

LAKE MARGARET – A HYDRO ELECTRIC POWER SCHEME, INDUSTRIAL OBSOLESCENCE AND REBIRTH

Sarah Waight

Hobart City Council, Hobart, Australia (current)
Hydro Tasmania Consulting, Hobart, Australia (2005-2009)

INTRODUCTION

Lake Margaret is located on Tasmania's West Coast, about 10 km to the north of the town of Queenstown. It is the site of the Lake Margaret Power Scheme a small, by comparison with the output of other power schemes in Tasmania, but highly significant historical hydro electric scheme. The Lake Margaret Power Scheme was commissioned in 1914 by the then Mt Lyell Mining and Railway Company, one of the most historically significant mining operations in Australia, remaining in the hands of the mine until 1985 when its ownership was transferred to the Hydro Electric Corporation (HEC), now called Hydro Tasmania. It was managed under contract initially and now, directly operated by Hydro Tasmania, a Government Business Enterprise.



Location of Lake Margaret

Hydro Tasmania is Australia's largest renewable energy generator with 28 small to medium-sized hydro electric power stations across the State. It also has interests in wind farms. The energy business generates approximately 60% of Australia's renewable energy production. Lake Margaret is the oldest power station in the Hydro Tasmania stable.

In 2004, through the Hydro Tasmania Cultural Heritage Program, a process to systematically identify and assess the heritage values of all Hydro Tasmania owned assets in the system, commenced. The work, undertaken by Paul Davies Pty Ltd found Lake Margaret to be one of four Hydro Tasmania assets identified as having highly significant heritage values. A Conservation Management Plan (CMP) was prepared in 2006 by Paul Davies Pty Ltd based on the Lake Margaret Cultural Heritage Study by Godden Mackay dated 1994.

This paper places the current redevelopment of the Lake Margaret Power Scheme in an historical context. This context is a story about the interweaving pressures and priorities to harness water in a pattern of altered rainfall, community pressure to save a local asset, maintenance regimes, the challenges of investing in an aging asset and obsolescence, as well as a wider appreciation of the heritage values of a large scale hydro industrial site.

HISTORY OF THE SITE

Mr Hugh Crisp, a surveyor who visited the Lake Margaret area and Yolande River in 1893–94, saw it as a site with water power potential that could generate hydro-electric power for the Mt Lyell Mining and Railway Company Limited. A rain gauge was installed at the lake in 1901, but initial survey results did not inspire any immediate reaction and the Mt Lyell Company mine manager, Robert Sticht, publicly dismissed the possibility of using hydro power. He said "the worst problem you will find is to find an application and use for the electric power generated".¹ So, it seemed the rain gauge erected on an island in Lake Margaret had collected its information in vain. However, ten years later the situation was to change and so did Sticht's opinion.

The scarcity of easily accessible wood had increased the cost of steam power to run the mine works. Today, the denuded hills around Queenstown are the legacy of, among other factors, an overdependence on wood to generate power. In 1911, Robert Sticht, facing this scarcity and rising wage costs, estimated that hydro electric power would save £50,000 a year.² In 1911, a site was selected for the power house in the valley of the Yolande River, below the falls and below Lake Margaret.

Over its 95 year history, the site has had five major stages of development.

In the early years of the construction phase, works included building an access point for labourers and materials into the station site. A two foot steel tramway was built along the existing timber getting tracks; only the last four miles was built from scratch. Labourers from many countries, including Maltese stoneworkers, lived in the cold, wet conditions at the site and a nearby construction camp.



Lake Margaret Power Station under construction

The initial development phase included the construction of the dam, a woodstave pipeline, tramway to the dam, headworks and two steel penstocks, a power station with four horizontal Pelton wheels, transmission lines to connect the station to the Mt Lyell mine, and a switch house in Queenstown.

The second phase of development increased the station size and output with two additional generator sets. Correspondingly a third penstock was added. The dam wall was raised and many of the temporary structures such as makeshift houses were demolished and a permanent village built. Many of these houses still stand today.

