

Challenges of improving the connectivity of an abandoned Yarra River water course

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Key Points

- More frequent re-engagement of an abandoned Yarra River channel meander loop to achieve improve connectivity and fish passage movement
- Flow regime for tunnel had to be retained for historic and amenity values
- Effective weir works were required to increase the frequency of flows connecting to the channel
- Additional physical constraints within the reach of channel due to infrastructure had to be overcome to achieve an effective flow through the meander loop
- Design footprint of the works within the sensitive environment of the upper Yarra led to stringent planning requirements and emphasis on site environmental management
- Prudent site management and an environmentally conscientious contractor led to minimising the construction footprint and impact on the environment

Abstract

During the gold rush era the Little and Big Peninsula Tunnels were created on the Yarra River to enable alluvial gold miners to readily access the bed in the cut-off sections of river channel. The feasibility of reengaging the reach of channel cutoff by the Big Peninsula Tunnel was investigated, as the project appeared to offer potential significant river health improvement outcomes, however over its development the project has confronted many challenges. This included balancing the river health objectives for the project with the need to maintain normal flows through the tunnel due to its historical significance, and amenity value as a the tourist attraction. The ecological benefits of reengaging in terms connectivity and habitat for fish, frogs and macroinvertebrate had to also acknowledge the observed environmental values that had adapted within the abandoned channels. To achieve the hydraulic connectivity improvement between the Yarra River tunnel diversion and abandoned channel, excavating into a shallow rock bench to lower the effective weir control was required. The effectiveness of lowering the weir control was limited by physical constraints within the channel, preventing an effective flow through the meander loop. Overcoming more physical constraints including engineering solutions for a Melbourne Water Corporation (MWC) Yarra Valley Water Main and pipe tracks crossings, access road and culvert crossing and channel bed re-profiling whilst minimising disturbance. The implementation of the works in the sensitive environment in the upper Yarra, were subject to stringent local planning requirements and approvals. This further bolstered the need for prudent site management in terms of managing access to site, limitations on construction methods and footprint, and a focus on vegetation management. Following implementation the project presents an opportunity to verify ecological outcomes through ongoing monitoring and research.

Keywords

Flow connectivity, fish passage, engineering, site environmental management

Introduction

During the gold rush era the Little and Big Peninsula Tunnels were created on the Yarra River to enable alluvial gold miners to readily access the bed in the cut-off sections of river channel. The project appeared to offer an easy gain towards meeting significant river health improvement outcomes. However, the project from investigation, design and through to construction has confronted many challenges.

Feasibility

An investigation was undertaken to consider the benefits and assess the feasibility of reengaging sections of Yarra River, cut off by the creation of the Little Peninsula Tunnel and Big Peninsula Tunnels on the Yarra River. The sites are located on the Yarra River downstream of McMahons and Armstrong Creek. The locality plan in Figure 1 below indicates the locations of the tunnels and abandoned channels



Figure 1. Locality plan – Big Peninsula & Little Peninsula sites

Stakeholder Engagement

Parks Victoria (PV) have been the key stakeholder for this project as the land manager for the Yarra Ranges National Park. PV were previously not supportive of major fish ladder works that would alter the course of the Yarra River permanently and compromise the flow regime of the historic tunnel. In defining the objectives for the project, it became a clear requirement that normal flows had to be retained through the tunnel given its historical significance, and amenity value as the tourist attraction. These discussions with PV have been ongoing throughout the investigation and design phase of the project and led to the inclusion of improved community infrastructure at the site including replacing a degrading boardwalk and viewing platform as part of the construction works.

A recent project of a similar nature became bogged down in controversy with a number of community groups opposing the project, leading to significant delays and reputational damage to the government authority. Given the similarity of the environmental objective of fish passage competing against the social value and heritage of the historical diversion, this has led to a cautious approach with the design in terms of not modifying the “normal” flow regime to the tunnel (refer to Figure 2). To avoid potential community backlash

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or misconceptions MWC has also prepared a Communications plan to assist in the engagement of all relevant stakeholders groups.



