Owning & Operating a Railway in the Wilderness

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1 INTRODUCTION

The reopening of the unique and historic railway from Queenstown to Strahan in Tasmania's harsh but picturesque West Coast wilderness was a task that involved many people, organisations and interests, in Tasmania, in Australia and around the world.

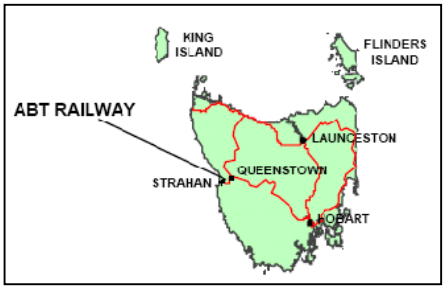

Fig 1: Site plan

This railway, once the lifeblood of the Mt Lyell Mining & Railway Company, ceased operations in 1963 after some 65 years in service transporting ore to the ports on Macquarie Harbour. The original construction of the railway that commenced in 1894 was a significant engineering achievement in its day. Survey lines were cut through virtually impenetrable rain forest in wet and cold conditions, with the crews backpacking their equipment, clothing, food and living quarters into a base camp from where they would live and work for many weeks. Despite these challenging working conditions, the earthworks and bridge construction for the first stage of the Railway from Queenstown to Teepookana, a distance of 22.5kms, was completed in 19 months, with regular train services commencing in early 1897. The line was extended, some two and a half years later, a further 12kms to Regatta Point, Strahan.

The steep terrain led to the adoption of a special rail track that allowed trains to climb inclines of up to 1 in 13; known as the Abt system after its Swiss inventor, Dr Roman Abt. In this system a toothed "rack" rail located centrally between the 3' - 6" (1067mm) gauge running rails, engages the pinion drive wheel of a purpose-built locomotive. Both the rack and adhesion drive engines are operating when the Abt locomotive is traversing the system. The five original Abt locomotives were designed and manufactured in England and the parts transported to Tasmania for reassembly and commissioning. The units were changed from coal to oil firing in the 1950's. [1,2]

Fig 2: West Coast Wilderness (Abt) Railway Route

The reconstruction of the railway that commenced in 2000 was also a significant engineering achievement. It had to overcome a different set of challenges; cost minimisation, environmental and historic values and trade-offs, experience and skills transfer, and ending up with a stable operating business that is, at least, cost neutral to its owner; the people of Tasmanian.

In recognition of the significant achievement in the planning, design and construction activities embodied in this restoration exercise, the Abt Railway Project was awarded both the Institution of Engineers Tasmania Division Engineering Excellence Award 2001 and the Australian Engineering Excellence Award 2001.

The rebirth of the railway celebrates the past achievements of those early West Coast miners and rail builders and the work to create a future for the railway. It provides an example of what can be done to preserve the railway heritage skills and expertise that are seen to be dying out around Australia.

Although the paper provides background material and examples of issues on the restoration project as a whole that may assist others involved with such a project, the main focus is on the lessons learnt with the track construction.

2 THE ABT RESTORATION PROJECT

Following improved road access to the West Coast and increasing maintenance costs of the infrastructure and locomotives, the Abt Railway closed in 1963. From that time on there was strong pressure from a group of dedicated Westcoasters for the reconstruction of the railway as a tourist attraction, featuring the unique rail system and its mining history.

After various investigations into the feasibility of the re-establishment of the Abt Railway, in 1998 the Federal Government approved the allocation of $20.45M from the Prime Minister's Federation Fund. The Abt Railway reconstruction was seen as an engineering project with a strong focus on heritage and environment. It was seen as offering major benefits to Tasmania and in particular the depressed West Coast region with additional employment, regional development, increased tourism and renewed local community and business confidence.

From the outset it was generally accepted that the project would be working within severe budget constraints, so innovation in methodology and use of materials was needed if the dream was to be fulfilled.

Other funding sources included the Tasmanian State Government and the successful railway Operator.

