

- report

Engineering Background Discussion Paper

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Prepared for
Land Mokoan Land Use Strategy Group

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Revision History

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1 Introduction

Beca have been commissioned by the Department of Sustainability and Environment to undertake a land use study for the Lake Mokoan decommissioning project.

2 Objectives

The brief for this paper was to provide engineering advice on issues associated with the decommissioning of the lake and future uses of the restoration area.

3 Scope of work

The areas covered by this paper include:

- Engineering issues related to the decommissioning/draining
- Retention or demolition of the dam wall and channels
- Drainage and flood management in the restored dry-land area and downstream waterway
- Sedimentation of lake bed
- Hydraulic functioning of restored waterways (e.g. flow depths, flood levels)
- Engineering issues associated with the provision of infrastructure in the restored dry-land area (roads, power, telecommunications, drainage)

4 Methodology

A literature review has been undertaken to identify issues that will require consideration in the later stages of this study. The literature review covers only the previous studies/reports listed in the project bibliography.

The objective of this discussion paper is to provide the "Lake Mokoan Land Use Strategy" project team with contextual background of information regarding broad engineering issues. The outcomes from the Reliability Report are likely to greatly impact the findings for this report. The Beca Engineer will be attending a meeting on 2nd September with GMW to be updated on the project, modelling and findings of this report.

As this stage the engineering issues are limited to broad engineering issues. As the options develop, other issues will be raised and will need to be reviewed and revisited in this paper.

No discussions with authorities have been undertaken and no site inspection has been carried out.

5 Literature review

The study "Water Savings in Bulk Water system in Northern Victoria" (SKM, 2002) investigated potential savings in the State owned bulk water systems of Northern Victoria. Eleven options were modelled and five were described as potentially providing water savings at an economically viable cost. One of those was to drain Lake Mokoan and restore the former Winton Swamp.

The Lake Mokoan Study (URS, 2003) built on earlier work, including the SKM Water Savings study, and presented options for the future management of Lake Mokoan. The study describes the present situation, options for the future management and the community response.

The Lake Mokoan Study (URS, 2003) describes Lake Mokoan as an off-river storage in the Broken river Valley near Benalla. It was formed by the construction of an embankment to inundate a series of wetlands, the largest being Winton and Green Swamps.

Water is supplied to the lake via a channel from the Broken River upstream of Benalla. Water for downstream irrigators is supplied back to the Broken River at Casey's Weir in times of demand.

As described in the URS study, Option 1 - the return to Winton Swamp would involve:

- Draining the lake
- Fixing the outlet gates open
- Removing Hollands and Broken Weirs
- Backfilling and revegetating the inlet and outlet channels
- Removing the channel structures
- Reinstating existing water supplies
- Rehabilitating the drained lake area
- Removing redundant community assets

Rehabilitation of the drained lake area is suggested to entail the creation of

- 8 wetlands with total area 2208ha
- 913 ha of buffer strip around the wetland
- 4779ha of "dry-land" area

The URS study also describes the offset measure planned to maintain the current reliability of water supply to irrigators affected by the Lake Mokoan decommissioning. These are beyond the scope of this paper.

Other issues described in the URS study include turbidity and water quality in the existing lake, downstream effects on flows and turbidity, dam safety issues, use of lake water for fire fighting, recreational use.

A study commissioned by the Rural City of Benalla (Brain Garrett & Associates, 2004) describes some of the issues and costs associated with the rehabilitation of the Winton and neighbouring swamps. This study raised the issue that the pre-existing wetlands may have been in-filled to some degree by sedimentation. The URS study identified that wave-

induced shear stress and foraging by carp resuspends bottom sediments. The soils under the lake are stated to be dispersive clays. Resuspended sediment is most likely to settle out in the deeper parts of the lake where still water conditions occur, i.e. the wetland and pre-existing watercourses.

The Brain Garrett & Associates study suggests that viewing sites, walkways, visitor facilities and access roads be provided at the restored wetlands. It suggests that infrastructure such as roads, drainage and power would be required to be provided should the dry-land area come into private ownership.

6 Existing conditions

6.1 Lake Mokoan Works

Lake Mokoan has a capacity of 365,000 ML, a surface area of about 7,880ha and a maximum depth of 7.3m. It has a relatively small local catchment area that provides an average annual inflow of 25,000 ML.

