

MORWELL RIVER DIVERSION PROJECT

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ABSTRACT

TRUenergy (Yallourn) owns and operates an open cut coal mine and power station at Yallourn in the Latrobe Valley, Victoria which supplies about 20 per cent of Victorian's electricity requirements. Further development of the mine meant that the Morwell River had to be diverted to allow access to further coal reserves. The reserves in the existing pit will be exhausted in 2007.

In 1999, tenders were called for the diversion of the river. The Environmental Effects Statement (EES) and engineering design had been completed and it was proposed to novate that design to the successful tenderer. At the same time, Yallourn encouraged tenderers to submit alternative proposals which would be more cost effective.

The Roche Thiess Linfox Joint Venture (RTL) submitted an alternative involving the rerouting of the river back through the old workings on an embankment. The alternative design involved the placing of 13 million m³ of mine overburden fill over a diversion length of some 3.5 km and the construction of 1.3 km of tunnel structure. RTL entered into an alliance agreement with the owner, resubmitted the EES, obtained revised planning approval, overcame technical difficulties associated with the foundation materials, negotiated a new site agreement and undertook construction of the works for completion within the original time frame and at a saving of some \$80m to the client.

KEY WORDS

Morwell River, river diversion, earthworks, construction, coal mine.

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INTRODUCTION

Yallourn has been operating as a power generator since 1921. The power station currently obtains its coal feed from the East Field open cut pit located to the east of the power station. This pit commenced operation about 15 years ago and will be exhausted in 2007. Additional coal reserves are situated further to the east and to the south of East Field but the Morwell River flows in a former river diversion between the existing mine and the new coal reserves in the Maryvale Field. The former diversion accommodated the low flow of the river in a buried 3m diameter concrete pipe which, while providing a sound engineering solution, did not provide a natural river environment.

The concept for the development of the Maryvale Coalfield envisaged the diversion of the Morwell River around to the eastern side of Maryvale in a revegetated open channel which mimicked the natural sections of the river. To support this concept, a detailed design and EES were completed and the diversion put out to tender in 2000. An innovative and highly cost-effective alternative tender was received from the Roche Thiess Linfox Joint Venture which proposed a different route for the diversion. This novel solution involved the placement of the river on an embankment constructed through the old mine workings. The alternative proposal had a number of advantages including shorter distance, utilisation of waste mine overburden, provision of access to additional coal reserves, significantly less environmental impact and reduced cost of some \$80 million under the conforming tender solution. This saving was particularly attractive to the power station owner since after privatisation of the industry, they were operating in a highly competitive electricity market.

While the alternative offered considerable cost savings over the conforming tender design, it did present considerable problems with regard to project approvals and timing. The alternative design was a significant departure from the original concept which meant that a supplementary environmental impact statement had to be prepared and new Ministerial planning approval sought. The task of obtaining the necessary approvals was extremely complex and involved liaison with numerous government departments and other interested community groups. The time required to obtain these approvals meant that construction had to be compressed in order to still comply with the requirement to access new coal areas by 2006. Failure to provide the access to the coal would have resulted in the closure of the power station which currently supplies about 20 per cent of Victoria's electricity. The consequences of the project failing to deliver were enormous.

Aside from the planning issues, there were also a number of key technical issues unresolved at the time of the submission of the alternative proposal and some scepticism as to the technical feasibility due to the high risks associated with these issues. The main items that needed to be addressed before a final decision to proceed could be made were:

- the hydraulics of the diversion system, in particular flood levels upstream of the diversion and the possibility of flooding adjacent mines and key infrastructure such as the Princes Highway; and
- the stability of the river embankment as it was going to be built on top of several different types of existing foundations. A portion was to be partly founded on previously dumped unconsolidated overburden materials which had dubious strength parameters, as well as a coal dyke between Midfield and Eastfield

These issues were addressed in 2000/2001 through extensive FLAC modelling and the construction of a trial embankment. This work confirmed that a viable arrangement could be developed and a concept design for the alternative diversion was prepared in 2001, following which the detailed design of the works was undertaken.

A Supplementary Report was subsequently prepared to the original EES to enable the relevant authorities and members of the public to review the environmental effects of the alternative proposal. The Supplementary Report and submissions from interested parties were considered by the relevant government Ministers and a Work Plan variation under the Mineral Resources Development Act (1990) were formally approved for the alternative proposal in January 2002.

In March 2001, Yallourn Energy and RTL agreed to enter into an alliance agreement for various works at Yallourn including the design and construction of the alternative Morwell River Diversion (MRD). To enable the project to stay on target, the initial Works started without the Alliance Agreement fully established and signed off. Whilst it was identified as a risk, the Alliance team members worked closely to keep the common goal in mind while commencing the Works as well as setting up the Alliance parameters and associated Agreement. This bold move proved to be a positive one that clearly created a strong Alliance bond at the beginning, and was only further strengthened from there on.