State legislation established the Abt Railway Ministerial Corporation (ARMC) to oversee the implementation process and to manage the railway as a Government-owned but privately operated tourist railway.

Planning commenced immediately with the formation of an Abt Railway Steering Committee and the appointment of engineering consultants, Sinclair Knight Merz (SKM), to undertake the engineering scoping and planning, environmental impact assessment, the preparation of tender documents and the calling of tenders.

The planning process became an exercise in balancing the requirements of up-to-date technical standards, occupational health and safety standards and the newly introduced rail safety legislation, environmental, historic, cultural and socially significant issues, against the backdrop of tight budget constraints.

In additional to the tourism-focussed passenger operation between Queenstown and Strahan, the new rail system had to cater for a freight service for the extraction of the valuable Huon pine timber and Leatherwood honey from the Teepookana Plateau.

The other major implementation contracts, In addition to the SKM consultancy contracts for planning and contract supervision, were:

- Railway Operator - awarded to Abt Wilderness Railway, a company owned by Launceston-based entrepreneur, Roger Smith. It included funding of building restoration, construction of stations along the route and the manufacture of carriages.
- Locomotive Refurbishment Contract - awarded to Hobart engineering firm, Saunders & Ward P/L for the refurbishment of Abt Nos 1 and 3 locomotives and a Drewry diesel locomotive (V6). S&W engaged John Wally of Festiniog Railway in Wales to provide the boiler design.
- Principal Siteworks Contract - awarded to Tasmania construction firm, Hazell Bros Civil Contracting P/L (HBCC) who engaged Hobart-based firm, Johnstone McGee & Gandy (JMG) as their principal design consultant.

A number of other Tasmanian and Australian firms contributed to the restoration process through design and manufacturing activities.

2.1 Economy in use of materials

A primary objective was to achieve economy in the use of resources. Information gathering through workshops and innovation opportunities offered through the choice of the design and construct contract process, helped achieve this objective.

Retention of the original route led to the greatest economy in the use of resources, as most of the original formation was intact.

Further economies were achieved with the re-use of materials including:

- rail
- Bailey Bridging
- refurbishment of Iron Bridge
- recycling girders for Queen River Bridge
- original bridge footings
- use of existing culverts (eg. Huon pine)

The Government supplied 27kms of second-hand 60lb rail recovered from a closed Tasmania rail line. The remainder of the rail was to be sourced

by the contractor as well as the supply of all rail jewellery. Although inspected while in storage, which identified two different rail types, the rail installation and on-going maintenance highlighted problems that are discussed later in this paper.

During the preparation of their successful confirming tender, HBCC recognised that a "fit for purpose" approach was needed to meet the financial constraints. After negotiation, an alternative tender, which maximised the use of second-hand materials whilst still providing a safe outcome and a responsible approach to maintenance levels, was accepted. The extensive use second-hand timber sleepers, fishplates, baseplates and other rail jewellery, demanded significant application of professional skill and experience in their assessment in the track design, construction and eventual development of appropriate maintenance management regimes.

When disagreement arose regarding the technical standards to be applied in a "fit for purpose" scenario, which threatened to delay the contract completion, the Principal convened a workshop to work through the key issues and develop appropriate standards. The workshop included representatives Superintendent, Principal, Operator, Contractor and his track laying subcontractor, rail designers and rail industry experts.

With safety of the railway a prime concern, the workshop identified critical areas where the specified standards could not be met without the possibility of considerable delay and expense. The issues, concerns, risks and possible treatments were discussed at some length. One example related to tight curvature locations, where it was agreed that the outside curve would be welded, a guard rail fitted along the inside curve rail and gauge bars installed adjacent to every fourth timber sleeper. This action was to minimise both the possibility and the consequences of a derailment.

2.2 Environment and heritage aspects

The environment through which the railway travels reflects its century-long history of human intervention and impact, from the orange-coloured mines tailings that border the King River to the remnant Rhododendron and Fuchsia plantations at the fettler cottage locations dotted along the route. The preservation of cultural and heritage aspects of the railway became a key focus of the environmental assessment and restoration process.

