

This will be applicable for the panel that will be placed at the start of the tour through the site.

Title: The title of the interpretation panel is proposed to be The Adelong Falls Gold Mill Ruins – The Reefer Battery.
This is the preferred title that has been adopted by the Tumut Shire Council's Adelong Falls Gold Mill Ruins Committee.
Layout: will be in accordance with god interpretive practice and include the logos of Tumut Shire Council and Engineers Australia utilizing the services of a graphic designer.

Graphics: will include a plan of the site showing the relative positioning of the process line components and the path to be taken through the site.

Themes:

Primary [historical]:
a body of text will be derived from the nomination document relating to the place of the Reefer Battery in the life of the Adelong Goldfield.

Secondary [engineering]:
a body of text derived from the nomination document relating to the important developments instigated by the mill owners Wilson and Ritchie

Tertiary [social]:
a body of text with photos of the mill owners Wilson and Ritchie.

Location of the Interpretation Panel and Heritage Marker

Heritage Marker: at the same location where the other markers have been placed – the viewing platform which is directly opposite the Reefer Battery site and across Adelong Creek.

Interpretation Panel: at the start of the self-guided Reefer Battery tour walk,

Manufacture

The panels will be manufactured by firms who are known to have produced signage of the appropriate quality and durability.

Funding
The information panel and frame, including its placement, will be paid for by Tumut Shire Council from a budget item set aside for this purpose.