Figure 2. Yarra River, Big Peninsula Tunnel River, Big Peninsula Tunnel

Ecological Assessment

The assessment of the existing key ecological values in the Yarra River in the reach containing the Little Peninsula Tunnel and Big Peninsula Tunnel included considering fish, macroinvertebrates and vegetation. Whilst fish monitoring of the Yarra River near the tunnels (McGuckin 2011, 2015) reveal that some native species including short finned eel, river blackfish were located upstream and downstream of the site, other key species such as Australian smelt had been only sited downstream. Macroinvertebrate community within the Yarra River channel is considered in good condition (MWC HWS, 2013). Also riparian vegetation is intact, with mostly continuous coverage of ground layers, ferns and shrubs, mid and upper canopy trees. Whilst some weed species are present, though these are not considered dominant.

In summary from the ecological site assessment:

- Little Peninsula Tunnel - The abandoned channel at Little Peninsula tunnel appears to be engaged relatively frequently, and has good habitat for fish, frogs and macroinvertebrate.
- Big Peninsula Tunnel - Whilst there are some existing environmental values in the abandoned channel at Big Peninsula tunnel (e.g. aquatic vegetation in isolated pools providing frog habitat), there will be ecological benefits for reengaging the reach of Yarra River abandoned channel more frequently in terms of upstream fish passage as well as improved habitat for fish, frogs and macroinvertebrate.

The more frequent and higher magnitude flows would result in aquatic habitat that more clearly resembles riverine habitat, which may enhance habitat for macroinvertebrates and native fish. It is expected that wetland habitat would be retained for frogs and fish, with the flows remaining an occasional event. Furthermore, improving the flow connectivity with the Yarra River upstream would allow passage for fish to the Yarra channel and tributaries downstream of the Upper Yarra reservoir.

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Flow Regime

From the Yarra River stream gauge analysis, flows were derived that are considered representative of both the Little Peninsula Tunnel and Big Peninsula Tunnel locations on the Yarra River. There is a seasonal pattern and variation with the derived Yarra River flows at the study area, with the winter-spring flows at the site being more influenced by the catchment response below the Upper Yarra Reservoir, and the summer–autumn flows being more influenced by the occurrence of release flows from the Upper Yarra Reservoir.

An environmental flow release was monitored using water level data loggers and time lapse cameras. The Little Peninsula channel was observed to have occasional connectivity with the Yarra River, during the May–June 2015 flow release event. The Big Peninsula channel did not appear to have connectivity with the Yarra River during the monitoring event, indicating that fish passage would not be possible via the Big Peninsula channel under the flow regime equivalent to the environmental flow release event. The abandoned channel at Big Peninsula tunnel did respond to local runoff inflows, where the ponded water levels remain relatively high due to the higher bed levels from artificial controls downstream

From the ecological and hydrological assessment it was concluded that there was no immediate requirement to modify the current arrangement to increase the frequency of engagement at Little Peninsula Tunnel. The project subsequently focused on assessing the hydraulic conditions at Big Peninsula tunnel, to assess the feasibility of modifying the conditions to more frequently engage the abandoned channel from the Yarra River upstream.

Hydraulic Disconnectivity

The hydraulic conditions at Big Peninsula tunnel were assessed to determine the feasibility of engaging the abandoned channel more frequently from the Yarra River upstream. The hydraulic controls and levels (i.e. natural outcropping rock) within the Yarra River channel could not be altered as part of the design solution, so lowering the effective “side cast weir” control as the connection to the abandoned channel was required. A hydraulic model was established for the Yarra River upstream of the Big Peninsula Tunnel, where a rating curve was derived at the location to determine what water level will engage with the effective “side cast control”.

The existing threshold flow conditions on the Yarra River where flow will begin to enter the abandoned channel was estimated to be just over 10 m³/s, and this is expected to occur less frequently than annually. From the hydraulic analysis, it was determined that lowering of the existing control by approximately 400 mm would achieve a worthwhile frequency of engagement (3-4 times per year) and average annual period of inundation (~10 days) of the abandoned channel from the Yarra River upstream. This was also expected to enable a flow connection during typical managed environmental flows releases from Upper Yarra Reservoir.

Whilst the effective side cast control will be lowered and sized to provide a targeted inflow regime, to achieve an effective flow that can continue along the full meander loop flow path, additional works within the channel were required.