Old photographs show evidence of large areas of clear-felling ahead of the construction of the original Abt Railway. Since its closure, the wilderness vegetation has reclaimed its land and the contract called for strict controls on clearing.

Adherence to the original route location, minimal impact on the railway cuttings, the restoration of the few remaining structures and the design and construction of the replacement bridges were singled out for specific attention to reflect the heritage significance of the rail infrastructure.

The majority of the original timber trestle bridges were replaced with steel trestle bridges positioned on the original bridge foundations, with four bridges being constructed with replica squared timber trestles, corbels and girders.

Fig 3: Construction of replica timber trestle bridge

The Iron Bridge crossing the King River at Teepookana was retained but required strengthening and containment grit blasting from a suspended platform to remove the existing lead paint coatings and repainted.

Fig 4: Restored Iron Bridge at Teepookana

Original drainage structures, including Huon pine culverts, have been retained if they were still functioning but this functionality could not be determined until after the Siteworks contract had been let and the contractor had cleared

vegetation around the culvert sites.

The steam Abt locomotives have been fully restored to meet current operational and safety standards while retaining their authenticity. Three locomotives are now currently navigating the steep sections of the line over the Rinadeena Saddle from Queenstown to the halfway point at Dubbil Barril. Over winter months the Abt locomotive runs the full length to Strahan.

Two of the original Drewry diesel locomotives have been restored and are used on the flat run from Strahan to Dubbil Barril. The restoration of a third Drewry is planned as a future addition to the fleet.

Eight replica passenger carriages have been constructed as part of the Operator contract and fitted out in local timbers, including Huon pine, Blackwood, Sassafras and Myrtle.

Although substantially damaged by fire in the early stages of the restoration, part of the original Queenstown Station is incorporated into the new building. At the Strahan end, the original Regatta Point Station and Locomotive Shed have been restored and are in use.

The original turntable at Dubbil Barril could not be removed from site so it was restored in-place and is now in daily use to turn the steam locomotive for its return to Queenstown and the diesel locomotive to Regatta Point. Two other period turntables have been restored and are in daily use at Queenstown and Regatta Point.

3 RAIL TRACK RESTORATION

The decision to execute the Principal Siteworks as a design and construct contract was seen as the best process to achieve cost savings through innovation. This process however offered significant risks for the contractor in that the condition of much of the original formation, embankments and drainage structures could not be fully accessed ahead of site access.

Construction started in February 2000 and had a tight schedule of 21 months, with the expectation that the railway would be in full operation by Christmas 2001.

ITEM	SPECIFICATION
Gauge	1067mm
Rail	60lb/yd and 61lb/yd
Sleeper spacing	900mm all timber on rack section with 1 steel to 3 timber on rest of track
Axle loads	10t but modified to 12.5t after weighing of refurbished locomotives
Max speed	40kph
Min curvature	80m but modified during the contract to allow 60m at specific tight curve locations

The very restricted nature of the site meant that there were only three access points; Queenstown towards Rinadeena from the North, from the Strahan end eastward and from a track off the Lyell Highway at Rinadeena.

The critical path on the project was the bridge construction. 28 bridges and 2 batter protection structures had to be constructed one at a time with one crew working progressively from the Rinadeena Saddle southward to Dubbil Barril while a second crew worked from the King River crossing at the Quarter Mile Bridge towards Dubbil Barril. The trestle units of both steel and timber were prepared off-site and transported to the bridge site for placement on the prepared footings, followed by girders and decking, before moving on to the next bridge location. Despite the restricted nature of the site and the requirement for minimal landscape and vegetation disturbance, the bridge construction was completed to schedule.

Formation preparation, embankment stabilisation and drainage works followed on behind the bridge construction.

The track laying method of yard preparation of rail and sleeper panels and transported to the construction front on skeleton track was adopted to speed up this activity. However, the restricted and circuitous nature of the track route presented problems with the use of second-hand rail in prepared panels, as there was little opportunity for on-site selection of panels. The end result was:

- curved rail on straight sections
- straight rail on curves
- multiple junction joints

- fish plates that did not fish
- staggered joints.