¹ K. M. Dallas, 'Water Power in Tasmanian History', *Tasmanian Historical Research Association Papers and Proceedings*, 1960, p. 92.

² Dallas, p. 90.

The third era of development was from 1918 to 1933 and included the installation of a seventh Pelton wheel and annex into the main station. It was during this period that a second power station was built, utilising the water discharged from the main station, along with the river water, was collected in a weir and transported via a second woodstave pipeline to a single penstock and down to the lower station with a one Francis wheel turbine.

The fourth period was from 1933 to 1973 and was a period of renewal and change. Some of the major works included the replacement of the 1914 woodstave pipeline from Lake Margaret, replacement of the penstocks and surge tower, additional transmission lines, upgrading of the power house and the post tensioning of the dam. For residents of Lake Margaret, 1964 represented a major change to life and work at the station when the tramline connecting the remote village and Queenstown was replaced by a road to enable car travel into the site, thus ending the isolated nature of the site.

The fifth period of development goes through to 2005. In 1985, the Hydro Electric Commission now Hydro Tasmania, purchased the power station from Renison Goldfield Ltd as part of a Tasmanian Government deal to ensure the longevity of the Mt Lyell mine, and in doing so, inherited a maintenance intensive and aging asset. Works during this period included the upgrading of the station and road infrastructure, the removal of footbridges, road bridges, and some houses. It was during this time that many engineering, condition and safety reports were commissioned as well as the initial cultural heritage study and preparatory work on the CMP.

The final era of development is that of the last four years and it is described in detail further on in this paper. This episode is about the public debate, the renewed interest and appreciation of industrial assets and the eventual decision to redevelop Lake Margaret.

HYDRO ELECTRIC POWER AND LAKE MARGARET

Lake Margaret Power Scheme is a small hydro power scheme with the potential, when operating at full capacity, of 8.4 MW. In general, the station has produced on average 1.2 MW, approximately 0.5% of Tasmania's power generation each year. By comparison, the Gordon dam, the largest in Tasmania, has a capacity of 432 MW.

The Lake Margaret site is on 2,100 ha of land vested by the Crown with HT. The catchment of Lake Margaret includes numerous small feeder lakes including Lake Peter, Lake Paul and Lake Mary. The rainfall is one of the highest in the state with a long term average of 2,898mm.

Lake Margaret is a naturally occurring glacial lake, enlarged by the construction of the dam which utilised the existing topography and materials. The stone in the concrete for the dam was made using the local conglomerate rock, and the sand was sluiced from the alluvial flat near a rock bar. In 2008, lake levels were lowered to enable a dry inspection of the intake. Unexpectedly, it also revealed the original timber coffer dam, tramway and stone walling at the bottom of the lake. The dam has been modified and raised twice, including in 2007. It was post tensioned and grouted in 1974.

In the journey of the water from the lake to the power station, the water passes through the intake where a valve controls the flow of water. The connecting pipes, screens and cast iron sluice gates used in regulating flow from the dam were all made in the Mt Lyell Mine's Queenstown workshops. The water flows along the pipeline into the penstock, down to the power station. Across the river from the power station is the village which includes eight houses, the singlemen's quarters, a community hall, various elements such as tramway formations, steps, air raid shelters and the remains of a swimming pool.

One hundred metres down stream on the Yolande River is a weir. It is here that the pipeline and infrastructure for the lower power station begins.

As a whole, the Lake Margaret setting is picturesque and spectacular in an area of great natural beauty. From the top of the penstocks and along the pipeline, the rugged coastline of western Tasmania is visible. Also on view is the wild weather surging in across the Southern Ocean.

WOODSTAVE PIPELINE

The centrepiece of the Lake Margaret Power Scheme – both from a power generation and cultural heritage perspective – is a 2.2 km pipeline made of woodstaves. It is a low pressure pipeline, which carries the water from the dam to a high pressure pipe (or penstock). In some power schemes this can be a canal or flume. The Lake Margaret woodstave pipeline is a large pipe made from planks of wood held in place by metal hoops or bands in combination with the pressure of the water. It is similar in construction to a cooper's barrel. In fact, in the past, the makers of these pipelines also manufactured barrels. It snakes its way around a granite cliff, dropping 27 metres over its full length.