Design

The design of the reengagement works included the weir connection configuration as well as the various discrete works required to achieve the hydraulic through flow. The works as presented in Figure 3 and 4 were required as part of the design, and further described following:

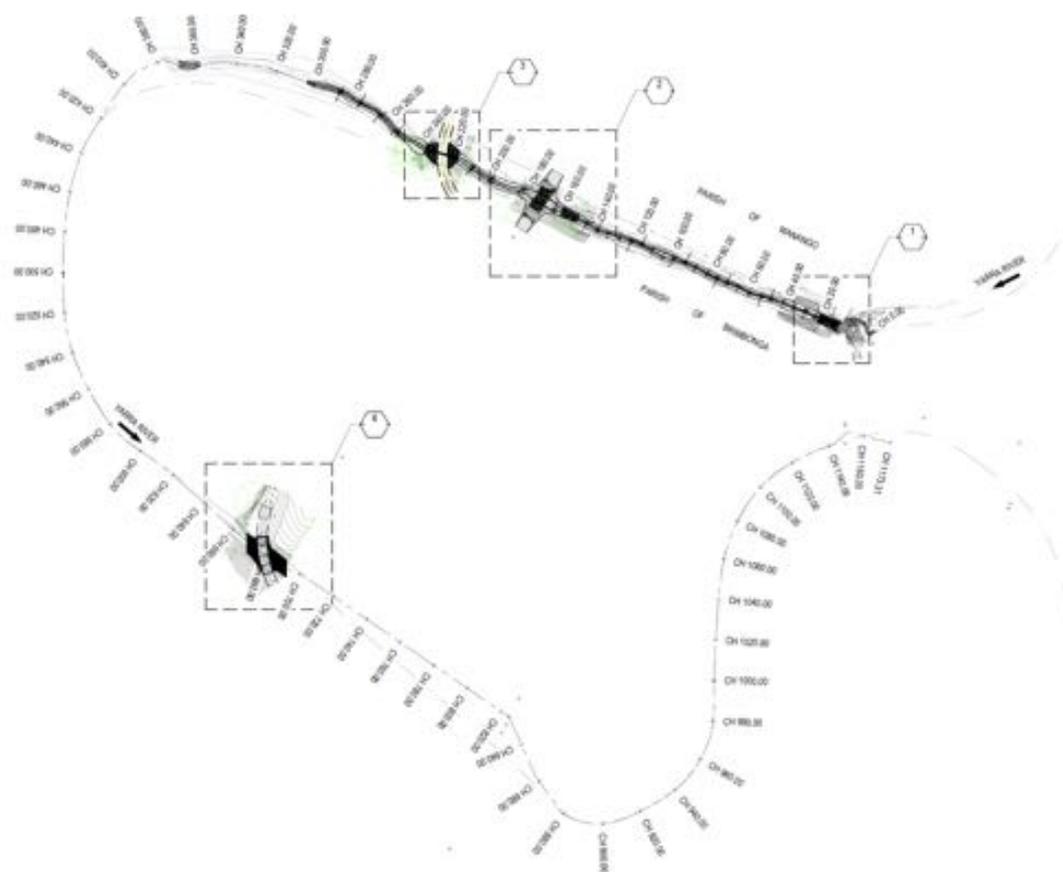


Figure 3. – Yarra River Re-engagement Works (Layout)

These works are further described below:

Site 1 - Side cast weir works– The effective side cast control was configured and formed as a graded rock structure with rock rip rap to protect from erosion and be fish passage friendly. To achieve this the weir control and channel width was limited to 1.0 metre base width to create more favourable depth conditions whilst still achieving the targeted effective inflow.

Site 2 -Pipe track crossing works #1 (including MWC Yarra Valley Water Main Water protection) – The bed of the channel over the MWC Water supply pipeline needed to be lowered by over 1000 mm, which then required protection of the MWC pipe and maintain a minimum cover of 800 mm. To achieve this the design included 300 mm concrete encasement for length of water supply main pipeline, 200 mm bedding on top of concrete pipe encasement with rock beaching of 300 mm thick to surface of the bed

Site 3 - Lowering of pipe at access crossing - The existing culvert pipe invert level at the access road crossing was 600 mm above the proposed lowered level at the pipe track crossing. The pipe was replaced with a culvert (600 mm x 400 mm) matching the re-profiled bed levels and preferred from a fish passage perspective.

Meander loop channel profiling (including pipe track crossing) – Channel profiling works were required over 300 m as to complete the connectivity of the flow path beyond the extent of works at each of the above discrete works sites (refer to Figure 4). The design intent was to achieve this whilst minimising the disturbance and footprint of the works. The works were design as a small low flow channel cut into the

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existing bed of the channel. The works included locally variable batters, designated pool areas providing further habitat benefits, and planting with a combination of prescribed aquatic and semi aquatic plants.