Although it was established by early inspection that there were two rail types, it became evident during construction that there were at least eight different rail cross-sections. The issue became one of matching available fishplates with rails and coping with the many minor rail adjustments.

Appropriately sized fishplates to match the various sections were in limited supply, requiring the contractor to cut down 80lb/yd rail plates to add to numbers and modify undersized plates with build up welding to provide a satisfactory fishing surface. An innovative build-up alternative utilizing metal shims to fit between the plate and the rail flange was also trialled.

Rail welding also presented a challenge as the damp site conditions that existed at the time of the track laying threatened the effectiveness of Thermit welding. With the assistance of Institute of Railway Technology at Monash University, a strong semi-automatic wire welding procedure was developed that permitted welding under a broader range of climatic conditions. After filling the 12-15mm weld gap, fishplates were epoxied back on to the web and fishing surfaces for added strength. This method permitted work in remote locations along the track with costs not exceeding those of Thermit welding. Recent inspections have shown that there have been no failures of these welded joints.

After five years of operation there is little evidence that the mechanical joints or other elements of the rail are overloaded. Fishplate and bolt failures are a rare event.

The rail track is however quite flexible and the resultant movement of the track, particularly over sections where curves and clearances are tight requires regular attention to joints and track realignment. The up side is that simple crow bar work can reposition the track.

During construction there was much discussion about the need and frequency of tamping. Regular inspection since the contractor's handover has not seen a need for a wholesale mechanical tamping exercise; in fact the view is that anything but hand tamping at isolated locations could be counter productive.

4 OWNERSHIP AND OPERATION

In 1999 the Tasmanian Parliament passed the Abt Railway Development Act, which established the Abt Railway Ministerial Corporation. The ARMC functions were to:

- arrange necessary approvals for construction of the railway development,
- arrange for the construction,
- arrange for a person to operate the railway and
- facilitate associated developments in the vicinity of the railway,

with the powers to purchase, hold or dispose of real or personal property, enter into agreements or contracts and undertake any other activity necessary to perform the functions under the Act.

The ARMC owns the Abt Railway assets, including land, buildings, rail track, locomotives, carriages and other rolling stock. These assets are leased to the Operator with an initial 20-year period with options to extend of a further two periods of 10 years. Under the lease agreement, the Operator assumes all responsibility as the Operator and Owner under the Tasmanian Rail Safety Act. In addition to the rail safety responsibilities, the Operator pays a rental to the ARMC and is required to fully maintain and if necessary repair the leased assets.

After the restoration project was completed, the Abt Railway Steering Committee was disbanded and the responsibility for ARMC passed to the Department of Infrastructure Energy and Resources (DIER).

As the Secretary of DIER is also the Rail Safety Regulator under the Rail Safety legislation, there existed a potential conflict of interest as a rail owner as well as the Rail Regulator. Although such conflicts are not uncommon in Government agencies, a "Chinese wall" has been established by nominating the DIER Deputy Secretary Infrastructure as the ARMC Delegate with a separate management structure. The Operator experiences two auditing functions; an annual Rail Safety audit and a more frequent asset condition audit from ARMC staff. A Governance Chart detailing the interaction and responsibilities of the various bodies is shown at Attachment A.

In 2002, the original lessee and operator, Abt Wilderness Railway, was experiencing financial difficulties and the leases and responsibilities as Operator were reassigned to West Coast Wilderness Railway (WCWR), a company wholly-owned by the Federal Group, which operates accommodation and other tourism ventures in Strahan and throughout Tasmania.

The railway commenced full operation between Queenstown and Strahan in January 2003 and runs all year round. There are four scheduled trips each day over the summer months with the rack and pinion fitted Abt steam locomotives departing Queenstown Station for the trip over the rack section, meeting up at the halfway point at Dubbil Barril with the diesel service from Strahan. Here the passengers change trains to complete their journey. Over the winter months a single Abt locomotive trip runs the full length in one direction each day. A bus service operates between the two centres to return the passengers to their initial departure point.