In June 2001, SMEC Victoria Pty Ltd was engaged as the lead designer for the project with Golder Associates Pty Ltd as the geotechnical engineer and GHD Pty Ltd as the peer reviewer. The Reinforced Earth Company was engaged to design the tunnel structure and to supply the precast concrete tunnel units.

PROJECT SCOPE

The principal components of the alternative design for the diversion comprised:

Diversion Embankment

The river diversion comprises a low-flow channel located in a 70m wide flood plain. Along most its length, the channel has been formed by construction of an embankment. Some excavation was required at each end of the channel where the existing ground is locally high relative to the channel invert and crest levels.

Services Relocation

Construction of the diversion channel required relocation of a number of major services associated with the existing mine, including;

- southern and northern fire service mains,
- Loy Yang Low Quality (LYLQ) water main,
- ash pipelines, and
- Gippsland Water sewer main.

All the services were realigned to pass under the diversion channel. During their relocation, none could be taken out of service for more than a few days, since they all formed critical functions for the power generation. Failure to satisfactorily relocate the Loy Yang Low Quality water main, for example, could have seen the shut down of the Loy Yang power stations, the largest suppliers of electricity to Victoria. All the relocations were treated as individual projects in themselves due to the associated high risks if Works were not completed within the time constraints of the two Power Stations (Yallourn and Loy Yang) and Yallourn Mine.

Conveyor Tunnels

The MRD embankment crosses four existing coal and overburden conveyors. The coal conveyors provide the transport system for the power station feed. All conveyors were required to remain in operation during and after construction of the MRD. The conveyors were realigned and precast concrete tunnel arch units placed over them. These were subsequently covered by the diversion embankment fill. The depth of fill meant that the tunnel structures had to accommodate

settlement of up to 1.5m. The design of the tunnels incorporated segmental sections which were designed to accommodate the very large settlements predicted by the FLAC modelling.

Vehicle Crossings

Two heavy vehicle crossings (capable of supporting a D10 dozer and the stacker) were provided across the river channel, one near each end of the diversion channel. Both crossings incorporated a series of box culverts across the low-flow channel, with access roads extending up the banks of the flood plain on each side of the river. The final design changed dramatically from the initial design, which was only picked up and communicated as a potential issue by the Construction Team as a part of the ongoing Alliance partnering atmosphere. The movement of the stacker had not even been fully contemplated by the Mine, as it wasn't going to be moved for some 5-10 years, until raised by the Construction team to the Mine staff. Subsequently the Mine staff reprioritised their resources to support the MRD design and construction schedule.

Levees

The Yallourn Mine incorporates a series of levees adjacent to the Morwell and Latrobe Rivers to provide protection against flooding. The hydraulic modelling undertaken indicated that these were necessary to protect critical Latrobe Valley infrastructure and to maintain a 1 in 10,000 year flood protection to the mine. The Yallourn Mine Levee, which protects the southern side of the mine, upstream of the MRD, had to be raised. The Latrobe River Levee is located along the northern side of the mine adjacent to the Latrobe River. With the extensions to the development of East Field, a new section of levee needed to be constructed in the vicinity of the downstream end of the current Morwell River.

Morwell West Drain

The Morwell West Drain is located to the south of the Yallourn Mine, adjacent to the proposed Maryvale pit. The drain currently discharges into the existing Morwell River approximately 2km from its downstream end. As this section of the Morwell River will be excavated as part of the further development of the Yallourn coal field, it was necessary to divert the drain around the extended mine. The design of this part of the project proved to be particularly challenging since there was a stand of nationally significant Strzeleckii Eucalypt Gums along the watercourse which needed to be protected and the topography did not suggest an obvious diversion path. The ultimate design involved a lined watercourse constructed in the batters of the mine.

PROJECT CONSTRAINTS

Logistical problems

The river diversion had to be undertaken within an operating coal mine without disruption of the coal mining operations. A maximum of 12 hours supply of power station feed coal can be stockpiled in the raw coal bunker at the power station. Scheduling of the construction of the conveyor tunnels and liaison with mine and power station operators was a critical activity during the construction of this section of the works.

Other logistical problems were caused by the size of the project. The diversion itself is 3.5 km long and the borrow pits were up to 4 km from the diversion embankment. To minimize travelling time, a site office and compound was established remote from the power station near the principal borrow area.