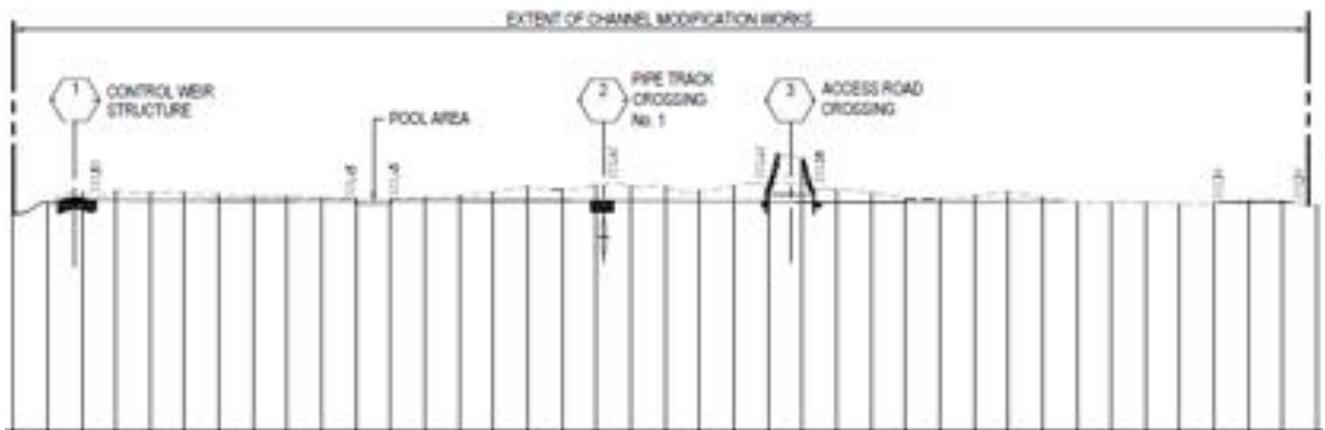


Figure 4. – Yarra River Re-engagement Works (Reprofiling)

Site 4 - Pipe track crossing works #2 – The works included formalising the ford crossing arrangement as well as providing rock protection of the access road crossing and pipe crossing from erosion due to increased flows and more frequent periods of inundation to be expected.

Planning Permit

The local planning context given the sensitive nature of the environment within the Yarra Ranges Council proved to be complex. Based on the proposed works, a planning permit was triggered and required under the various provisions of the Yarra Ranges Planning Scheme including (amongst others) the Public Conservation and Resource Zone (PCRZ), Environmental Significance Overlay Schedule 1 (ESO1), the Native Vegetation Particular Provision and the Upper Yarra Valley and Dandenong Ranges Region Particular Provision.

The planning application was subsequently submitted for the vegetation removal associated with the proposed works for the Yarra River reconnection. The project was considered aligned with the relevant planning provisions and was not expected to pose an unreasonable environmental impact. However the planning permit process led to significant delays in the project implementation. The planning permit issued was conditional on an offset being provided for the expected removal vegetation. Also, Tree Protection Zones (TPZ) were to be determined, with all works within the Structural Root Zone (SRZ) of the impacted trees to be overseen by an arborist. All impacted tree ferns were to be transplanted with their root ball intact with their reinstatement subject to various stringent requirements.

Implementation

The design documentation consisted of the design drawings and technical specifications detailing the various discrete works, including requirements for the Contractor to prepare a Site Environmental Management Plan (SEMP). MWC prescribed detailed requirements for the SEMP that the appointed contractor (Wood Environmental Services) adhered too, as a means of emphasizing the importance of the environmental management of the works

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SEMP

Key elements of the SEMP included restrictions on the access and minimising construction footprints within the waterway and forested areas. Of particular interest were:

Access to works sites - Access to the specific sites was to be via the pipe track clearing and along the bed was limited to the route to be disturbed by the channel works between Site 1 & Site 2.

Selection of "low impact" equipment - The Contactor adopted use of selected machinery that would minimise disturbance, such as compact machinery (8 tone excavators) as well as rubber tracked wheeled loaders (Morooka) used for earthmoving and rock work delivery to specific sites.