After the 1963 rail closure, the rail formation was used for road access to the Teepookana Plateau, the only remaining Huon pine harvest location. Vehicle access to the Plateau ceased once the restoration project commenced and access is now available by railway only. Trucks and other plant and equipment use roll-on roll-off facilities at Lowana to board the freight wagons for the seven-kilometre trip to Lower Landing at the base of the Plateau. This freight service is also used for the transport of beehives to the Plateau for the harvesting of the valuable Leatherwood honey over summer and autumn months.

ARMC and WCWR work closely together to identify and implement projects to enhance the railway operation and its tourist and heritage value. Refurbishment of a third steam locomotive, Abt No. 5, was jointly funded by the State Government and Federal group and came into operation in early 2006. Other joint projects have included the restoration of an original guards van and the housing of a display of Abt Railway memorabilia in the Queenstown Station with the assistance of the Mt Lyell Abt Railway Society.

5 CHALLENGES & IMPROVEMENT OPPORTUNITIES

The railway has been operating satisfactorily for over five years. The challenge for its future success rests with its long-term commercial viability and this in turn depends principally on patronage.

The railway has already played its part as a tourist draw card with increased tourist visitation to Tasmania's rugged West Coast and improved economic activity.

Setting the commercial realities aside, there are a number of environmental and technical challenges for the railway's continued success. These include:

- Evacuation of passengers in the event of a breakdown or illness,
- Fallen trees,
- Rock falls and embankment slips,
- Bush fires

Access to and evacuation of passengers in the event of a breakdown can take hours. This is a significant problem and the Operator is working to improve communication and access for recovery operations.

Fallen trees and minor rock falls are often encountered during the daily early morning full-length track inspection. Major slips and washouts do occur after heavy rain; a not uncommon occurrence on the West Coast of Tasmania. Such an event closed the railway operation between Strahan and Dubbil Barril for some weeks in 2004.

A large portion of the most inaccessible part of the railway runs through State Forest and a major bushfire event is a significant risk.

The Operator has been working closely with the State Emergency Services to minimise the dangers to people and property in the case of the above events.

Although the Operator has to demonstrate at annual Rail Safety audits that the railway is maintained in a safe condition, the long-term condition of the asset is of major concern for the ARMC. All asset items have a finite life and eventual replacement is the responsibility of the Operator and must be planned for.

The Operator is required to insure the whole of the leased asset against events such as damage or fire and is required to establish a "sinking fund" towards asset replacement.

Some of the site-specific problems that this railway experiences are:

- rusting of steel elements,
- breakdown of paint work on bridges and other coated steel,
- moss/lichen growth on rail elements.

Aggressive rusting and moss build is occurring on the exposed steel elements such as rail, rail jewellery, the rack rail and the steel sleepers. Rust pitting is already evident on the steel trestle and Bailey bridges.

6 CONCLUSION

The West Coast of Tasmania is a truly picturesque setting in which to run a tourist railway with its beautiful mountainous wilderness scenery contrasted against the stark evidence of over 100 years of mining and other resource harvesting.

It is also a harsh, unforgiving environment and the original construction and successful operation of this "railway in the wilderness" over its 65 years is testimony to the strength and determination of the West Coast's early pioneers. Maintenance and upkeep in this harsh environment became a significant financial drain and contributed to the railway's closure.

The reconstruction, with somewhat different but no less challenging demands, has also been a significant engineering achievement. Its continued operation, like its processor, is also one of economic viability.

The successful restoration of the Abt Railway is evidence that former railways can be brought back to life for the enjoyment of future generations and as a living and working monument that celebrates the past achievements of our forefathers.

7 ACKNOWLEDGEMENTS

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8 REFERENCES

1. Rae L. The Abt Railway Tasmania's West Coast Wilderness Railway.

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ATTACHMENT A