The works were conducted within a coal mine and hence were subject to the requirements of the Mineral Resources Development Act 1990 which is administered by Inspectors from the Minerals and Petroleum Regulation Branch of the Department of Primary Industry. Normal construction work practices had to be modified to address particular hazards associated with the coal mine environment.

Weather conditions

Earthworks in the Latrobe Valley are severely limited by the wet weather experienced during the winter and spring. The effective season for earthworks extends from December to May, a period of about six months. Traditionally, bulk earthmoving machinery is stood down during wet period, along with the majority of the workforce. This proved to be a challenge, particularly with a workforce who was partly drawn from redundant employees from the Yallourn Mine and who were not accustomed to stand-downs. Earthworks were programmed to commence in November 2001, however, extended rains during the winter season meant that significant earthworks could not commence until January 2002, which put further pressure on the project team to achieve the completion date.

Workforce factors

Even with the challenge of working with the Workforce to continually address their concerns due to highly differing conditions from what they were used to working in, along with a traditionally highly unionised atmosphere, over 710,000 man-hours were expended over the life of the contract with no Industrial Relations lost days and a Lost Time Injury Frequency Rate of 2.8. This close partnership between Management and the Workforce contributed to the success of the on-time completion of the project.

Community concerns

The proposed development lay between the communities of Yallourn North and Morwell. The potential impact on these communities was recognised, particularly with regard to the generation of noise and dust from the construction works. The construction activities had to be restricted during severe weather conditions conducive to generating noise and dust problems.

Environmental issues

Flora and fauna assessments were undertaken for the original environmental effects statement. The recorded flora included one plant species of national significance (Strzeleckii Gum), one plant species of State significance (Green Scentbark) and 22 plant species of regional significance.

The recorded fauna included one species of State significance (Great Egret) and three species of regional significance; the Wedge-tailed Eagle, the Australian Hobby and the Blue-winged Parrot.

The alternative river diversion proposal was to have significantly less impact on the flora and fauna of the area and this was viewed positively by the planning authorities during their assessment process.

Another positive involved the enhancement of an existing weir with a purpose-built fish ladder so native fish could traverse the river upstream of the embankment for the first time in approximately 30 years.

Additionally, in the final season, there was considerable work around archaeological sites, waterways, and endangered fauna. When working around these identified environmentally sensitive areas the workforce was educated through various management methods to help gain “ownership” of the works and highlight the potential impacts.

Heritage Issues

The flood plains along the Morwell and Latrobe Rivers were recognised as areas of significance for aboriginal and early European heritage. The works would impact some of these areas and appropriate mitigation measures had to be included in the planning and construction process.

Stability Issues

Two critical geotechnical issues and potential high risk areas associated with the project related to the foundation conditions for the diversion channel. These were:

- the dumped overburden material, which comprise up to 60m depth of unconsolidated sand, silt, and clay, which are highly compressible and of low strength; and
- the coal dyke, which is located on so called interseam material which includes clayey material which has undergone significant movement and reduction in strength, associated with development of the adjacent coal mine.

Due to the technical uncertainty associated with the performance of the dumped overburden and coal dyke foundations, they were both subject to extensive investigations, including instrumentation, and detailed modelling and analysis, to assess their likely behaviour during and after construction of the works.

The embankment was constructed using the overburden materials that had to be stripped from above the coal required for future power station feed. The embankment was zoned to suit the technical requirements of the structure, including permeability, drainage and stability, and the mining sequence of Yallourn Energy. The structure was designed to standards appropriate for a major piece of civil infrastructure, namely large dams.

To ensure the integrity of the river and to prevent possible failure of the embankment through leakage from the river, a non-dispersive clay liner material had to be sourced. The locally available clays are generally highly dispersive in nature and this aspect of the project presented a great challenge to the project team. An extensive program of investigations and testing, including treatment, was undertaken to identify an appropriate source of liner material.

The source ultimately adopted was the Recent alluvial clay deposits associated with the former lower reaches of the Morwell River. These soils were found to be the most stable in the area, and had been subject to a similar regime as will occur in the diversion channel.

CONCLUSION

The completed project includes 13 million cubic metres³ of engineered fill, 3.5 km of river channel, 1.3 km of conveyor tunnel and associated services and revegetation with 40,000 plants at a total cost of some \$120m.

The project was completed on time and under budget with no lost time due to industrial issues and with a low lost time injury frequency rate for over 710,000 man-hours worked. The industrial record achieved is particularly significant given the challenging industrial environment of the Latrobe Valley.

The Alliance team, through innovation and commitment, achieved diversion of the river on 27 May 2005.

The successful completion of the diversion project realised substantial savings for TRUenergy

and has made a significant contribution to them being able to continue to access coal for the power station feed at competitive rates until at least 2032.