Woodstave pipelines are still made in other parts of the world and can be found in hydro electric schemes in Canada, South America and the Caribbean. In Tasmania, there are three other examples dating to the 1950s. One can be found at Wayatinah, where there are twin pipes, 4.1 metres in diameter and another at the Clarence or Tungatinah pipeline where there is 6.6 km of woodstave in a combination steel-woodstave pipeline.

The original woodstave pipeline at Lake Margaret was made of Oregon timber imported from America. At the time, it was the largest pipe of its type in Tasmania. It was formed from 30 staves, or planks, of variable lengths with an internal diameter of four feet held together by mild steel bands. All work was done by the Australian Wood Pipe Company of Sydney. A surge pipe was constructed from King Billy Pine, which was locally abundant. It was built in the same way as the woodstave, essentially as an experiment to test the longevity of the King Billy pine, should it be required in the future.

The Oregon woodstave pipeline proved to be a failure and in 1938, after only twenty four years of operation and intensive maintenance, it required replacement. The locally abundant King Billy Pine had proved its endurance with the surge pipe. And so the decision was made to use King Billy pine, although some detractors continued to question the suitability and untested nature of the wood. The timber was harvested from the local hills and milled locally.

Most woodstave pipelines have a life span of between 40 and 50 years before needing to be replaced. Remarkably, the King Billy pipeline lasted for 69 years. In the last few years, ongoing maintenance became difficult and labour intensive. The operators of the station would tap wedges between the planks and patch holes with metal plates, rubber or whatever came to hand. Some sections, supported high off the ground, were wet, slippery and a hazard to repair. Slowly, the pipeline became a giant soaker hose with water spurting out in all directions and drenching anyone walking to the dam. Wet weather gear was essential and the experience was dramatic, adding to its impact and fascination. Its state of deterioration caused HT unease and concern.



Leaking King Billy woodstave pipeline in 2007

HERITAGE VALUES AND THE IDENTIFICATION PROCESS

Comparative research by Godden Mackay gives an overview of power generation developments around Australia. It places Lake Margaret as the second oldest power station in existence in Tasmania, the earliest being Moorina, commissioned in 1909. These two stations represent an early era of private hydro development much smaller by comparison with later government funded undertakings. These studies informed the most recent CMP of 2006.

Today, the heritage significance of Lake Margaret is well acknowledged and is part of a growing awareness of Hydro Tasmania's long and fascinating social and industrial history in Tasmania. The Lake Margaret CMP contains the following statement of significance:

The Lake Margaret power complex is a place of outstanding cultural heritage value. It encapsulates the early development of power generation in Australia and Tasmania and the pioneering enterprise of the West Coast of Tasmania that was integrally linked to mining development on a site of great natural beauty and value. The development of the Mt Lyell Mining and Railway Company mines (an icon mining venture in Australia) and Queenstown was dependant on the operation of the station.

The place is one of the earliest power schemes in Australia whose value is enhanced by its continuous operation. It is the last privately built and operated scheme in Tasmania and marks a major change from private to public power generation in the State.

The site is a rare and intact example of not only the power generating plant with its rare set of early generating and control equipment but the associated infrastructure of dam, pipelines, headworks, the village and the very rare second station added in 1931.

Lake Margaret has the ability, more than any other hydro power station in Tasmania, to demonstrate all aspects of its history and operation within an accessible wilderness area. It is a place that has very high interpretative value.³

Davies also assessed the site against the Tasmanian *Historic Cultural Heritage Act 1995* criteria as an assessment of the significance of the site and found it met all seven criteria.

2006 - THE POWER STATION CLOSES

³ Davies, P. Lake Margaret Power Scheme A Conservation Management Plan, p. 39

The Hydro Tasmania Board decided in December 2005 to shut down the Lake Margaret Power Station due to concerns about the safety of the King Billy woodstave pipeline, and it scheduled a shutdown for June 2006.