The Lake Mokoan works are described in the URS study as comprising the storage embankment and outlet works, diversion weirs on the Broken River and Hollands Creek and the inlet and outlet channels.

The storage embankment is approximately 7.5km long, 10.8m high at its highest section and averages 6m high over its length. The URS report describes it as a homogeneous earthfill structure with upstream transitional filter layers next to riprap on the upstream face. The embankment fill is described as dispersive clay material.

The risk of geotechnical failure of the embankment due to earthquake shaking or rain infiltration was raised in a recent dam safety inspection.

The outlet structure comprises a twin cell tower accessed from the embankment via a footbridge. The tower is connected to a twin cell box culvert constructed in a trench under the embankment. There is a dissipater at the outlet of the culvert into the outlet channel.

The Broken river and Hollands Creek diversion weirs comprise an embankment, a sloped rockfill armoured spillway, grassed spillway, low flow culvert and gated off-take to the inlet channel.

The unlined earthen inlet and outlet channels are 21km and 8km long respectively. They have a bed width of 15m, depth of 2.5m and a capacity of 2,500ML/d. The design flow level in the channel is generally just below natural ground level. The channels have berms for maintenance access at about natural ground level. The material excavated from the channel waterway has been placed outside the berm and limits entry of local runoff.

Major structures along the channels comprise bridges for road and internal farm access, subways and siphons to maintain local cross-drainage and drop structures to maintain the design bed longitudinal slope and prevent bed erosion.

6.2 Drainage

The Lake Mokoan Study states that the local lake catchment is relatively small (330 km²) with the main tributaries being Seven Mile Creek, Winton Creek, Eleven Mile Creek and Show Creek. These tributaries drain the Victorian Uplands to the south, including the Lurg Hills. The local catchment is shown in Figure 1.

The URS study describes the Mokoan area as a low-gradient floodplain and suggests the pre-existing catchment would have comprised wetlands of various depths and varying degrees of permanency. The construction of the dam wall has allowed drainage of these wetlands to be regulated. The potential flood alleviation benefit of the Mokoan channel has been studied as part of the Benalla Floodplain Management Study (Cardno Willing, 2002).

Whether or not the pre-existing watercourses remain on the lakebed is not known. Sedimentation of the lakebed may have in-filled these to some degree.

6.3 Other Infrastructure

Some roads that pre-existing prior to the lake construction are reported to remain on the lakebed. Their state is not known but they are presumed to be unsealed. It is assumed that no other engineering infrastructure exists on the lakebed.

7 Key issues/conclusions

This section identifies the key engineering issues to be addressed in the development and assessment of options. This list of issues is not exhaustive but is intended to provide the basis for the next stage of the land use study. Further investigations will be required to scope and address most of these issues.

Many of the issues identified are independent of the land use option, e.g. regulating the rate of lake emptying to avoid downstream flooding. Others, such as power, telecommunications and road requirements in the restoration area are entirely dependent on the land use options considered and cannot be advanced until the options have been identified.

7.1 Engineering issues related to the decommissioning/draining

- Regulating the rate of draining to avoid downstream flooding or excessive flows
- Hydraulic design of the opening through the embankment (alternatively the gates could be locked open, however fish passage and flood mitigation need to be considered)
- Wave-induced shear stress and sediment resuspension in the lake during the lowering (may be covered elsewhere)
- Cost / benefits of retaining versus removing the earthfill embankment (including geotechnical stability issues)
- Time for the lake bed to dry to enable access by machinery (e.g. if required for removal of dead trees, construction of roads)
- Demolition of structures

- OH&S issues related to structures during and after decommissioning
- Contracting philosophy for the decommissioning works (tender packages, etc)
- Cost estimate for the decommissioning works
- Availability and access for fire fighting water
- Affect of lake lowering on groundwater

7.2 Drainage

- Drainage and flood management in the restored dry-land area
- Modelling to predict flow depths and frequency of flows from the restored swamps
- Effect of filling of inlet and outlet channels on local drainage
- Changes to downstream flows and river levels due to the removal of Lake Mokoan
- Hydraulic design of restored waterways (e.g. flow depths, flood levels, restoring natural shape and form, connectivity)
- Degree of sedimentation of the lake bed and the possible need to stabilise or dredge sediments to restore wetlands and watercourses
- Fish passage (may be covered elsewhere)
- Erosion of restored waterways where they have been denuded of vegetation
- Revegetation of waterways (may be covered elsewhere)

7.3 Other Infrastructure

Data has only recently been received relating to other infrastructure on the site.