Protection of vegetation - The contractor not only adhered to requirements of TPZ and SRZ's, but was able to further reduce the construction footprint and retained many of the trees that were expected to be removed based on the information prepared for the planning permit. Introduction of weeds species was seen as a key threat to the sensitive environment, and biosecurity measures such as stringent wash down requirements for all vehicles entering the leaving the site were adhered to.

Construction

The construction of the works were sequenced to minimise construction risk and impacts on the environment and general public, and to ensure full compliance with the Site Environmental Management Plan (SEMP). All works were undertaken prior to forming the control weir at Site 1. The MWC Pipe Track Crossing and Pipe Protection Works (Site 2) were prioritised to be undertaken at the start of the construction works, as the outcome of these works would determine the extent to which the intended reprofiled channel could be achieved. The culvert lowering works at the access crossing (Site 3) required minimising the construction period for the inconvenience of the loss in the use of the bushfire access road. The Control Weir Works (Site 1) could then be undertaken followed by the channel profiling works, with the intent of immediately revegetating in accordance with the revegetation plan

The implementation of the key works is depicted in the photos within the following tables. Table 1 includes the photos associated with the pipe protection works.

Table 1.- Construction Photos (Site 2).

MWC Pipe Track Crossing and pipe Protection Works



Pre-existing



Pre-existing (flowing reverse)



Pipe protection works

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For the works that occur within the vicinity of the MWC water supply asset, the alignment and depth from existing surface was proved at 3 locations as part of the set of works. To address issues with potential lateral movement the exposure of the water supply pipe main was limited to 8 m lengths. The sequence was then pour concrete, wait at least 2 days for concrete to cure, then expose and pour the remaining 8 m sections, before backfilling and reinstating.

Table 2.- Construction Photos (Site 1 & Channel Profiling).



The channel reprofiling works was undertaken using the low impact compact machinery and low impact construction methods. Many of the trees that were expected to be removed in plan, were able to be retained via adjusting the alignment and footprint of the channel works where possible. The construction methodology for the rock weir was expected to use hydraulic breakers to cut into the rock shelf. The constructor was able rip the underlying rock shelf and reuse the rock as part of the graded rock formation.

Monitoring

It is intended that monitoring of the works will be undertaken. Of particular interest will be whether the intended reengagement occurs with the managed environmental flow releases that will occur throughout the year. During the construction works there was an environmental flow releases that unintentionally impacted

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the works. Whilst it caused some nuisance to the construction activity, it provided some demonstration that the weir lowering works will create an effective connection of Yarra River flow to the channel.

Indirectly a monitoring opportunity has evolved with the installation of time lapse cameras. Wild deer were seen as a potential threat to any new planted vegetation, and this potential threat to the new plants is to be addressed with the placement of deer exclusion stakes. As part of the trial of the technology time lapse cameras have been established on site that provides an opportunity for ongoing monitoring post works.

In future managed flow release events there will be opportunities to install water level loggers to gain a further insight into frequency of connection and flow inundation periods.

Conclusions

It was concluded there would be ecological benefits of more frequent engagement of the abandoned Yarra River channel meander loop at Big Peninsula tunnel as well improving connectivity and fish passage movement. In achieving more frequent engagement, the flow regime for tunnel had to be retained to preserve historic and amenity values. At the point of connection, weir works were required to increase the frequency of flows connecting to the channel. Additional physical constraints within the abandoned reach of channel due to infrastructure had to be overcome to achieve an effective flow through the meander loop. The design footprint of the works within the sensitive environment of the upper Yarra led to stringent planning requirements and emphasis on site environmental management. Through prudent site management and an environmentally conscientious contractor the construction footprint and impact on the environment was minimised. An environmental flow release that occurred during the construction period provided some confirmation that for the targeted flows the works have created an effective connection of Yarra River flows to the channel that can be continued to be monitored post implementation.

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Michael Von Storkirch from MWC (Service Delivery) who project managed the delivery of the works, and provided access to construction information (SEMP documentation, site photos)

Wood Environmental Services, the appointed contractor for the works

Parks Victoria

Shire of Yarra Ranges

References

Potential benefits to native fish by improving passage at selected barriers in the Upper Yarra River Catchment, John McGuckin, Streamline Research P/L, 2011.

Yarra River basin barrier investigation, John McGuckin, Streamline Research, 2015

Healthy Waterways Strategy, MWC, 2013

Yarra River Channel Re-engagement Study, GHD, 2016