Many reports and future options on the condition and viability of Lake Margaret informed the Board's decision. The primary reason for the Board's decision was that it was an ageing asset with significant safety risks, especially the woodstave pipeline. The Board identified an unacceptable level of risk associated with a potential failure of the pipeline.

A Care and Preservation Plan was put into place. Its objectives were twofold: to ensure the scheme and all associated assets were at a safe level and to do this in a way that was sympathetic to the heritage values of the site. Providing the option of a restart was always part of the intent of the Care and Preservation Plan.

Prior to the shut down, a decision was made to preserve three lengths of the 1938 woodstave pipeline by reinforcing the wood internally and bracing the steel supports on the tall sections. End caps were constructed to prevent access, to hide the internal galvanised bracing and reduce the risk of fire damage. The ends were staggered to show how the pipeline may have looked during construction.



A preserved section of the King Billy woodstave pipeline, 2008

Events surrounding the shutdown unfolded in the period from 2005 to 2007. On the other side of the state, the Mayor of the West Coast, a one time employee of the Mt Lyell mine with first hand knowledge of the station, was agitating for the scheme to remain open. He openly questioned and criticised Hydro Tasmania, pointing to the historic values of the site, the generation potential and the benefits a functioning scheme could bring to the West Coast community. In October 2005, the Lake Margaret Community Liaison Group (CLG) was established. It involved the West Coast Mayor, Hydro Tasmania representatives and community and tourism interests from the West Coast bringing all parties to the table. At the June 2006 CLG meeting, the West Coast Mayor opened up the meeting to the local community. The debate was emotional, there were even placards. On the day of the power station shut down, the Mayor visited the site and wore a black arm band. The criticism grew and began to come from outside the west coast community – from heritage practitioners, past employees, engineers – retired and practising.

It should be noted that today, Hydro Tasmania is a vastly different organisation to that of its heyday with a charter to build dams. In 1998 the HEC was disaggregated into generation, transmission and retail businesses, with Hydro Tasmania becoming the generation business. However, people's perceptions of Hydro Tasmania haven't shifted to the same degree. It is still seen as an organisation geared up, resourced and capable with the same financial and personnel capacity that it had thirty years ago. With hindsight, Hydro Tasmania failed to recognise, understand and accept that it needed to communicate its messages about Lake Margaret more clearly and at a community level. The central message it failed to communicate was that there were numerous future options for the site that it was willing to consider, but the safety issues required an immediate shutdown.

A further irony was that, while the remainder of the State suffered from drought conditions and water storages were low, Lake Margaret continued to receive solid and consistent rainfall into its catchment. Yet, it was the only station not running.

The debate raged over the woodstave pipeline, and for some, its removal was seen as a major departure from all identified heritage management recommendations with little effort put into providing a sound explanation as to the practicalities and reasons behind all of the decisions. It was seen as removing the 'jewel in the crown' and that the integrity of the site and its ability to demonstrate the whole power generation process would be destroyed.

To counteract the debate, Hydro Tasmania requested further studies. Consultants took 222 core samples of the woodstave pipeline and analysed them. The results showed that the timber had an average thickness, in some areas of 29.6mm compared to the original thickness of 48 mm, an average loss of almost 20mm of wood. Factors such as ice, wind, UV light and the passage of water internally had worn the wood into a fibrous state. In some places, there was little wood internally and concluded that it was at the end of its serviceable life and at risk of failure. Another study found the foundations of the pipeline were in very poor condition and had little structural integrity. An indicative assessment of the tourism potential was also commissioned. The findings weren't encouraging; the tourism potential was poor. Slowly, through meetings, discussions and presentations with critics, this information started to filter through.

Meanwhile, the push was on for the Tasmanian Heritage Council to list the site on the Tasmanian Heritage Register and speedily, the site was provisionally listed in August 2006, triggering the need for permits from the Heritage Council. Final listing came through on 28 February 2007.