The mapping exercise will locate the location of the following infrastructure.

- Roads
- Power
- Telecommunications

8 Next Steps

The next stage of the engineering project will be to

- Build a relationship with the local Council Authority and Local Government Officers ie. GMW, Benalla to understating of how the Reliability Project fits within this project scope.
- Play an active role in the development of the future options to ensure the engineering issues are considered as part of the on going review of the project.

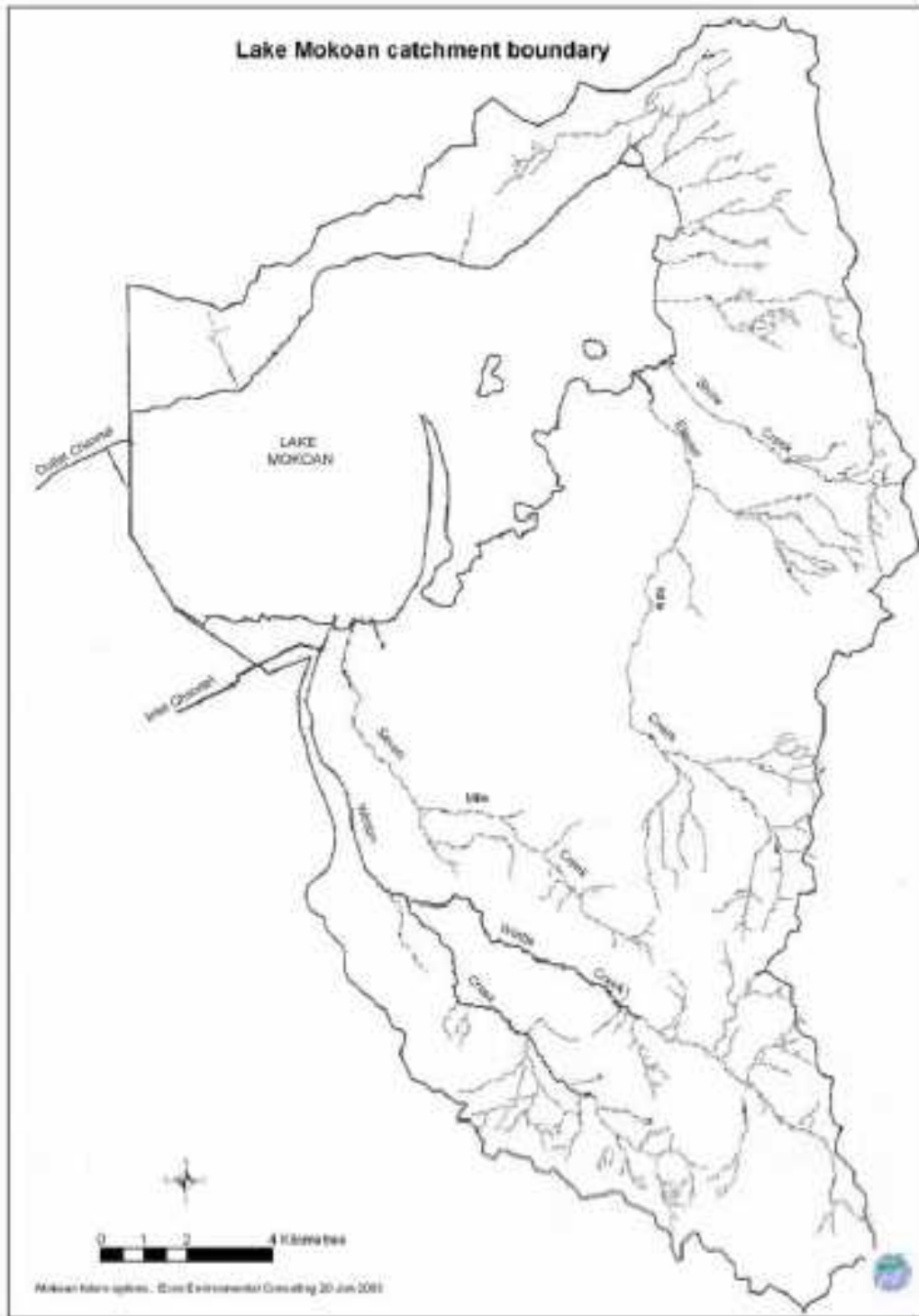


Figure 1 - Lake Mokoan catchment