At this stage it was realised that a development application for the removal of the woodstave pipeline, lodged with the West Coast Council, was likely to be refused: the decision based partly on advice from Heritage Tasmania. Hydro Tasmania geared up to Appeal the decision. At the same time an emergency National Heritage Listing was lodged by concerned west coast community members. Discussions with Heritage Tasmania ensued and Hydro Tasmania prepared an application for the removal of the woodstave. Further negotiations and work with the community based on a commitment to construct a replacement woodstave pipeline and prepare a feasibility study on the possible operating future of the power scheme proved fruitful and were central to the eventual approvals issued by the West Coast Council and Heritage Tasmania.

In November 2006, Hydro Tasmania released a feasibility study for the redevelopment of Lake Margaret. All three options involved the replacement of the pipeline with another woodstave pipeline and community feedback was sought. The main options were:

- Minimalist refurbishment of the existing upper station
- Build a new power station with a single generator adjacent to the existing power station
- Combined refurbishment of the upper station together with redevelopment of new lower station.

With the station shutdown early in July 2007, heavy rains drenched the Lake Margaret site and the historic stone wall supporting the pipeline collapsed leaving no option for the dewatering of the pipeline, three days earlier than planned. It was predicted that within a short period of time the wood would dry, shrink and collapse, but it remained relatively intact until its recent demolition.

Relationships with stakeholders improved and in 2008, the Hydro Tasmania Chief Executive Officer reported the following: "Significant progress on the redevelopment of the Lake Margaret Power Station at Queenstown, culminating in a decision to refurbish the station and reinstate the woodstave pipeline, also helped to reshape this important relationship" (with the community of this region)⁴

⁴ Hydro Tasmania 2008, Hydro Tasmania Annual Report, CEO report, p. 3.

PLANNING FOR HERITAGE OUTCOMES

In 2005 Hydro Tasmania implemented a cultural heritage procedure through its Environment and Sustainability Management System to manage sites of heritage significance. It requires a Heritage Impact Assessment (HIA) to be prepared to evaluate and mitigate any heritage impacts. In the case of Lake Margaret, a HIA was prepared by Paul Davies for the shutdown of the station in 2006. In 2008, David Parham prepared a HIA for the redevelopment project and it formed the basis of the documentation for a second works application to the Tasmanian Heritage Council. So comprehensive was the documentation, including the HIA that the Tasmanian Heritage Council in their permit, commended Hydro Tasmania for the thoroughness of the submission, resulting in what was virtually an unconditional permit.

A STATION IS REBORN

In June 2008, the Hydro Tasmania Board approved funding of \$14.7 for the redevelopment of the Lake Margaret Power Station. It recommended the first option of a minimalist refurbishment with the following:

- The maintenance and upgrade of the dam
- The replacement of a woodstave pipeline in timber
- The modification of the hilltop valve
- The reinstatement of the walking track from the hilltop to the dam
- The return of the haulageway to service
- The replacement of a transformer
- The construction of a visitor access gallery in the power station
- The modification to enable safe unattended operation of the power station and other associated activities.

Work on site commenced in September 2008 with demolition of the woodstave pipeline. That month, Lake Margaret had the honour of being the wettest place in the southern hemisphere. Since then crews of 6 people have worked on the pipeline, constructing approximately 30 lineal metres of 1200mm diameter pipeline each day. A banding crew follows placing 15 lineal metres of bands each day. In total there will be 20,050 bands along the 2,169 metres of pipeline. The wood being used is Alaskan Yellow Cedar, recommended by the pipeline suppliers for its class 1 durability. The quantity of timber required is equivalent to 300,000 lineal feet or about 24 shipping containers worth. The work is being supervised by a woodstave expert from the International Tank and Pipe Company in Canada, the supplier of the woodstave.



Constructing the new woodstave pipeline in April 2009

The King Billy wood from the old pipeline has been stockpiled and depending on the results of the testing for contaminants from a timber preservative, will be disposed of through a tender process.

When completed and recommissioned in July 2009, the redevelopment will provide 50 GW of power into the system, which equates to enough power for 4000 homes. This fits neatly into Hydro Tasmania's current 1000 GW hours project which is to identify new hydro opportunities to mitigate the impact of drought combined with falling water storage levels.

LOWER STATION REDEVELOPMENT

Earlier this year, the Hydro Tasmania Board took another step toward the revitalisation of the Lake Margaret Power Scheme by approving funding to upgrade the Lower Lake Margaret Power Station.

The lower station was mothballed in 1995 due to the deteriorated state of the 1.9 km woodstave pipeline and steel penstock. The project will involve the removal of the remainder of the collapsed woodstave pipeline and its replacement along the narrow route, with a Glass Reinforced Plastic (GRP) pipe, a new penstock and a single Turgo turbine (a mini hydro) housed within an extension to the existing building. Access to this difficult location will be via a new road rather than by the arduous zig-zag walking track. A viewing platform is also planned to be built which will allow a complete view of the mothballed Francis turbine as well as the new turbine. It is planned that the station will be back and operating by mid 2010.

CONCLUSIONS

The \$14.7 million Lake Margaret main station redevelopment project is one of the largest refurbishment projects of an operating heritage asset in Tasmania, where the outcomes have been driven to some extent, by heritage management recommendations based on Burra Charter principles. The reality is, however, that this project would not have come about unless the expenditure was justified from a business perspective. The preferred redevelopment option of 'minimalist refurbishment' of retaining as much existing infrastructure in place as possible matches with the principle of 'do as much as necessary but as little as possible'.

It is recognised that the Lake Margaret station will always require significant on-going maintenance as well as specialised skills to, for example, start up machines and set loads. Despite plans to run the station in an unattended state it will always require a higher degree of presence than other stations that are operated remotely.

Hydro Tasmania has a culture of cleaning up and removing where possible all non-significant assets and, if necessary, returning sites back to nature. This is appropriate, particularly where the safety of personnel and a hazard free work space or environmental quality is paramount and it is in these cases that the legislative approach to identify that there are no 'prudent and feasible alternatives' is applied. Having the continued operation of a power station is a positive heritage outcome.

The training of Hydro Tasmania staff in heritage awareness has introduced staff to Burra Charter principles, with results where resources are saved. The approach to add layers of fabric has been accepted at Lake Margaret with good will and it has been an excellent case study for reinforcing the application of many Burra Charter practices and principles.

The Lake Margaret story is about obsolescence, change, making do, altering maintenance regimes as well as the changing priorities of the private and public sector. Places such as Lake Margaret are a valuable link to the lives and work of the people who brought them into existence and they represent exceptional human endeavor and innovation to move water to generate electricity. It also represents community, heritage and engineering sector pressure and a renewed appreciation within a large organisation of the benefits of an industrial heritage site. It is also the

story of rebirth, a positive effort to protect a heritage effort and manage change for sustainable energy outputs. It is also one of those unusual circumstances where the benefits of redeveloping a non-functioning asset align with its financial viability as well as good environmental and community outcomes.

These projects have brought together a wealth of talent, skills and expertise in heritage, engineering, civil construction, project planning, water power and many other fields to find a solution to a problem of large scale infrastructure redundancy. The project costs have been high, but in comparison to a highly engineered project to install a new power station it has been the cheaper alternative.

This paper has been prepared with the support of Hydro Tasmania. I would like to thank, in particular, the following people; Sandra Hogue, Helga Grant and David Brown. The return to service of this extraordinary industrial site would not have been possible without the hard work and dedication of many of my former Hydro Tasmania and HT Consulting colleagues. There are too many to mention here, but it has been a pleasure, during my employment as the Senior Heritage Consultant for HT Consulting, to collaborate with them on the many Lake Margaret projects.

All photographs are courtesy of Hydro Tasmania.

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GLOSSARY

- MW – megawatt = 1 million watts
GW – gigawatt = 1000 million watts
kWh – kilowatt hour = one unit of electrical energy
CMP – Conservation Management Plan